AN OVERVIEW OF TRADITIONAL AND MODERN FLUTES WITH REGARD TO MATERIAL, CONSTRUCTION AND TONE PRODUCTION

LISA THOM THMLIS003

A minor dissertation in fulfilment of the requirements for the award of the degree of Master of Music by performance

Faculty of the Humanities
University of Cape Town
2008

COMPULSARY DECLARATION

This work has not been previously submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

CONTENTS

AN OVERVIEW OF TRADITIONAL AND MODERN FLUTES WITH REGARD TO MATERIAL, CONSTRUCTION AND TONE PRODUCTION.

By Lisa Thom. South Africa, Bmus (Honours). University of Cape Town, 2008, 57 pages.

Abstract (summary)

The first flutes were made in prehistoric times when a caveman decided to hollow out a bone, pierce a small hole in it and blow in it in a particular way to make a sound. Since then different cultures from all over the world have made many different types of flutes. They are shaped differently, held differently and played in various ways, but the one thing they all have in common is that they are all hollow objects that produce a sound when the player blows air across a hole; this airstream oscillates—it either goes entirely into the hole or entirely out of the hole. This oscillation creates the vibration necessary to produce a sound, with the tube as a resonator. The airstream is either directed across the edge by the player's lips (transverse flute), or it is blown through a mouthpiece that channels the air across an edge (recorder). In both cases the air column passes through a hollow body where it vibrates to produce a note.

This survey discusses two main groups of flutes, namely, globular flutes (vessel flutes) and tubular flutes (held vertically and horizontally). The tubular flutes are subdivided further into three categories. The first is vertical flutes with plain cut heads (primitive vertical flutes, panpipes); obliquely cut heads (*nay*/*quasaba*/*kaval*); and notched heads (primitive notched flute, *kena, and shakuhachi*).

The second category of tubular flutes (held vertically) is the flageolet family (primitive flageolets, ringed flageolets, gemshorn, pipe and tabor, single and double flageolets and recorder).

The third and final category of tubular flutes is the transverse flute (held horizontally), which deals with primitive transverse flutes, central-embouchure flutes, *bansuri* and *menali* flutes (Indian classical flutes), *chi*, *di* and *dizi* (Chinese flutes), Western European

transverse flutes, fifes, Irish flutes and some flutes that are unusual and cannot be grouped in a particular category because they are experiments.

This survey deals with all the different types of materials used to make the instruments, how the instruments are constructed, and how the instruments are played. There is also a table describing each flute so one can see in a clear and accessible way what the differences between the various flutes are.

INTRODUCTION

Beginnings and mythology

The first flutes were made when prehistoric man first picked up a hollow bone or cane, or a dried up fruit shell and made a sound by blowing into it in a certain way. The first bone flute that has been found in Slovenia in 1996 is estimated to be between 43000 and 82000 years old. Medicine men were probably the first to use flutes, but because there were many different tribes around the world, there were different types of primitive flutes. This was the beginning of a long journey to the modern flute we know today. Not much has changed with regards to the basic technique used to play a flute (the player blows air across a hole; this airstream oscillates—it either goes entirely into the hole or entirely out of the hole. This oscillation creates the vibration necessary to produce a sound, with the tube as a resonator.) The initial breakthroughs were made tens of thousands of years ago. Every single culture all over the world has some kind of flute except for the Australian aborigines and the Fuegians.[1]

Figure 1

BONE FLUTE FROM THE STONE AGE

Found at Bornholm (Denmark) about 3000-2500 BC [2]

The flute has always been thought of as something magical and medicine men played them to connect with the spirit world to cure diseases or pray for rain.[3] This association to the magical and mythical world has been kept alive over time. Greece, India and Egypt all inherited legends that the Gods created the flute. In Greece the story of Pan or Athene is known, India has Krishna for a God and Egypt has Osiris.

---

[1] Anthony Baines, *Woodwind Instruments and Their History* (New York: Dover Publications, Inc, 1991), 171

[2] Karl Geiringer, *Musical Instruments Their History from the Stone Age to Present Day* (Great Britain: Unwin Brothers Limited, 1943), Plate II

[3] Baines: 171

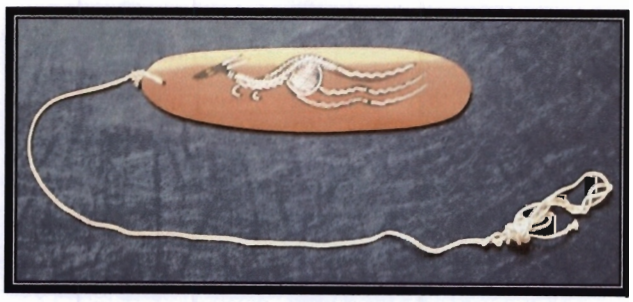
Pan is one legend that has crossed over into western flutes. He is depicted as a cave-dwelling shepherd-god who is half-goat half-man. He takes a liking to a young nymph named Syrinx and when he tries to chase her, the river nymphs save her by turning her into a reed-bed. When he cannot find her he sighs across the reeds, which makes a moaning sound. This inspires him to cut the reeds and bind them together at different lengths to make panpipes (*syrinx*). Although panpipes are not transverse flutes, all kinds of flutes have since been associated with pastoral images.[4]

The story of Krishna has also crossed over to the Western music world with Albert Roussel (French composer and flautist) writing a set of four pieces called 'Joueurs de Flûte'. One of these pieces is called 'Krishna' and depicts the God playing on his Bansuri flute. This is a transverse flute, unlike the panpipes played by Pan, however it still shows one way the story has been kept alive and has crossed over from traditional India to Western civilization.

The instruments

Flutes are broadly classified in a group called aerophones. There are two types of aerophones. The first type is called 'free aerophones' where the air is not confined by the instrument itself (bull roarer).

Figure 2



BULL ROARER [5]

[4] Ardal Powell, *The Flute* (New Haven and London: Yale University Press, 2002), 11
[5] Property of Trevor Wye

A bull roarer is a flat piece of wood or bone, which is attached to a string and is spun around rapidly in the air to create a sound. Instead of the musician using his own breath he uses the air around him.[6]

The second type is when the air vibrates inside a tube or vessel to create a sound. This type of aerophone includes all flutes as well as reed instruments and instruments that produce a sound by vibrating the lips (brass).[7]

Flutes can be further subdivided with regards to their shape, size and the way they are held and played, but the similarity between them is that they are all hollow objects that produce a sound when the player blows air across a hole; this airstream oscillates—it either goes entirely into the hole or entirely out of the hole. This oscillation creates the vibration necessary to produce a sound, with the tube as a resonator. The air stream is either directed across the edge by the player's lips (transverse flute), or it is blown through a mouthpiece that channels the air across an edge (recorder). In both cases the air column passes through a hollow body where it vibrates to produce a note. Many different types of flutes are played around the world today, but apart from traditional folk instruments the silver transverse flute has become the dominant flute.[8]

Apart from the two major divisions above (mouthpiece vs lips), the flute family can be sub-divided further by looking at their shapes. A flute can be tubular (transverse flute) or globular (ocarina). If the flute is tubular it can be cylindrical or tapered. It can be open at both ends or closed at one end. It can have finger holes or it can be without (panpipes). The embouchure hole can also be notched or modified in some way.

There are also flutes where the air stream is blown through the nose instead of the mouth.[9] A nose flute can be globular (vessel flute) or tubular, transverse or vertical. The

---

[6] Bruno Nettle/Victoria Lindsay Levine(I;II,2;IV;V,2), Elaine Keillor (II,1;V,1): 'Amerindian music, §III, 4: Aerophones', *Grove Music Online* (Accessed 20 August 2007), http://www.grovemusic.com
[7] Howard Mayer Brown/ Frances Palmer: 'Aerophone', *Grove Music Online* (Accessed 23 September 2007), http://www.grovemusic.com
[8] Powell: 1
[9] Philip Bate, *The Flute* (London: Ernest Benn Ltd, New York: W.W. Norton, 1969), 2

only difference is that the musician plays the flute using breath from his nose instead of his mouth. These tend to be found in the Pacific Islands and South East Asia, and they believed that the nasal breath was associated with magic and religion.[10]

This review will not go into much detail on nose flutes, as there is no distinguishing characteristic apart from the fact that the air stream comes from the nose rather than the mouth. If the reader is interested in nose flutes, a good reference is *The New Grove Dictionary of Music and Musicians*.

The Study of Flutes

Western musicians only really became interested in the history and the development of the flute about 200 years ago. Before that educated people were not aware of the vast history of the flute. Specialists were the only ones who knew anything about instruments older than 200 years old, and most musicians thought it was pointless to collect old instruments that were of no use. The Victorians, however, were obsessed with progress, history and codification, so it was in this era that historical study first began. The first musicians that researched the flute's history merely highlighted its imperfections, as well as the incompetence of the musicians and theorists.[11] There were many music specialists, however, who realised this view was simple and incorrect and they believed that it was still important to look back on past developments to see how ideas and requirements have changed over time.

It was only in the 20th century that this closed-minded attitude changed. The radio and recording industry, the avant-garde movement, folk music revival (Irish flute), a new interest in non-western music (Indian classical music), and the return of period-instruments and early music performances all affected how musicians viewed past developments. As musicians became more interested in stylistic interpretation they researched Renaissance, Baroque, and Classical music and learnt more about the music they were playing, in order to perform and interpret pieces accurately. It made musicians

[10] Mervyn McLean: 'Nose Flute', *Grove Music Online* (Accessed 20 August 2007), http://www.grovemusic.com
[11] Powell: 1

more aware of the connection between the instruments, the musical style and the performance practice.[12]

There are various books on the subject of the flute each offering different aspects. Anthony Baines is one of the most well known authors on the subject and has written several books about woodwind instruments and their history. He has also written articles in *The New Grove Dictionary of Music and Musicians*. Philip Bate has written *The Flute*, which offers a wide range of information from the origins of flutes from around the world, as well as dealing with the more technical aspect of acoustics and mechanisms. Raymond Meylan wrote *The Flute* and I found it has good pictures, but the content is not very extensive and would recommend the Baines and Bate for more accurate information. Another good book on this subject is Nancy Toff's *The Flute Book.* It has a great deal of information on the flute from the Baroque flute up to the modern flute, but for more ethnic flutes, the Baines and Bate are better choices. Toff also tends to become quite technical in her writing. Ardal Powell is a very good source with his book *The Flute*. It has great deal of information about the flute, but can also be very detailed. There is a wealth of information about the flute in *The New Grove Dictionary of Music and MusiciansI,* especially on ethnic flutes and their construction and material, as well as western flutes. Grey Larsen has written *The Essential Guide to Irish Flute and Tin Whistle*, which is a great book that gives a brief history about Irish music and the flutes used to play it. It goes into detail about how to learn the Irish flute as well.

My intention is to research and show a broad overview of the most important traditional and modern flutes with regards to material, construction, tone production and technique. By placing the various flutes into specific groups it is easy to understand and follow and will serve as a good reference to those who wish to get a better understanding of the many different types of flutes known today. The flutes table also highlights the similarities and differences in an approachable manner.

---

[12] Powell: 2

FLUTE GROUPS

1. GLOBULAR BORE (VESSEL FLUTES)

Vessel flutes are round with a beak-shaped mouthpiece (like a recorder) and can be made from bone, terracotta, or porcelain.[13] There are also ocarinas where the player blows air across a hole (like a transverse flute). They usually have no harmonics and can rarely be overblown to play up an octave.

Some vessel flutes have no finger-holes, but they can have up to eight. There is no specification, but vessel flutes with no finger-holes are classed as whistles and are generally used for birdcalls or as a signalling device (as they can play only one note). When they are used for musical purposes they are classed as flutes. If there are holes, they can be placed anywhere on the body because the size of the hole determines the pitch, not their placement. When two fingers uncover either of two holes of the same size, the pitch rises by the same amount, no matter where the two holes are. When the player covers all the finger-holes, the instrument acts like a stopped pipe, and will sound about an octave lower than a similar sized open-ended flute.

1.1 PRIMITIVE VESSEL FLUTES

The first vessel flutes were made from stone, wood, bone or shell. The Chinese were making clay whistles by 4000 BC and in pre-Columbian times clay vessel flutes were made in many shapes and sizes throughout Latin America.

In Africa, the Tsonga people made a vessel flute called a *rhonge*. It was made from a sala fruit that was ripened and dried and it was mostly played by herd-boys. The primitive people from Kenya used vessel flutes made from animal shells to imitate the honey-guide bird. [14]

---

[13] Raymond Meylan, *The Flute* (London: B.T. Batsford Ltd, 1988), 18
[14] David Liggins: 'Ocarina', *Grove Music Online* (Accessed 24 January 2007), http://www.grovemusic.com

The example below is a Brazilian whistle, which is made from a dried fruit shell. Blowing air across the hole like on a transverse flute makes a sound.

Figure 3

BRAZILIAN WHISTLE [15]

The vessel flute below is the same as the Brazilian whistle, but it is made from the bone of a reindeer foot instead of a fruit shell. It was found in European Upper Palaeolithic sites. [16]

Figure 4

PHALANGE WHISTLE [17]

1.2 WESTERN OCARINA

By the mid 19th century in Europe, vessel flutes were made out of clay in the form of birds and were used as toys for children. Around 1853, Giuseppe Luigi Donati (1836-1925) invented the Western vessel flute and called it the 'ocarina' (It. 'little goose') and since then the name has applied to other vessel flutes as well.

---

[15] Baines: 172
[16] Baines: 173
[17] Baines: 172

There is a hole at the bottom of the ocarina and when the player blows air through the duct the air blows across the hole at the bottom, causing the air inside to vibrate and sounds a note. The mouthpiece can be found anywhere on the body and is often part of the design (tail of the bird: below).[18]

Figure 5

OCARINA [19]

By 1863, the ocarina had become very popular and Donati performed with four other players in five-part harmony on ocarinas of varying sizes. They played well-known folk tunes and popular Italian opera themes. From 1870, Donati continued making ocarinas in Budrio and the players toured Europe. Later, some of the performers also made ocarinas and lived in Budrio where the tradition of ocarina making continued. Donati expanded his business to Bologna, and he later settled in Milan where he made ocarinas for the rest of his life.[20]

Italian ocarinas were initially shaped like an elongated egg and they have not changed much. They can range from 6cm in length up to 48cm and some have the addition of tuning-slides, keys for larger holes, and some holes are split to make semitones possible.[21]

---

[18] David Liggins: 'Ocarina', *Grove Music Online* (Accessed 24 January 2007), http://www.grovemusic.com
[19] Property of Trevor Wye
[20] David Liggins: 'Ocarina', *Grove Music Online* (Accessed 24 January 2007), http://www.grovemusic.com
[21] David Liggins: 'Ocarina', *Grove Music Online* (Accessed 24 January 2007), http://www.grovemusic.com

Figure 6

ITALIAN OCARINA[22]

John Taylor invented the 'English' ocarina in the early 1960s. His ocarina only had four holes because he discovered that a diatonic octave could be played by cross-fingering four holes of varying sizes. This ocarina became very popular and had spread throughout England by 1970. This ocarina had one small, one medium and two large holes. If one hole is opened at a time a pentatonic scale can be played and if the player uses cross-fingerings and half-holing a chromatic scale can be played. Various developments were made with regards to range and size, but the standard four-hole ocarina and Donati's Italian version are the most widely used and accepted. Around 1980 a plastic version of the four-hole system was made by John North Langley (Adelaide), but it was mostly used in schools for children.

Ocarinas play all sorts of music and the most well-known performer who played with great virtuosity and dexterity was Mosé Tapiero who made over 30 recordings prior to World War I. [23]

[22] Property of Dario Broccardo
[23] David Liggins: 'Ocarina', *Grove Music Online* (Accessed 24 January 2007), http://www.grovemusic.com

2. TUBULAR FLUTES

2.1 Vertical Flutes

A vertical flute is held to the front of the player pointing downwards as opposed to the transverse flute, which is held to the side of the player. There are various types of vertical flutes. A vertical flute can have a beak shaped mouthpiece (recorder) or it can be played like a transverse flute by blowing across the top end (panpipe). The top end of the flute can either be cut straight off or alternatively cut obliquely, or it can have a notch cut into it. These various types of vertical flutes will be discussed in more detail below.

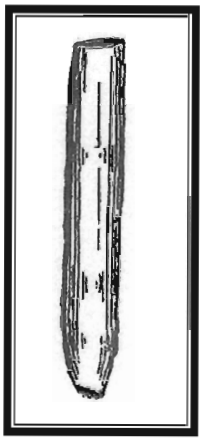
Plain cut vertical flutes

A vertical plain cut flute is a tube that has been cut off straight at the top end and carefully filed to create an edge. The top end of the flute is held below the player's lower lip and it is played by blowing air across the hole.[24]

2.1.1 PRIMITIVE VERTICAL FLUTES

One type of primitive vertical flute is the 'Bushman's flute', a flute made from an ostrich quill, which is stopped at the bottom. It is blown across the top by sticking the tongue out slightly and curling it to create a channel for the wind.[25]

Figure 7



BUSHMAN'S FLUTE [26]

[24] Meylan: 14
[25] Baines: 173
[26] Baines: 172

2.1.2 PANPIPES

Panpipes are sets of vertical tubes of varying lengths that are bound together. They can be bound in a row or a bundle, but the latter is less common. They are stopped on the lower end by the knot in the cane and are cut straight across the top. There are no finger holes so each tube plays one note.

Panpipes are common in Romanian folk music today and two very famous panpipe players from Rumania are Fanica Luca and Gheorge Zamfir. The earliest existing representation of panpipes in Europe is found on three bronze urns in North East Italy from the Illyrian Halstatt culture (6th and 5th centuries BC). The panpipes are illustrated in scenes such as offertory processions and festive meals.[27]

Figure 8

BRONZE URN
End of 6th century BC[28]

In Greece, however, where panpipes were called the *syrinx*, they were depicted in rustic settings and had a lower status. In China, panpipes were found very early in history.

[27] James McKinnon: 'Panpipes', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XIV, 159
[28] Meylan: 15

They were first used for tuning where twelve notes of the chromatic scale were divided into two rows of pipes with each row producing a whole-tone scale.[29]

Panpipes are also found in Burma, the Central Pacific islands, and Western Latin America such as Peru and Ecuador.[30]

Figure 9

PANPIPES [31]

Obliquely cut vertical flutes

An oblique flute is usually made from a plain piece of cane (about a yard long) with six finger holes and it is held to the side across the body because of the length. This makes it fairly difficult to play as it is hollow throughout and the player must use a lot of air to get a good sound. It is often mistaken for a transverse flute from the pictures because it is held across the body. The oblique flute is an end blown flute and the top end can be cut obliquely, straight off (Egyptian *nay*) or bevelled off all round to a sharp rim (Turko-Balkan *kaval*). The oblique flute is made for people who use small intervals in their music, as the distance between the holes is very small and two fingers sometimes need to be raised to play a whole tone. It has a beautiful breathy, reedy sound and the player

[29] James McKinnon: 'Panpipes', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XIV, 159
[30] James McKinnon: 'Panpipes', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XIV, 160
[31] Property of Dario Broccardo

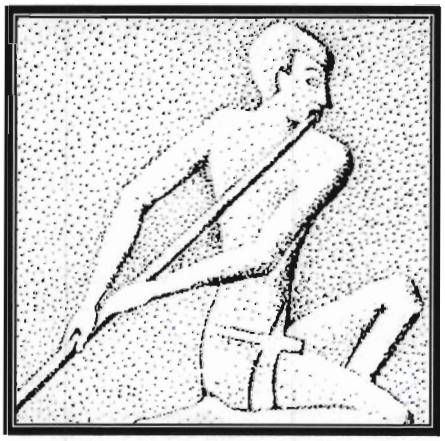
often sings while playing at the same time creating a drone, which gives it quite a unique sound.[32]

2.1.3 NAY/QUASABA/KAVAL

In Egypt, because it is so dry, natural materials are preserved for long periods of time and a few ancient musical instruments have survived. The Egyptians believed that heaven was an idealised version of life on earth and they therefore depicted happy domestic scenes with feasting, dancing and singing in the hope that it would influence their afterlife.

This resulted in many tomb paintings and sculptures of musical instruments. There are illustrations of flutes from the Egyptian New Kingdom period (3000 BC), and actual instruments have been found, which represents a type of flute that exists all over the Islamic world today.[33] This flute is called the *nay* and it is an example of an oblique flute. Today, oblique flutes are found in Asia, Cameroon, Madagascar and Algeria where they are called the *quasaba*. In Indonesia, South America, the Sahara, Iran and the Balkan countries they have the name *kaval*.[34]

Figure 10



NAY
Drawing based
on the tomb of Kadwa, Gizeh [35]

[32] Bate: 57
[33] Bate: 57
[34] Meylan: 23
[35] Meylan: 22

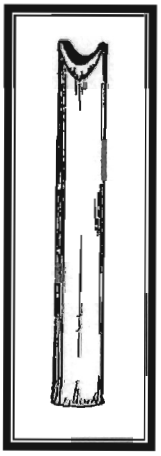
Notched Vertical Flutes

The head of the notched flute is different to the plain cut or the oblique flute. This flute is also cut across the top of the tube like the panpipes, but there is a notch cut into the wood on the opposite side of the tube to where the lower lip rests. The lip almost completely covers the hole so that the airstream can be directed towards the notch.[36]

2.1.4 PRIMITIVE NOTCHED FLUTE

In South-East Asia, the first bamboo flute was made with a notched head. It is end-blown and the notch is cut on the opposite side to where the mouth is placed.[37] The example below has a shallower notch cut on the other side to make it easier, because the bore is so narrow, but when the bore is wider this is not needed.

Figure 11



PRIMITIVE NOTCHED FLUTE [38]

2.1.5 KENA/QUENA

The *quena* is an end-blown notched flute from the Andes, which dates from 900-200 BC (Peru). It was originally made from animal, bird or human bone, gold, silver, clay or gourd. Today, *quenas* are 25 to 50cm long and are usually made from cane, although some are still made from bone. It has five or six finger-holes on the lower part of the

[36] Meylan: 16
[37] Baines: 173
[38] Baines: 172

body as well as a thumb-hole at the back. It has a two-octave range and chromatic notes are produced with the use of cross fingerings and half holing.

This *quena* plays pentatonic melodies and is generally a solo instrument but can be joined by a second player a third above or below, as well as by a *bombo* or *caja* (drums). Many regional dances are performed to this music, such as the *huaynos, bailecitos,* and *carnavalitos* (regional dances). The *quena* is mostly found in Peru and Bolivia, but it is also found in Northern Chile and Argentina and a few are in Ecuador, Columbia, Venezuela and the Guianas (a region in Northeast South America that includes the former British Guiana, now Guyana, the former Dutch Guiana, now Suriname, and French Guiana).[39]

Figure 12

KENA [40]

[39] John M. Schechter: 'Kena', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XV, 503

[40] Property of Trevor Wye

2.1.6 SHAKUHACHI

The *shakuhachi* is a notched flute made from bamboo. It was first imported to Japan from China (8th century), but was found in a Japanese form around the 15th century and has been very popular ever since. Men generally play the *shakuhachi*; women have rarely played it in the past few centuries, though they commonly played the original Chinese instrument. The name comes from an old Japanese measurement *isshaku hassun* (54.5cm), which is the length of the most common *shakuhachi.* There are, however, eighteen *shakuhachi* in total, of varying lengths from 33.5cm to 84.5cm. The bamboo that is used to make this instrument is called *madake*.[41]

Figure 13

SHAKUHACHI [42]

Its joints are large and widely spaced and the lower part of the bamboo plant with the root is used to make the instrument. There are seven rings incorporated into the instrument

[41] 'Shakuhachi', *Grove Music Online* (Accessed August 2007), http://www.grovemusic.com
[42] Property of Trevor Wye

(seven is a mystical number in Japan). There are three in the middle, one at the top and three close together at the root end. The *shakuhachi* was originally made in one piece, but today it is made in two parts so that it can be easily carried. The bamboo is heated and then shaped and any abnormalities are smoothed out and the bell is given an upward curve to improve its appearance.

The shakuhachi bore is reverse-conical (tapers towards the bottom), with a diameter of approximately 2cm wide in the upper part and 1.5cm wide in the lower part. This reverse-conical shape follows the natural way the bamboo grows; the internal bore of the plant becomes narrower towards the root, even though the exterior of the plant widens marginally, flaring into a bell.

This *shakuhachi* has four holes and one thumb-hole at the back. Its range is three-octaves plus a fourth and the fundamental notes are d^1, f^1, g^1, a^1, and c^2. Chromatic notes are played using half holes and by adjusting the embouchure. An experienced player could play the entire range, but traditional pieces do not usually go higher than two and a half octaves. The *shakuhachi* has a huge dynamic range and can play a very soft *piano* to a ringing strong *forte*. The melody characteristically swells between these two extremes and ends each phrase with a grace note. There is a variety of repertoire for this instrument. Original music was played called *honkyoko* (14^{th} to the 16^{th} century). Music was borrowed from the koto repertory *(gaikyoku)*; and new pieces were played called *shinkyoku*, which were mostly Western-influenced compositions that the *shakuhachi* played with other instruments.[43]

2.2 Flageolets

Flageolets are duct flutes. A "duct" flute is any flute where the air stream is directed through a narrow duct toward the edge the air is blown across. This can be done artificially, by inserting a plug or block, or it can be natural, for example, where there is a natural node inside the tube (e.g. of cane). Flageolets have a 'fipple' mouthpiece. A fipple is a wooden plug inside the mouthpiece, set away from the tube to create the

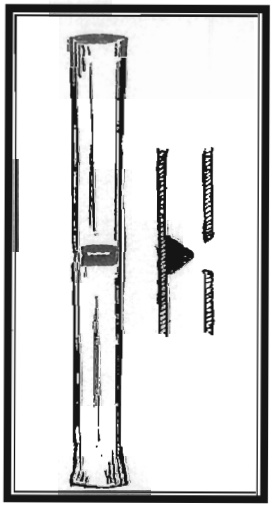
[43] 'Shakuhachi', *Grove Music Online* (Accessed August 2007), http://www.grovemusic.com

narrow duct, called a 'flue' or 'windway'. The lips cover the opening entirely, and don't play a role in directing the air. Because of this the player cannot influence dynamics or nuances. A flageolet is held vertically. The term *flageolet* was first used in the late 12th century and was most likely used to describe a pipe (of pipe and tabor), as well as certain types of reedpipes, a fipple flute (similar to recorder but has less holes), or even a double flageolet (two pipes).[44]

2.2.1 PRIMITIVE FLAGEOLET

The medicine men from the American Indian tribes made a 'Mataco whistle', which is made from a bird bone. It is not blown across the top, but is played like a flageolet (opening covered entirely). There is a hole in the middle with a lump of resin under the hole. This deflects the air on to the farther edge of the hole. It can be blown on either side and if the hole is not in the middle it will sound two separate notes.[45]

Figure 14



MATACO WHISTLE [46]

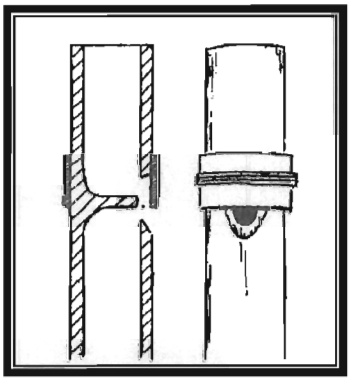
[44] Beryl Kenyon de Pascual: 'Flageolet, §1: 'Single Flageolet', *Grove Music Online* (Accessed 19 August 2007), http://www.grovemusic.com
[45] Baines: 173
[46] Baines: 172

2.2.2 RINGED FLAGEOLETS

The following examples are flageolets that are similar to the primitive 'Mataco whistle' above. A resin block is placed inside the tube and an adjustable leaf ring is attached to the outside of the tube half covering the hole. This idea originated in South East Asia, Indonesia and both Americas.[47]

The first example is the Burmese *palwee*. It has a knot or a piece of wax in the cane underneath the mouth hole, which deflects the air. The top half of the hole is then covered by a leaf, paper ring, or metal plate so that the air is directed to the lower edge of the hole.[48]

Figure 15



BURMESE PALWEE [49]

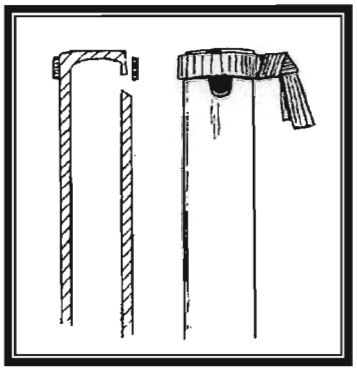
The next example of a non-Western flageolet is the Javenese *suling*. It is the only wind instrument in the *gamelans*. The *gamelans* are orchestras of tuned percussion instruments. They were brought into Bali by Hindu Javanese in the 15th century and used the tonal systems of Javenese music. These ancient forms have been preserved in modern Bali. They are mostly made up of tuned percussion instruments, but there are two-stringed fiddles and flutes of two different sizes. The flutes are used in the theatrical music.

---

[47] Baines: 187
[48] Baines: 188
[49] Baines: 187

The upper end of the Javenese *suling* is closed with a knot and a short shallow channel is cut on the outside. This channel is then covered with a band, which is tied around the top. The player blows air through the channel, which then leads to the voicing hole.[50]

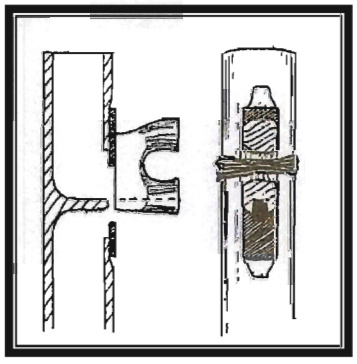
Figure 16



JAVANESE SULING [51]

The final example of a non-Western flageolet is the North American Indian 'Lover's flute' or Apache flute. It is similar to the Burmese *palwee* (above) as it also has a deflector (knot in cane or resin), which is found underneath a long hole. A metal plate, which has a slot cut into it, is placed over the hole. The lower edge of this metal slot is the edge where the air oscillates. The upper part of this slot is covered by a saddle made from wood, which is held together by a piece of string. [52]

Figure 17



APACHE FLUTE [53]

[50] Baines: 188
[51] Baines: 187
[52] Baines: 188
[53] Baines: 187

2.2.3 GEMSHORN

The word gemshorn is German for 'chamois' and is a medieval folk recorder that was originally made from the horn of a chamois (small European and Asian mountain antelope), but was later made from the horn of a domestic ox. It is made in several sizes and sounds similar to an ocarina. From 1450 onwards organs had a flute organ stop with the same name. There are no surviving gemshorns, but this organ stop proves there was such an instrument. Modern versions have been reconstructed using the horns of a gazelle, but they are not historically accurate. There are also reconstructions from ox horn. This instrument, in sound and construction can be placed between the simple flageolet and the recorder.[54]

Figure 18

SET OF FOUR GEMSHORNS

As reconstructed by Horace Fitzpatrick (private collection)[55]

The gemshorn has a soft, husky tone that projects well. It has a thumb-hole, which shows it is a true predecessor of the recorder (some other fipple flutes have no thumb holes). It has similar pitches to the cylindrical medieval recorder and they both have a metal tuning band that can be moved, which helps to improve the tone and flattens the pitch as the instruments warm up. The descant gemshorn has a range of a 6th and the bass and great

[54] Horace Fitzpatrick, 'Gemshorn', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), VII, 229

[55] Horace Fitzpatrick, 'Gemshorn', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), VII, 230

bass instruments have a range of a 10th. The most popular pitched gemshorns were the soprano, alto and tenor and they all have a range of a 9th. The bore is a stopped, inverted cone and can be overblown to the 14th, which produces a second octave.

The gemshorn is used for medieval and early Renaissance dance music, as well as secular polyphony, carols and sacred madrigals. They blend well with voices and the tenor and bass gemshorns can be used in recorder ensembles as they project better than the tenor and bass recorders.[56]

2.2.4 PIPE AND TABOR

The pipe is also a duct flute or flageolet, which usually has three finger-holes, sometimes four, and they are all played with the one hand. There is also a thumb-hole at the back. The English Pipe is about 30cm long and is pitched in the key of D. It has a range of a 12th and some can play two octaves. If the player blows gently the fundamental is sounded, but it is not used and the first four notes of the scale are second partial tones that are an octave above the fundamental. The pipe is played with the left hand and the player holds the drumstick with his right hand.

The tabor is a small side drum with a snare made of gut. The snare crosses the head and vibrates when the drumstick strikes it. The English tabor is quite shallow, the Basque *atabal* is a bit deeper and the French tabor is very deep with the shell twice as long as the heads are wide. The English and the Basque tabors have been around since the Middle Ages and the French tabor is from the 15th century. It is attached to the left wrist or shoulder by a string and is beaten by the drumstick in the right hand. Drums are not part of this survey, but have to be mentioned with the pipe because the pipe player simultaneously plays the drum.

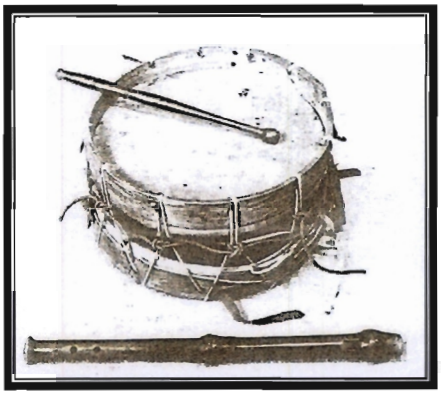
Pipes made today have a fairly narrow cylindrical bore so that overblowing is made possible and it sometimes tapers to the bottom. The scale is not always the same, but

[56] Horace Fitzpatrick, 'Gemshorn', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), VII, 230

some have what is called a neutral third, which plays the pitch between a major and a minor third. Some also have a neutral fourth that can be lowered to a perfect fourth with the use of cross fingering. Spanish pipes are larger and have a wider bore and a stronger sound compared with the English and French pipes.

English tabor pipes were usually manufactured or home made, but were sometimes imported from France. They are usually made of boxwood, but some are made from ivory. Tabor pipes are still made in Marseilles and San Sebastián and similar types of pipes are the Zuffolo and the Picco pipe.[57]

Figure 19



ENGLISH PIPE AND TABOR

19th century

(Victoria and Albert Museum, London)[58]

2.2.5 SINGLE FLAGEOLET

In the 17th century the term flageolet was used to describe a small duct flute in D with a mouthpiece like the recorder. It is flared at the bottom end and has six holes and it has a conical bore (tapers towards the bottom). The single flageolet is different because of the way the finger-holes are arranged. Both instruments have six holes, but the single flageolet has four finger-holes in the front and two thumb-holes at the back. The holes are arranged in this way because the instrument is so small. Martin Mersenne (*Harmonie universelle*, 1636) wrote a tutor book for the single flageolet with a fingering chart.

[57] Anthony Baines and Hélène La Rue: 'Pipe and Tabor, §1:Description', *Grove Music Online* (Accessed 17 August 2007), http://www.grovemusic.com

[58] Anthony Baines, 'Pipe and Tabor', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XIV, 763

Chromatic notes are played using half-holing and it has a range from c^1-a^2 if the player used the exit hole as a seventh hole, but it probably sounded two octaves above the written range.

Flageolets were originally made from ivory, ebony or boxwood and in the 19th century Cocus wood was also used. The *arigot* is similar to the single flageolet, as it has the same fingering system, but it was usually made from a bird or animal bone and had a very piercing sound.

In the middle of the 17th century the flageolet became increasingly popular in England and in Germany the flageolet was first played in a concert in 1643 (Nuremberg) and thereafter grew in popularity and by the 17th century it was found in the Low Countries. The flageolet imitated a bird very well and composers like Handel wrote music for the flageolet in his work *Rinaldo* (1711).

By the 18th century the flageolet began to decrease in popularity. It had a fairly weak tone and small range. A slightly longer one was developed with six finger-holes in the front and with a larger range and there were some with one to six keys made in the 19th century. William Bainbridge (London) was a very well known flageolet maker and he introduced a system of fingering using numbers to make it easy for beginners. Flageolets were used in the Promenade Concerts in London and English Flageolets were made in German centres from the mid-18th century onwards.

By the end of the 18th century a 'Viennese' flageolet that had eight finger-holes instead of the usual six was being played in Russia and German-speaking countries and tutor books for the English flageolet were published in America at the beginning of the 19th century.

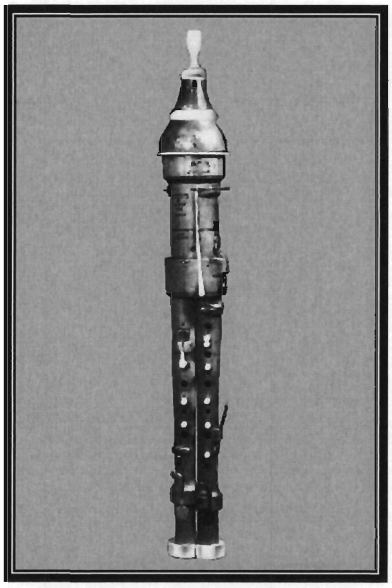
Professional musicians in France were performing on the 'quadrille' flageolet in A, but there were several other flageolets at the time as well in various keys. There were also flageolets made with the early Boehm system of fingering using ring keys. There are a number of works written for the flageolet. Some are technically not too advanced and

others are well-written and require a certain degree of skill from the player. For example, Carnaud wrote a method book around 1835 (*Méthode pour le Flageolet*) with various pieces that require a good technique and understanding of the instrument.[59]

2.2.6 DOUBLE FLAGEOLET

The Double flageolet has inverse conical bores. William Bainbridge invented it in 1806 and he made them in two sizes. The first has the octave pitched in G and second is pitched a fourth below in D. The player can play octaves in thirds and sixths and does not need another player to play in harmony as one hand commands each flageolet. The mouthpiece is made from ivory and forms the headjoint. The airstream is directed into six concentric channels, which makes it fairly difficult for breath control. The second joint is just below the mouth piece and has a hollow space with a sponge inside to absorb moisture. The third joint contains a tube with the plug for each flageolet and each has a 'wind-cutter' that the player can use to manually close off the air of one of the tubes. If the right hand flageolet is closed off, then the player can play the left hand flageolet with both hands.

Figure 20



DOUBLE FLAGEOLET [60]

[59] Beryl Kenyon de Pascual (1): 'Flageolet, §1: 'Single Flageolet', *Grove Music Online* (Accessed 19 August 2007), http://www.grovemusic.com

Bainbridge later made a transverse double flageolet in 1819. It was called a 'double flute-flageolet' and was played like a normal flageolet, but was held to the side like a transverse flute. In the 1820s he went even further to patent a triple flageolet, where the three upper joints of the double flageolet were replaced by one joint and the third stopped pipe was inserted into the side. The left hand thumb was used to operate four closed keys and it could play a range just short of an octave. There was a support added on so the player could lean it on his knee while playing.[61]

2.2.7 RECORDER

The earliest surviving recorder is a descant made of elmwood, which was found under a house from the 15th Century in Dordrecht. Today it can be viewed in the Gemeentemuseum in The Hague.

The recorder most likely originated as an art instrument (more for decoration than playing) in the 14th Century in Northern Italy and only became established there by the 16th Century. Ganassi published a recorder tutor book (1535) in Venice, which is the first surviving method book. The word 'recorder' is found in some English poems, which were written in the 15th Century, such as *Squyr of Lowe Degre* (c1400) or the Scottish *Buke of the Howlate* (c1450).

Sculptures and paintings can be unclear and it is difficult to tell exactly what instrument is being played, but towards the end of the 15th Century and during the 16th Century, there are paintings where recorders become more frequent and can be seen more clearly. [62]

---

[60] Beryl Kenyon de Pascual (1), William Waterhouse (2): 'Flageolet', *Grove Music Online* (Accessed 19 August 2007), http://www.grovemusic.com

[61] William Waterhouse (2): 'Flageolet, §2: Double Flageolet', *Grove Music Online* (Accessed 19 August 2007), http://www.grovemusic.com

[62] Edgar Hunt: 'Recorder', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XV, 651

Prior to the 18th century, the recorder was merely known as the flute (*flauto*). As time passed and different types of flutes were being developed (especially the transverse flute), the number of names increased in an attempt to tell them apart.
In England the recorder was called the common flute or English flute, because the transverse flute (German flute) did not reach England until later. The French named the recorder *flûte d' Angleterre* for the same reason.

Other names are derived from the instrument's appearance, its sound, the geographical regions where it was more popular, or how it is held.

For example, names derived from appearance are the French *flûte à bec* and German *schnabelflöte*; they describe the beak-shaped mouthpiece. As previously discussed, the name 'fipple flute' or blockflöte comes from the plug that virtually closes the tube at the top to form a whistle mouthpiece. Recorders before the 17th century had no footjoint, so a ninth hole was bored for the little finger in the right hand. When this hole was not used it was blocked with wax or a piece of wood and hence acquired the name *flûte à neuf trous* ("ninth hole" or "nine holes").

Names that characterize the sweet tone of the recorder are *flauto dolce* (Italian) and *flûte douce* (French).

And lastly, there are various names to describe how the recorder is held (vertically) such as *flauto diretto* (Italian), *Langsflöte* (German), or *flety proste* (Polish).[63] In fact, the transverse flute was distinguished from the recorder by a name indicating how it is held: *traversa*.

As discussed thus far the term 'flute' can be a very general term that describes all flutes, including transverse flutes and fipple flutes, by the same name. Today the term 'flute' is generally used to describe the transverse flute.

---

[63] Edgar Hunt. 'Recorder', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XV, 649

Recorders are generally made from wood, sometimes ivory, but today they are also made of plastic. The recorder has seven finger-holes and one thumb-hole at the back. It is the main member of the fipple family. The fact that it has a thumb-hole separates it from the other fipple flutes. The recorder was used mostly in the music of Purcell, Bach, Handel, Telemann and many other Baroque composers. It did not manage to survive in the orchestra beyond the Baroque Period and the flute took over where the recorder could not continue, but recorder is still played today and there are many 20th century works written for it.

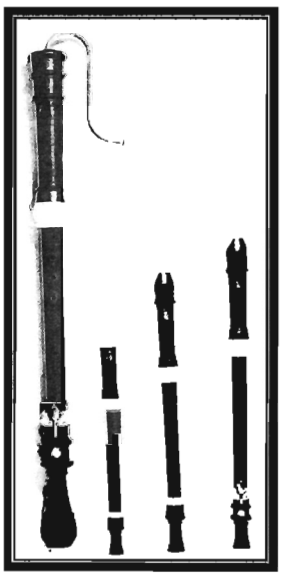
Modern recorders are similar in design to recorders from the end of the 17th Century to mid 18th Century. Today the recorder is made in three parts, namely, the head, middle joint, and the foot joint. The headjoint has a cylindrical bore and a beak-shaped mouth piece. The middle joint has six finger-holes and one thumb-hole at the back, and the foot joint has the seventh hole. The bore of the middle joint and foot joint tapers all the way to the bottom of the recorder, which helps with intonation. The holes are also placed in their correct acoustical position and made to their correct size to make the instrument in tune with itself.

Recorders are made in different sizes and are named according to different vocal ranges such as descant, treble, tenor, and bass. There are also extreme sizes like the sopranino and the great bass. The lowest note of the descant being c^2, the treble f^1, the tenor c^1 and the bass is F. There are also recorders in D called the 'sixth flute' because the lowest note is d^2, which is a sixth above the treble. A recorder with the lowest note an octave below is called the 'alto' or 'voice flute'. And lastly, there was the B♭ recorder or 'quart flute', which is a fourth above the treble.

The average range of the Renaissance recorder was an octave plus a sixth above, although if played by an expert it was possible to play a full second octave. The range of the Baroque recorder is two octaves plus a whole tone, and the recorder today has the same range, although there are some avant-garde works that ask for chords and other special effects. The chromatic notes are played with cross-fingerings and because this

worked so well, there was no need to add a key system like on other woodwind instruments. It requires very little breath control and the holes are quite small and easy to cover. There is only one key added on the bass recorder (lowest note) and sometimes the tenor. Where the cross fingerings do not work on the two lowest semitones of all the recorders, two small holes have been bored next to each other to make half-holing much easier. These holes were only added at the end of the 17th century. In addition the bass recorder uses a crook (metal tube) to bend the bore so that the finger holes are a comfortable reach from the mouth.[64]

Figure 21



FOUR RECORDERS

BRESSEN LONDON (Late 17th century)

Left to right: bass in F, treble in F, alto in D, tenor in C[65]

2.2.8 FLUTE AND RECORDER

The baroque flute and the recorder were initially used simultaneously in orchestras, as the use of varying instrumentation was fairly common. But as time went on the flute began to overtake the recorder. The range of the flute could play half an octave higher than the recorder and the notes could speak easier in the upper octave, which resulted in an agile

[64] Edgar Hunt. 'Recorder', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XV, 649

[65] Edgar Hunt. 'Recorder', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrrell (London: Macmillan, 2001), XV, 654

sound. The recorder has a very limited dynamic range, as the mouthpiece is inflexible and although the tone is very clear it tends to have little variation in tone colour. The flute player uses his lips to control the tone and for this reason uses more varied dynamics and tone colours. The pitch on the flute can also be better controlled, which reduces intonation problems. This made it much more exciting for composers of that time because these qualities gave them more to work with and could compose pieces accordingly. For example, composers began to write very *cantabile* melodies that allowed the flute player to play with more expression and more contrast in dynamics.

This transition from the recorder was, however, a very long one and took almost a century to complete. The French were the first to embrace the change and the Germans followed shortly after at the beginning of the 18th century. In England the flute only became popular in orchestras in 1714 when George I became king. The Italians introduced the flute around 1715, but it took a few years to really gain popularity.

The many names used for the flute and recorder makes it very difficult to trace. As mentioned above the recorder was known as the *flute*, *flûte douce*, *flauto*, *Blockflöte*, common flute, and English flute. The transverse flute was called *flûte transversiére*, *traverso*, *flûte d'Allemagne*, *Querflöte* or German flute. Most composers were precise about stating which instrument they wanted to use, but some were very unclear.[66] The best way to tell which instrument was wanted is to look at the range of the part, as well as the keys. The best keys for the baroque flute were G major, D major, A major, E minor and B minor whereas F major, C major, D minor and A minor were the best keys for the recorder. This is, however, not a set rule and there are a few examples of pieces in keys not comfortable for the instrument. For example, f^3 on the baroque flute is a very unstable note and Bach wrote this note for the flute in his Cantata no 78. Over the course of the 18th century the flute became the preferred instrument of choice and the recorder was regarded as an instrument for amateurs.[67]

[66] Nancy Toff, *The Flute Book* (New York Oxford: Oxford University Press, 1996), 188
[67] Toff: 189

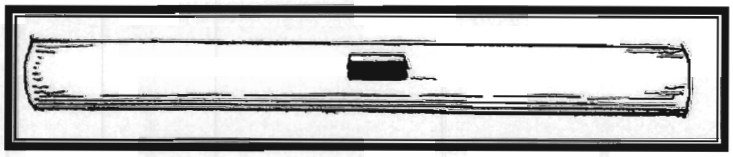
2.3 Transverse Flutes

The edge of the transverse flute where the air is blown across is not found at the top like the vertical end-blown flute. It is on the side of the tube near the top end and the flute is held sideways. The mouth hole is oval or round and it is called an aperture or an embouchure hole. The finger-holes are in line with the embouchure hole and the lower lip is placed on the inner rim of the embouchure hole. The airstream is directed across the hole to make a sound.[68] Ethnic transverse flutes are all made from some kind of wood, which will be discussed further (pages 32 to 35). Western transverse flutes were initially made of wood and as they began to develop flute makers learnt how to work metal. Refer to pages 49-52 (materials and bore) for more information on materials for flutes.

2.3.1 PRIMITIVE TRANSVERSE FLUTE

Primitive transverse flutes were found in Brazil. They are slightly different to normal transverse flutes as the embouchure hole is in the middle. Some of them have both ends open and some have one end stopped.[69]

Figure 22



BRAZILIAN TRANSVERSE FLUTE [70]

2.3.2 CENTRAL-EMBOUCHURE FLUTE

The mouth-hole of a transverse flute does not need to be placed at the top end of the tube. As shown above it can be placed in the centre of the tube. This flute is called a hole-less harmonic flute and is found in parts of South East Asia. It is open at both ends and is played by using the thumbs of each hand to stop or open each side. If the embouchure hole is off centre it makes two different lengths of tubing. Various notes can be played on this flute. For example, if the tube is 18 inches long and the embouchure hole is ½-

[68] Meylan: 16
[69] Baines: 173
[70] Baines: 172

inch off centre the following notes are made possible: if the tube is stopped at both ends the longer tube is sounded and the fundamental will be e^1 with the harmonics e^3, $g\sharp^3$. If both ends are open the longer tube is used again and sounds the fundamental e^2 and the harmonics e^3 and b^3. If the shorter half is stopped this half is sounded with the fundamental $f\sharp^1$ and the harmonics $c\sharp^3$ and possibly $a\sharp^3$. If the longer half is stopped the shorter half is still sounded with the fundamental $f\sharp^2$ and the harmonic $f\sharp^3$. This allows the player to play a pentatonic scale of b^2, $c\sharp^3$, e^3, $f\sharp^3$, $g\sharp^3$ and b^3.

There are some central-embouchure flutes that were used in Chinese ceremonial music in the 18th century that had three finger-holes on either side of the embouchure hole. This flute is based on the flute mentioned above, where both ends are open, and by closing or opening various holes; the tube is shortened or lengthened accordingly.[71]

2.3.3 BANSURI AND MENALI / PULANGOIL (INDIA)

Greece, India and Egypt are three places that have inherited legends that the Gods invented the flute. Among these three legendary birthplaces of the flute only India has a transverse flute (*bansuri*). Egypt has the *nay*, which is end-blown or oblique, and Greece has the *panpipes*. Both have been mentioned already (panpipes: pg 11, nay: pg 13) and are also vertical flutes. There are two types of classical Indian transverse flutes used today. Firstly, there is a shorter instrument about 30cm long called the *menali* or *pulangoil* and it is used in southern Carnatic music. It has 7 or 8 finger-holes.

There is a more common one from Northern India called the *bansuri*. It is about twice as long as the *menali* and has 6 or 7 finger-holes. It is made of bamboo with a wide bore, thin walls and a range of three octaves. It is not clear how similar it is to the original instruments from nearly a thousand years ago, but it is made in a simple way with no keys or accessories and it is thought that they have not changed much over time. It is held to the left of the player, which is most commonly found in medieval illustrations of the flute-player. It is thought that some kind of Indian flute became known in Byzantium

[71] Baines: 184

around the 10th century, and from there it was transmitted through Europe. Medieval flutes are often drawn with bindings or mounts at the ends similar to those on an Indian flute.

Figure 23

BANSURI [72]

2.3.4 CHI, DI AND DIZI (CHINA)

The Chinese *chi* is thought to be the earliest example of a transverse flute and it dates back to the 9th century BC. It may have even derived from a Central Asian flute that is even older. The *chi* was used for rituals and there was another Chinese flute called the *di*, which was a military flute and was later used in operas and other music. Both the Chinese flute and Indian classical flute are similar and it is thought that they may have been connected in some way. Like the *bansuri*, the *chi* is held to the left of the player.[73]

The most popular Chinese wind instrument is the *di* or *dizi*. It has a few names depending on the era. In ancient times it was called the *heng-ch'ui* (horizontal pipe) and later it was called the *heng-ti* (horizontal flute). It is made from bamboo and has six finger-holes and a thumb hole as well as two vent holes. There is another hole between the mouth hole and the first finger-hole that is covered with a thin membrane of bamboo paper or garlic skin. When the flute is played the membrane vibrates and makes a buzzing, 'reedy' sound. This sound is very characteristic and it sets the *dizi* apart from any other flute. There is usually a tassel tied to the vent holes and this is used to hang the flute on the wall. It is used for all types of music such as solos, regional operas and ballads, folk orchestral music, songs and dances. It also has a greater dynamic range than other Chinese wind instruments[74].

---

[72] Property of Trevor Wye
[73] Powell: 11
[74] Alan R. Thrasher: 'Di', *Grove Music Online* (Accessed 20 August 2007), http://www.grovemusic.com

Figure 24

DIZI [75]

2.3.5 WESTERN EUROPEAN TRANSVERSE FLUTES

Unclear evidence of transverse flutes in Greece and Rome

There is virtually no evidence to support the idea that there were transverse flutes in Ancient Greece and Rome. The Greek *aulos* and Roman *tibia* were initially thought to be flutes, but are in fact reed instruments like bagpipes. Post-classical Greek and Etruscan civilizations may have had a transverse flute, but it is unclear. Athanaeus mentions a *photinx* in his *Histories of Poseidonos of ApameiaI* (135-50 BC), which could have been a transverse flute, but there is no description of it so it is also unclear.

Figure 25

ETRUSCAN FUNERAL URN

Found near Perusa (2nd century BC) [76]

[75] Property of Trevor Wye

The Etruscan funeral urn (above) found near Perusa dates from the late 2nd or early 1st century BC could be a transverse flute player holding the flute to his right, but it is the only evidence that a transverse flute existed in the Roman world. There is a reed instrument held horizontally called a *plagiaulos* and they were more common, which implies that the urn is most likely a *plagiaulos*.[77]

Another example of a transverse flute from Roman times was found on a Roman coin with a picture of Pan playing the transverse flute. The coin is from a Syrian town of Caesarea.

Figure 26

PAN PLAYING TRANSVERSE FLUTE

Cast of a Roman coin (169 AD) [78]

These few examples of transverse flutes suggest that the Romans and Etruscans (Italy) might have played the transverse flute. However, there is not enough evidence to support the idea that the ancient Greeks played the transverse flute. After the fall of Rome there are no art works with transverse flutes and flutes in artworks are only found from the 10th and 11th centuries.[79]

---

[76] Meylan: 37
[77] Powell: 12
[78] Meylan: 39
[79] Jeremy Montagu (I, II), Howard Mayer Brown/Jaap Frank, Ardal Powell (II): 'Flute, §II, 4(i): The Western Transverse Flute: To 1500', *Grove Music Online* (Accessed 17 August 2007), http://www.grovemusic.com

Minstrels

In the middle of the 4th century, the church banned theatre in Rome as it was said to be immoral. This affected musicians greatly as they played a very important role in the theatre. In the church, vocal music was the only music allowed and even the organ was not used.[80] For this reason, many musicians became mobile, playing and singing wherever they were welcome. This kept musical instruments alive and the techniques and knowledge of their instruments was preserved and developed later by minstrels of different periods and class. This continued for 300 years and by the middle of the 7th century the church accepted instrumental music once more. Most musical instruments in their primitive forms then entered Europe from the East via the Eastern European Empire (Byzantium), as well as from the Baltic coast (north-east), or through the Islamic empires (North Africa).[81]

The Middle Ages

The history of the transverse flute is difficult to trace and it was only from 1700 that the flute in its baroque form was invented, with music printed and published for it. There are no transverse flutes that survived from the Middle Ages so the only way we can understand how they sounded and what music they played is from looking at the traditional cultures of the time.

Only a small amount of music was written down in the medieval period and most of it comes with no instructions for instrumentation or performance. There is no music that indicates that it should be played by the flute, but it is most likely that the music was played by ear or improvised. The music we know from manuscripts was very well known already and for this reason it was not necessary to write it down, and pieces that were notated changed and evolved over time anyway.[82]

---

[80] Bate: 69
[81] Bate: 70
[82] Powell: 7

Byzantine Images

Another route from which the transverse flute entered Europe was from Asia via Byzantium (Eastern European Empire, now Istanbul) to Germany in the later Middle Ages. This probably happened as the transverse flute is found on Byzantine carvings, paintings and artworks of the 10th and 11th centuries. Some of these artworks contain realistic representations and some contain mythical, religious and pastoral symbols, but nonetheless, this is why the transverse flute initially had the name 'German flute'.[83]

Western European Images

All the earliest Western European images of transverse flutes came from Germanic lands. For example, the bronze water vessel (*aquamanile*) from Hungary below depicts a flute player on the back of a horse playing a drum (11th century).

Figure 27

RIDER PLAYING FLUTE [84]

[83] Bate 70
[84] Meylan: 50

An example of a transverse flute from the 12th century is found in a miniature of three sirens with one of them playing the flute (below). It is from a German encyclopedia (*Hortus deliciarium*).[85]

Figure 28

SIRENS PLAYING THE FLUTE [86]

An example from the 14th century is the Manesse manuscript (c1340) by Meister Rumslaut called *Der Kanzler* (below). It reflects the courtly life of that time, but there are mixed ideas as to whether it is a realistic representation of a transverse flute. The flute is held to the player's right (only illustration of this period). However, both the flute and the violin are pointing inwards towards the singer, which makes it look symmetrical and was most likely done for artistic reasons rather than for accuracy. Some think it is realistic and others disagree, but nevertheless, the flute, according to Canon Francis W. Galpin (1858-1945, he spent a lifetime in the practical study of old instruments in

[85] Jeremy Montagu (I, II), Howard Mayer Brown/Jaap Frank, Ardal Powell (II): 'Flute, §II, 4(i): The Western Transverse Flute: To 1500', *Grove Music Online* (Accessed 17 August 2007), http://www.grovemusic.com

[86] Meylan: 44

collecting them and recording their history) did become popular amongst minnesingers in the 13th century.[87]

Figure 29

DER KANZLER [88]

The Florentine ivory casket below is probably a realistic representation of the flute. Everything is sculptured in great detail. One can see the lines on the tree trunk and the man's hair looks like a crown of leaves. The flute is probably the correct size proportionately and is held correctly (flutes were held to the left in the Middle Ages).[89]

Figure 30

FLORENTINE IVORY CASKET [90]

[87] Powell: 10
[88] Powell: 9
[89] Meylan: 43
[90] Meylan: 47

Below is another example of a realistic representation of a transverse flute from the Middle Ages. It is from a stairway in Kiev and illustrates the Imperial Circus in Constantinople with jugglers, actors, acrobats and musicians. The flute player is holding his flute to the left, which is correct for the time, and he is playing with various other musicians.[91]

Figure 31

STAIRWAY IN KIEV [92]

Transverse flutes (today, but especially in the Middle Ages) are often depicted as symbols of myth and legend, as well as the idealized pastoral or spiritual life. Myths are not accurate stories anyway, so it stands to reason that flutes depicted in mythological scenery would not necessarily be accurate either.[93]

The manuscript below shows a shepherd playing the flute. It is very simply drawn with the trees looking a little unrealistic. The miniature illustrates the awakening of nature after the Easter festival, and it probably represents rural life in the 11th century.[94]

---

[91] Meylan: 46
[92] Meylan: 3rd colour picture (between pg 64 and 65)
[93] Powell: 10
[94] Powell: 12

Figure 32

MANUSCRIPT OF SHEPHERD PLAYING THE FLUTE [95]

The word 'flute' is such a general term that it is equally difficult to interpret written materials from that period. There is no point looking for specific words like 'flutist' or 'flute-player' because the role of musicians has changed dramatically since then. The modern flute player would spend much time studying the technique of the flute, but in medieval times performers could play many instruments (stringed, wind, percussion) and probably knew more about creating a festive atmosphere and keeping the audience entertained. Wind players were considered a lower class than string players and it is thought that they mostly played by ear or improvised. Because written music during the Middle Ages was rare we will have to examine other sources of references to find out more.[96] The first written reference of a flute in England was in 1492. King Henry VIII compiled an inventory of musical instruments in 1547 where he shows the difference between the flute and recorder ('fflutes' [sic] and 'recorders').[97]

By the end of the 15th century transverse flutes are found in many pictures and artworks throughout Western Europe as it finally established itself as a notable instrument. Although there are no surviving flutes from this time, we can still study them by looking at instruments today. A number of wind instruments have lived on and are played as folk instruments in various countries in Europe. Most of the instruments are simply made and

[95] Powell: 8
[96] Powell: 10
[97] Bate: 71

have hardly changed over time and the music they play is most likely folk tunes that have been passed down the generations and may be similar to what the minstrels played seven centuries ago.[98] The sound of the instruments can be reconstructed and we can hopefully learn more about flutes from the Middle Ages.

2.3.6 THE FIFE

The earliest documented reference of the fife is from 1463 (Italy). It is an inventory of instruments belonging to a wealthy Florentine, Piero di' Medici (1416-69). There are four Flemish fifes, three Italian fifes and three fifes decorated with silver. Piero's son Lorenzo de' Medici (1449-92) also had an inventory containing a set of five fifes, three with silver ferrules and a set of large fifes in a case.[99]

In the later Middle Ages and the Renaissance Period, fifes became part of the military and in 1476 Switzerland defeated Burgundy in the battles of Grandson and Morat in Burgundy. This was said to be due to the rigid and disciplined formations of soldiers as they stepped in perfect rhythm to the beat of a fife and drum in the centre of each formation. This type of military formation became extremely popular and spread throughout the continent in the late 15th century and by 1481, six thousand Swiss mercenaries had entered the military under Louis XI of France. Over the next twenty years two thirds of the continent were using this Swiss formation, including the fife and drum signals. The use of fifes and drums became a permanent part of European military culture. In 1491, two drummers and a fifer (Germans) performed at Charles' VIII and Anne of Brittany's wedding.[100] Again in 1494, drums, fifes and trumpets played for a French banquet and by 1516, Charles VIII had established his own fife and drum corps called *phiffres et tambourines*. These musicians were mainly from Switzerland or Germany. In 1520, there were five fifers and three drummers at the field of the Cloth of Gold where Henry VIII (England) and Francois I (France) held the famous summit meeting. Fifes and drums had now spread across Europe and from 1548-1814.[101] The

[98] Baines: 211
[99] Powell: 30
[100] Powell: 28
[101] Powell: 29

fife was already a common folk instrument in the 16th century in the Swiss states and this has continued until today. It was, however, already being played as early as 1374 in the city of Basel. [102]

The fife has a cylindrical bore that is narrower than the modern transverse flute, which results in a shriller tone. It is usually made from one piece of wood and some have brass ferrules as well as metal at both ends. It has six finger-holes and can have one or more keys added.

Fifes were built in two sizes at this time, with a range of an octave and a half. The lowest note of the one was G^1 and the other was $D\sharp^1$. They used different fingerings to other flutes. Mersenne (also wrote fingering chart for the flageolet) wrote a fingering chart for the fife in his *Harmonie universelle*, 1636-7 and Virdung illustrates the fife in his *Musica getutscht* (1511) and shows no difference between the fife (*Zwerchfeiff*) and the ordinary flute. [103]

Figure 33

MILITARY FIFERS [104]

[102] Powell: 27
[103] Howard Mayer Brown/Jaap Frank (with Raoul F. Camus and Susan Cifaldi): 'Fife', *Grove Music Online* (Accessed 29 August 2007), http://www.grovemusic.com
[104] Powell: 29

The military fifes are two to three feet long and the drums are around 2.5 feet wide and deep, with a snare on the lower head. The drums are played with heavy beaters and an energetic stroke. Some pictures of military fifes have 7 or 8 finger-holes, which is the same as the modern fife.[105]

If the pictures are accurate, the military fifes are different to fifes used for consort music, or notated ensemble pieces.[106] The style of playing of the military fife is also quite different from consort music. It was known as Swiss playing style and uses a special hard articulation played together with large side drums. The music was improvised, but the fifers had special figurations provided for them that they combined.[107]

The fife in Britain disappeared during the 17th century, but reappeared in the middle of the 18th century as a cylindrical bored fife made from one piece of wood with no keys. Most fifers played two different sizes (B♭ and C), but by the 19th century these fifes were replaced by one short conical flute in B♭, which had no keys (sometimes one). It later had up to six keys and changed its name to a piccolo. In Europe the late 19th century a seventh hole was bored at the bottom end of the fife, which was played by the little finger of the right hand. The hole sometimes had a key to control it or it was left open.

The fife or descendants of it are found all over the world today, in particular in all the former British colonies, Ireland and Switzerland. In Brazil there is a fife and drum band tradition and in the West Indies there is a festival every year with drum and fife bands, but the fifes are made from bamboo. In America towards the end of the 19th century, civilian drum and fife bands were formed that were merely for show, as their use in the military was not needed. However, military style bands were reintroduced later on for education purposes in schools to re-enact history and there is a museum in Connecticut

[105] Powell: 30
[106] Powell: 30
[107] Powell: 31

today that contains original fifes and drums as well as a library of information about the bands.[108]

2.3.7 DEVELOPMENTS IN WESTERN TRANSVERSE FLUTES

In the baroque period, musicians found that composers were placing more and more pressure on them for greater dynamic contrasts and a wider melodic range. This in turn placed more pressure on instrument makers to make changes and improvements to their instruments so as to keep up with the changing times and the needs of the composers. As mentioned above (page 30) the recorder became less important as it could not live up to the new demands. The transverse flute was able to do this as it had a much larger range and a brighter tone, which projected well. The transverse flute did, however, need many changes and from 1700 there were two very different overlapping phases in the development of the transverse flute. The one type of flute system was the "German" or the "old system" flute and the other was the Boehm flute.[109]

For a detailed overview of the "old system" flutes (one-keyed, four-keyed, six-keyed and eight-keyed flute) refer to Appendix B (B12-18). For an overview of the Boehm system flutes refer to Appendix C (C19-23). For further developments on 19th century flutes refer to Appendix D (D24) and for information on modifications to the Boehm system flutes refer to Appendix E (E25-26).

2.3.8 IRISH FLUTE

Irish flutes are not flutes that are specially made for the Irish style of music, but are merely simple system flutes (post-baroque and pre-Boehm flutes). They have six tone holes with no keys. The lowest note is D (all tone holes covered) and by lifting each finger up one by one a D major scale is played. The fingering system of the Irish flute is the same as the tin whistle. This made the simple system flute a good instrument for Irish

[108] Howard Mayer Brown/Jaap Frank (with Raoul F. Camus and Susan Cifaldi): 'Fife', *Grove Music Online* (Accessed 29 August 2007), http://www.grovemusic.com
[109] Toff: 43

musicians. The techniques used on the tin whistle (traditional Irish instrument) could be easily used on the simple system flutes.[110]

Since the 1970s, however, as the Irish flute has become more popular there have been flutes designed specifically for traditional Irish music. They can be made with no keys or up to eight keys and they vary in price depending on whether they are for beginners or professionals.[111]

These flutes are similar to the simple system flutes from England (19th century). They have a larger bore, finger holes and embouchure hole. Charles Nicholson, an English soloist (1795-1837), had a great influence on Irish flute players as he produced a rich and strong tone. Matt Molloy is a good example of a fantastic Irish flute player who was able to duplicate the same sound as Nicholson.

In the 18th and 19th centuries the French and some American manufacturers still made simple system flutes with the smaller tone holes, which produced a more subtle tone. Some Irish flute players, while inspired by Molloy's playing, were more attracted to the softer flutes.

Most of the traditional Irish repertoire can be played on keyless simple system flutes and many players who have flutes with keys do not even use the keys. If the flautist wishes to play tunes written for the fiddle or the banjo, the keys are useful as they are often in modes such as D Dorian or G Dorian.

It is thought that the main reason Irish flute players used the simple system flute is because of its price. When the Boehm system flutes were developed and became the flute of choice by most flautists, many simple system flutes were discarded. This made it possible for the less affluent musicians (Irish) to be able to afford to play the flute.[112]

---

[110] Grey Larsen, *The Essential Guide to Irish Flute and Tin Whistle* (U.S.A: Mel Bay Publications, 2003), 50
[111] Larsen: 50
[112] Larsen: 52

Although most traditional Irish flute players played on simple system flutes it is possible to play Irish music on modern flutes. Players such as Paddy Carty, Paddy Taylor, Noel Rice and Joannie Madden (Irish-American) all play on modern flutes.

Paddy Carty and Paddy Taylor both played on a Radcliffe system flute as it has a similar fingering system to the simple system flute. It was introduced in 1870 by John Radcliffe and is similar to the Carte model (1851). It is basically a closed-hole Boehm flute made out of wood with an altered fingering system.[113]

Although modern flutes can be used for traditional Irish music, the simple system flutes are better as they require techniques that are not possible or difficult on modern flutes. One technique is where the player slides his fingers on and off the tone holes. This is possible on open-hole modern flutes, but it sounds better on keyless flutes. There are other techniques that are not possible on modern flutes such as shading (varying the strength of the strike, a strike being a pitched articulation executed by throwing the finger at a tone hole so that it hits the instrument at a high speed and creates a pitch lower than the original note). Another technique also not possible on modern flutes is partial hole finger vibrato. The tone of the modern flutes is also not the right character for traditional Irish music and the windy wooden sound of the simple system flutes is preferred amongst Irish musicians.[114]

2.3.9 MATERIALS AND BORE

In the last century woodwind instruments were made from Cocuswood from the Caribbean region, until it became a threatened species. Today, each woodwind instrument uses different woods for various reasons. The clarinet is made from Cocuswood, Boxwood, Ebony and African Blackwood (also called Grenadilla wood). Ebony and Grenadilla woods are incredibly stable and dense and have a good feel to them as they can polish up well. They also produce a resonant dark sound, which is

[113] Larsen: 53
[114] Larsen: 54

associated with the clarinet. The most popular wood for clarinets today is Grenadilla wood and the wood is taken from the heart of the tree. Germany, France, Japan, Italy, the United Kingdom, the United States and New Zealand all import Grenadilla wood for clarinets.

Oboes are also made from Grenadilla wood, but bassoons need to be made from a lighter wood, as a harder wood would be too expensive and too heavy. They are made from European maple as well as Sycamore as it is a medium weight and has a fine texture.

Wooden flutes were common up until World War II in the United Kingdom, the United States and the choice of wood was Cocuswood and Grenadilla wood. Other woods that were also used were Ebony, Ivory, Madagascar rosewood and Boxwood. Today wooden flutes are still made, but are not as popular as the metal ones. The most popular wood used today is still Grenadilla, but some are made from Honduras and Indian rosewoods. An American company makes wooden flutes from Maple, Rosewood as well as Apple and Pear woods. There are copies made of original renaissance flutes and they use traditional Boxwood and Maple timber.

Piccolos are traditionally made from Cocuswood, but they are uncommon today. Modern piccolos are made using Grenadilla wood. There are also many that have wooden bodies and a silver head and keys and there are student models made from plastic.[115] Plastic instruments are perfect for beginners or amateurs as the instrument is much cheaper. They are mass-produced in factories and although they are not perfect, they serve their purpose well. Professionals, however, still prefer to buy instruments that are hand-made with careful attention to detail and they are prepared to pay for it.[116]

Many of the woods were chosen because they are easy to turn and bore without cracking. From the beginning of the 19th century most flutes were made from silver, but some of the wooden flutes had metal tubing inside to give a ring to the sound. Silver is the most

[115] Global Trees Campaign: 'SoundWood Instruments and Woods-Woodwind', (Accessed 18 December 2007), http://www.globaltrees.org/proj.asp?id=46
[116] Bate: 209

favoured metal, although it is quite expensive, but it creates a very good sound with varying tone colours.[117] Gold flutes also have a very warm and solid tone. The famous William Kincaid played a platinum flute, which is the most expensive of the metals. Platinum has a density of 21.5 and in 1936 Verne Powell made a platinum flute for an exhibition of precious metals in the US and Edgard Varèse composed a piece for solo flute called "Density 21.5", which was premiered by Georges Barrère. Platinum flutes are normally made from 90% platinum and 10% iridium. Silver and gold are too soft to be made in their pure form and are mixed with other metals to increase their hardness. Silver flutes are generally 92.5% silver and the rest copper; gold flutes are usually 14 carat (58%) with the remainder made up of silver or copper. Alto flutes are often made up of 11 carat gold (42%) to strengthen the tube. In the 20th century many different materials have been used. Cheaper flutes are made from copper-nickel alloys ("nickel silver"), which contain no silver in them. They are 19% nickel alloy and the rest is copper. They are then plated with silver or gold to preserve the alloy metal. They are usually factory made and suitable for students as they are basic in design. The one downside to these instruments is that the plating wears away after years of use. Rudall Carte made stainless steel flutes from around 1935. Selmer produced Perspex flutes in the late 1940s and Uebel produced aluminium flutes in Germany. Some flutes have been made with Carbon fibre, which is a very strong material. There are also flutes made from a material called palladium (a mixture of gold and platinum).[118]

Around fifty years ago man-made ebonite was a very popular material to use for flute making. It works very well in changing weather conditions as it does not expand or shrink in different temperatures like metal does. It is easy to work with and results in a good quality instrument, although eventually it becomes unstable. These instruments are, however, very expensive to make. For this reason, plastic instruments became very popular, as they were cheaper and easier to make, which made it accessible to amateur musicians.

---

[117] Bate: 208
[118] Neville Fletcher, 'Silver, Gold or Platinum?' published in *The Flute* (August 1996)

When baroque wooden flutes were initially made, the craftsmen were highly skilled in their profession. The joints were shaped externally on a pole lathe, and the tube was bored with suitable bits and reamers. The diameter of the bore of the flute is 19mm so they had the correct tools to be able to bore the tube to that width.

When metal flutes were first made, the instrument makers had to use an entirely different method. The earliest metal flutes were made in one way. A sheet of metal was rolled up, then the seam was soldered together and then it was placed on a steel mandrel and hammered. To get the correct bore diameter (19mm) the tube was drawn, while still on the mandrel, through a hole in a block of lead. This had to be done slowly and with great force to get the best result. This brought the tube close to the mandrel and ironed out any bumps. The only problem with this method is that over time the seam corroded and was quite visible. In 1840, the first metal flute was made with no seam. However, the saddles that the keys fit over had to be soldered onto the tube and these also suffered from corrosion although it was not as noticeable as the tube seam.

In 1913, W.S. Haynes (Boston flute maker) came up with a solution where he was able to draw the saddle from the tube itself so it had no seams at all.[119] When the saddle was drawn it was quite rough on top so it needed to be smoothed so that the key could then close with no leaks.[120] This method is also thought to be acoustically better than the original way. This method has been used on all metal instruments today including saxophones.[121]

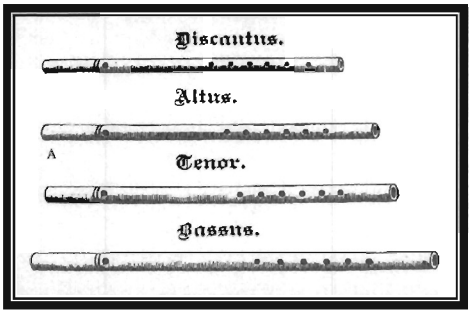
2.3.10 THE MODERN TRANSVERSE FLUTE FAMILY

Although our earliest references to Western transverse flutes are Medieval pictures, one of the earliest sources on Western transverse flutes is from the Renaissance: Martin Agricola's catalogue of musical instruments called *Musica Instrumentalis Deudsch* (1529). This catalogue shows a transverse flute in four different sizes *Schweitzer Pfeiffen*, which originated from the military fife.

---

[119] Bate: 217
[120] Bate: 218
[121] Bate: 219

Figure 34



Schweitzer Pfeiffen [122]

Since then the development of the larger and smaller flutes has been quite similar to the standard-sized flutes of today. There is the piccolo, the soprano flute pitched a minor third above the concert flute (not to be confused with the concert flute which is in the soprano range), the alto flute and the bass flute. All except the piccolo lacked technical development, as there was little repertoire written for them.[123]

These instruments were used to extend the range of the concert flute either up (soprano, piccolo) or down (alto and bass). The piccolo was the most common of them all and has achieved prominence in orchestras since the early 19th century (possibly even earlier, but its unclear whether composers wanted the piccolo or recorder), which resulted in more technical development of this instrument. The others are important members of the flute family, but will not be mentioned as they are well known and do not need much attention. Refer to the flutes table (Appendix A) for a brief overview of the flutes. The more unknown and unusual developments in flute history are more interesting and will be discussed further.

2.3.11 ODDITIES AND EXPERIMENTS

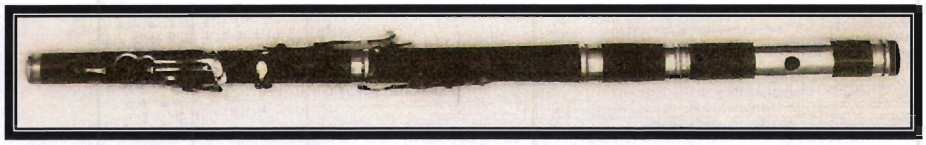
These flutes do not fit into a specific group and need to be classified separately (not all are transverse), but it is still fascinating to see how flute makers were experimenting with different ideas. They all date from the 1800s onward.

---

[122] Bate: 85
[123] Toff: 63

Flutes have been built for left-handed players who wanted to play holding the flute to the left. This is not as uncommon as one might think, as flutes in the middle ages were played to the left and many traditional flute players in Irish Ceili bands play on left handed one-keyed flutes.

Figure 35



LEFT HANDED FLUTE [124]

There is also a flute made to suit players with missing fingers, or even one hand, but only a few notable players have overcome their disability.[125]

Wigley and MacGregor made the *Flauto di Voce* in (1811), which is similar to MacGregor's alto flute (1810) as they both have a reflected head (headjoint bent back on itself in a U-shape).

Figure 36

EXAMPLE OF AN ALTO FLUTE WITH A REFLECTED HEAD [126]

The *flauto di voce* is pitched in A♭.[127] A hole was bored near the C♯ hole and covered with a thin membrane (similar to the Chinese *dizi*), which vibrated when played and made a thin reedy sound. However, the *flauto di voce* was not very popular in Europe.

---

[124] Bate: Plate 9g
[125] Bate: 201
[126] Property of KZNPO
[127] Bate: 201

The reflected head was applied on concert flutes and in 1889 Wünnenberg (Cologne) patented a flute with a barrel shaped wooden mouthpiece, which was mounted on a metal tube shaped like the letter P. It could fit any flute and meant that the player could play the flute vertically. It didn't serve much purpose and required a lot more effort to manufacture this flute. There is a good example of this flute, which is made from boxwood, in the National Museum of Ireland.

W. Wheatstone made a simpler headjoint than Wünnenberg did seventy years before him. The headjoint was the same length as a concert flute, but it was closed at the top, and had a circular hollow plug with a normal mouth hole shaped to fit the lips comfortably. This flute was not well known, but Bergonzoni (Bologna) patented a similar one in 1878.

Tomasso Giorgi (Florence) made a vertical flute in 1896 called the Giorgi Flute.

Figure 37

GIORGI FLUTE [128]

It had no whistle device, but was sounded by a free air-reed device. It was made from ebonite and had a cylindrical bore and the head was similar to Wheatstone's design. It

[128] Property of Trevor Wye

had no keys, but there were eleven holes and the range did not go below D^1.[129] Giorgi played his flute with great virtuosity, but others found the fingering system too difficult. A few of the flutes had one to four keys added later.

This flute is a collector's item today, but one of his earlier flutes was more important. In 1888 Giorgi and Schaffner (Florentine dentist) used flute, oboe and clarinet tubes of theoretical lengths and bored large rectangular holes of graduated sizes in their correct acoustical positions and covered them with a key system of rods and bell-cranks.

The fingering system would have been the same for the flute, oboe and clarinet, which would have been a great invention, but it arrived too late and could not compete with established systems. The Giorgi-Schaffner flute could have been better than Boehm's flute, but the mechanism was very complicated with many screws to adjust. The same year, Maino and Orsi (Milan) made instruments of all types for Giorgi and Schaffner with their mark on them and in 1889 they won the bronze medal at the Paris Exhibition.[130]

Figure 38

GIORGI-SCHAFFNER FLUTE [131]

[129] Bate: 202
[130] Bate: 203
[131] Bate: Plate 9g

There was also a vertical flute that looked like it had a normal concert flute embouchure hole, but it had a flageolet-type whistle head instead. A small ivory blow-tube was fitted to look like an ordinary concert flute headjoint, but it was merely a flageolet. Some were made horizontally, which made them look even more like concert flutes. They were made in different sizes, but the most notable one was the "Albion Flute" made by Bainbridge and Wood (London) around 1815. It was the same size as the concert flute and was made both vertically and horizontally.

Another strange flute was the walking-stick flute. These flutes were made in more sophisticated centres in Europe during the last half of the eighteenth century and during the Regency period in England. They were generally well made and looked very elegant. They had three joints, which remained together and they had extra length to make the walking stick a suitable length.[132] The mouth hole was near the handle and they had six holes bored and most had a D♯ key. As they were blocked at the bottom many of them had one or two large vent holes. They often had a silver or ivory handle and an elegant tassel.[133]

Figure 39

WALKING STICK FLUTES [134]

[132] Bate: 204
[133] Bate: 205
[134] Property of Trevor Wye

In 1910 Professor Abelardo Albisi (Milan) invented an instrument called the Albisiphone. Its lowest note is B and it has a two and a half octave range. It is an octave plus a semitone lower than the concert flute. It is held vertically with the headjoint bent twice near the embouchure hole. The player still blows across the hole (side-blown) and the headjoint is connected to the body by a double U-tube. It is 127cm long and the bore diameter is one and a half inches wide. It was fairly successful and several composers wrote for it. Zandonai wrote two operas called *Melenis* (1913) and *Francesca da Rimini* (1914), Mascagni wrote *Parisina* (1913), Friedrich Klosé wrote an orchestral work called *Der Sonne-Geist* (1919) and Giannetti wrote an adagio for Albisiphone and string quartet. It has a similar sound to the horn, with a warm and round sound. The Dutch flautist Ary van Leeuwen played the albisiphone.[135]

Figure 40

ALBISIPHONE [136]

[135] Toff: 75
[136] Bate: Plate 12a

The last and most bizarre flute is the Vermeulen flute. Greta Vermeulen designed it as a result of experimental work done between 1965 and 1973 at the State University of Utrecht. Its body is a double open tube with no side-holes or keys, but it has two thin-walled and closely fitted telescopic tubes sliding one within the other. It is played like a trombone with a slide and can be fully opened or closed. This means that the fundamental note can also be varied. The headjoint is built horizontally across the body in a T shape and the embouchure hole is more or less above the bore. The head is very similar to the Albisiphone, except the flute is longer on either side of the plugs to form a handle.[137] The fundamental range is a minor seventh and any notes above that are harmonics. This extends the range from c^1 to g^3, which is slightly less than a concert flute. A *glissando* is obviously possible, intonation depends on how good the player's ear is and legato playing is not possible, except for notes that come from the same register of overtones. Trilling is also out of the question, but nevertheless, a very interesting and unusual flute![138]

[137] Bate: 205
[138] Bate: 206

Appendix A: Arranged Alphabetically

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Albion Flute	Metal	1815 Bainbridge and Wood (London)	Tubular	Held vertically. Had a flageolet head that looked like an embouchure hole. Some were made horizontally so they looked even more like concert flutes.	Blow airstream across the embouchure hole.
Albisiphone	Metal	Professor Abelardo Albisi (Milan)	The diameter of the bore is one and a half inches.	Held vertically. Its lowest note is B and it has a two and a half octave range. It is an octave plus a semi-tone lower than the concert flute. The headjoint is bent twice near the embouchure hole.	Blow airstream across the embouchure hole. The player still blows across the hole (side-blown) and the headjoint is connected to the body by a double U-tube. It has a similar sound to the horn, with a warm and round sound.
Alto Flute	Wood or metal.	1854 Constructed by Boehm as a totally new instrument.	Cylindrical	Held horizontally. Pitched in G, a 4^{th} below the concert flute. It is a transposing instrument (music written a 4^{th} higher than it sounds)	Blow airstream across the embouchure hole. Has a powerful sonorous tone.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Apache Flute	Cane	North American	Tubular	It is played like a flageolet. Also has a deflector (Palwee) underneath a long hole. Metal plate over hole (with slot cut into it)	The lower edge of this metal slot is the edge where the air is split in two. Upper part covered by a saddle held together by string.
Bansuri	Plain bamboo	1st century BC	Tubular Wide bore Thin walls	Held horizontally. 40-80cm long. 6 or 7 finger holes and vent hole at the bottom. 3 oct range. Found in northern India. Characteristic: glissandi	Blow airstream across the embouchure hole much like on a western transverse flute. Windy tone quality
Bass Flute	Metal or wood.	19th century.	Cylindrical	Held horizontally. Most common one is pitched in C an octave below middle C. The headjoint doubles back in a U-bend to reach the player's lips.	Blow airstream across the embouchure hole. Lowest sounding flute.
Burmese Palwee	Cane	Burma	Tubular	It is played like a flageolet. Knot or piece of wax underneath the mouth hole (deflects the air). Top half of the hole covered with leaf/paper ring/ metal plate.	Air is directed to the lower half of the hole
Bushman's Flute	Ostrich quill	Africa	Tubular. Plain cut head.	Held vertically. Stopped at the bottom.	Blow across the top by sticking the tongue out slightly and curling it to create a passage of wind.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Central-embouchure Flute	Bone or wood	South-East Asia	Tubular	Held horizontally. Embouchure hole is in the middle. Open on each end. Played with the thumbs by opening or closing the openings on each side.	Blow airstream across the central embouchure hole
Chi	Bamboo	China 9th century BC	Tubular	Held horizontally to the left.	Blow airstream across the embouchure hole much like on a western transverse flute.
Concert Flute	Metal (Nickel-silver, sterling silver, gold, platinum). More rarely wood.	Developed from Boehm's 18th century model.	Cylindrical body and tapered head joint ("parabolic")	Held horizontally to the right. 67cm long. 19mm bore width. Three joints: Head, middle, and footjoint. Top end is stopped with a cork. Mechanism is based on Theobald Boehm's model (1847). They can have an open-hole or closed hole system.	Blow airstream across the embouchure hole.
Dizi	Bamboo	China	Tubular	Held horizontally. 6 finger holes and a thumb-hole as well as 2 vent holes. Characteristic: square membrane made from bamboo paper or garlic skin glued over a hole between the mouth hole and the 1st finger hole.	Buzzing effect as a result of the membrane. Reedy tone.
Double Flageolet	Ivory mouthpiece and wooden body	1806 (William Bainbridge)	Inverse conical	Held vertically. Two sizes. 1st: pitched in D. 2nd: pitched in G. Can play harmonies with oneself.	It is played like a recorder as it has a beak-shaped mouthpiece and the mouth covers the aperture completely

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
English Pipe and Tabor	Boxwood, but some are made from ivory	England	Tubular. Cylindrical.	Held Vertically. 3 finger-holes, sometimes 4 and a thumb-hole. Played with the left hand and holds the drumstick with his right hand. 30cm long and pitched in D. Range of an 11^{th} or 12^{th} and some can play two octaves. The tabor is a small side drum with a snare made of gut.	It is played like a recorder as it has a beak-shaped mouthpiece and the mouth covers the aperture completely.
Fife	Wood. Some have brass ferrules and metal at both ends.	1374 City of Basel Middle Ages	Narrow cylindrical bore. Narrower than the concert flute.	2-3 feet long. 7 or 8 finger-holes. They come in various sizes.	Blow airstream across the embouchure hole. Produces a shrill tone because of the narrow bore.
Flauto di Voce	Metal	1811 Wigley and MacGregor.	Cylindrical	Held horizontally. It has a reflected head. It is pitched in A♭. A hole is bored near the c^3 hole and a thin membrane is placed over the hole so it buzzes when the flute is played (like the Chinese dizi).	Blow airstream across the embouchure hole.
Flûte d'amour	Wood or metal.	18^{th} century.	Cylindrical	Held horizontally. Usually pitched in A, and minor 3^{rd} below the concert flute. The repertoire for 18^{th} and 19^{th} centuries is limited.	Blow airstream across the embouchure hole. Name describes the soulful tone and deeper pitch.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
French Pipe and tabor	Boxwood, but some are made from ivory	France	Tubular. Cylindrical.	Held Vertically.	It is played like a recorder as it has a beak-shaped mouthpiece and the mouth covers the aperture completely.
Gemshorn	Horn of a chamois	Europe	The bore is a stopped, inverted cone	It has a thumb-hole. It has similar pitches to the medieval recorder	It has a soft, husky tone that is able to project quite well. Has a sound similar to that of an ocarina
Giorgi Flute	Ebonite	1896 Tomasso Giorgi.	Cylindrical	Held vertically. It has no keys but later up to 4 were added. Had 11 holes with its lowest note being d^1.	Blow airstream across the embouchure hole.
Giorgi-Schaffner Flute	Metal	1888 Giorgi and Schaffner.	Tubular	Held horizontally. Bored large rectangular holes of graduated sizes in their correct acoustical position. Holes were covered with rods and bell-cranks. Fingering system was the same for flute, oboe and clarinet. Mechanism was very complicated.	Blow airstream across the embouchure hole.
Irish Flute	Wood	Pre-Boehm post-baroque flutes	Cylindrical	6 tone holes with no keys. Lowest note is d. Same fingering system as tin whistle. Were later made with up to 8 keys, but it works better without. Simple system flute	Blow airstream across the embouchure hole.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Javanese Suling	Cane	Gamelans	Tubular	It is played like a flageolet. Upper end closed with a knot. Short shallow channel cut on the outside towards the hole. Channel is covered with a band.	The player blows air through the channel, which then splits in two against the mouth hole to produce a sound.
Kaval	Cane Wood Metal	Indonesia, South America, Sahara, Iran, Balkan Countries	Tubular. Obliquely cut head.	Held obliquely (Across the body). 23cm of thin cane to 1 metre of wider cane. 5-8 holes and a thumb-hole.	Blow across the top. Some place it to the side of the lips and others place it against the teeth and arch the tongue to direct the airstream. It has breathy tone quality. The player may add a guttural drone.
Kena/ Quena	Cane	Peru 900-200 BC	Tubular.	Held Vertically Notched head. Entire embouchure hole virtually entirely covered by the lower lip. Range of over 2 octaves.5 or 6 finger holes and a thumb-hole.	Blow air across the hole at the top and the airstream will break over the notch to produce a sound.
Medieval transverse flute	Wood	14th century	Tubular	Held horizontally to the left. Very little is known about the transverse flute before the baroque period, as there are no surviving flutes from this period.	Blow airstream across the embouchure hole.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Menali	Plain bamboo	India 1st century BC	Tubular Wide bore Thin walls	Held horizontally to the left. 30cm long. 7 or 8 finger-holes. Used in Southern Carnatic music. Three oct range.	Blow airstream across the embouchure hole much like on a western transverse flute. Windy tone quality
Modern recorder	Wood, Ivory/ Plastic.	Similar design to baroque recorder, except they can also be made of plastic.	Tubular. Whistle mouthpiece (cylindrical) Bore of middle joint and foot joint tapers towards the end (conical).	Held Vertically. Made in 3 parts: mouthpiece, middle-joint and foot-joint. Beak-shaped mouthpiece. Middle-joint has 6 finger-holes and a thumb-hole. Foot-joint has the 7th finger-hole. Made in various sizes. Range: 2 oct plus a note). Chromatic notes played with cross fingerings.	Blow into the fipple and the air breaks in two inside the mouthpiece against the fipple to sound a note.
Nay	Cane Wood Metal	Egypt	Tubular. Obliquely cut head.	Held obliquely (Across the body). 23cm of thin cane to 1 metre of wider cane. 5-8 holes and a thumb-hole.	Blow across the top. Some place it to the side of the lips and others place it against the teeth and arch the tongue to direct the airstream. It has a breathy tone quality. The player may add a guttural drone.
Panpipes	Cane	China 2225 BC	Tubular. Plain cut head.	Held Vertically. No finger holes. Various pipes of different lengths joined together in a raft or bundle. Each pipe is tuned to sound one given note.	Blow air across the top. Lower ends are stopped by a knot in the cane or by wax.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Piccolo	Wood, silver, plastic.	1740 (Mentioned in Michel Corrette's Méthod book).	Most popular: conical bore with wooden or metal head.	Held horizontally to the right. Pitched an octave higher than the flute (music written octave lower than actual pitch). Only has 2 joints: head and body (lowest note d^2)	Blow airstream across the embouchure hole.
Primitive Flageolet 'Mataco Whistle'	Bird bone	American Indian	Tubular	It is not blown across, but played like a flageolet. Hole in middle with a lump of resin underneath.	Blow air into the mouthpiece and it deflect against the far edge of the hole in the middle to sound the note. It can be blown on either side and if the hole is not in the middle it can make two different notes.
Primitive Notched Flute	Bamboo	South-East Asia	Tubular. Notched head.	Held vertically	The lower lip almost entirely covers the hole and air is blown through the notch to produce a sound.
Primitive Transverse flute (Brazilian)	Bone	Brazil	Tubular	Held horizontally. Different to normal transverse flute because the embouchure hole is in the middle. Some have both ends open, and some have one end stopped.	Blow airstream across the embouchure hole.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Primitive vessel flute (ocarina)	Stone, wood, bone, or shell.	China 4000 BCE	Globular	China: clay whistles. Africa: Tsonga people used Gourds and fruit shells. Kenyan bushmen used animal shells. Amazon and New Guinea: Aerophones shaped like gourds attached to string. Hole cut inside that sounds a note when the air breaks across its edge.	Can have a beak mouthpiece (fipple) or a simple hole that is sounded by air blowing across it like on a transverse flute.
Quasaba	Cane Wood Metal	Asia, Cameroon, Madagascar, Algeria	Tubular. Obliquely cut head.	Held obliquely (Across the body). 23cm of thin cane to 1 metre of wider cane. 5-8 holes and a thumb-hole.	Blow across the top. Some place it to the side of the lips and others place it against the teeth and arch the tongue to direct the airstream. It has breathy tone quality. The player may add a guttural drone.
Renaissance Recorder	Wood sometimes ivory	Northern Italy 14th century	Tubular. Whistle mouthpiece and near-cylindrical bore.	Held vertically. Made out of one piece of wood. Has 7 finger-holes and thumb-hole. It has a fipple (whistle) mouth-piece. Chromatic notes played with cross fingerings.	Blow into the fipple and the air breaks in two inside the mouthpiece against the fipple to sound a note.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Shakuhachi	Root end of bamboo	China 8th century	Tubular Reverse conical bore	Held Vertically. Notched head. 4 large finger holes give a basic pentatonic scale of d f g a c. A three-octave range plus a fourth is possible by overblowing. Accidentals are made possible with the use of cross fingerings.	Blow the airstream across the hole at the top and break the air over the notch.
Single Flageolet	Ivory Ebony Boxwood and Cocus wood (19th century)	17th century	Conical Tapers towards the bottom.	Held Vertically. Small duct flute in D with a mouthpiece like the recorder. Flared at the bottom end and has six holes. Has four finger-holes in the front and two thumb-holes at the back.	It is played like a recorder as it has a beak-shaped mouthpiece and the mouth covers the aperture completely.
Soprano Flute (Third flute)	Wood or metal.	18th century.	Cylindrical	Held horizontally. Pitched a minor 3rd above the concert flute. Its development was similar to the concert flute through the 18th, 19th and 20th centuries. 18th century ones were pitched in F (concert flute's lowest note was d). Today they are pitched in E♭. Double E♭ clarinets in wind bands.	Blow airstream across the embouchure hole.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Spanish Pipe and Tabor	Boxwood, but some are made from ivory	Spain	Spanish pipes are larger and have a wider bore and a stronger sound compared with the English and French pipes	Held Vertically.	It is played like a recorder as it has a beak-shaped mouthpiece and the mouth covers the aperture completely.
Vermeulen flute	Metal	University of Utrecht. Greta Vermeulen designed it between 1965 and 1973.	Tubular	Its body is a double open tube with no side-holes or keys. It has two thin- walled and closely fitted telescopic tubes sliding one within the other. The headjoint is built horizontally across the body in a T shape and the embouchure hole is more or less above the bore. Glissando is obviously possible	Blow airstream across the embouchure hole. Played like a trombone with a slide and can be fully opened or closed. Results in a very unusual and interesting sound.
Walking stick Flute	Wood with a silver or ivory handle and an elegant tassel.	Mid 18th century in Europe and Regency Period in England.	Conical	Held horizontally. Generally well made and elegant. Had 3 joints that stayed together. Extra length was added to make the walking stick a suitable length. Mouth hole was near the handle. Has 6 holes and most have d♯ key.	Blow airstream across the embouchure hole.

Flutes	Material	Origin	Shape/Bore	Construction	Tone Production
Western Ocarina	Terracotta	Europe mid 19th century	Globular Hollow inside	8 finger holes on the top and 2 thumb-holes at the back. It has a vent hole at the bottom and a flattened tube at the side. If 2 finger holes are lifted of the same size, the note will rise by the same amount.	Cover the mouth hole with the lips and blow through the tube. The airstream will be directed across the edge of the hole at the bottom.

Appendix B

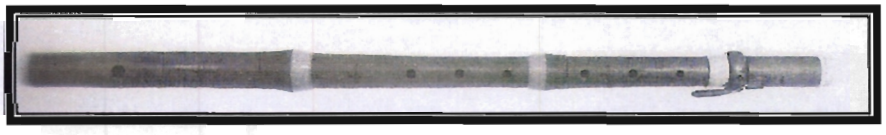
Old system flutes

The first transverse flutes in the Baroque period had only six holes. These holes were bored in the tube in positions to make it more comfortable for the hand position. This did, however, affect the tuning of the flute, because the holes were not in the correct acoustical positions. This resulted in a flat first and second octave as well as a large space between the third and fourth holes of the right hand, which made these holes quite difficult to cover. It also made F♯ very flat and difficult to play. To fix this, flautists resorted to alternative fingering, but these were also awkward to play. F would be played with the first and third finger of the right hand (fork fingering) and it resulted in difficult cross fingerings.[1]

One-keyed Flute

Jean Hotteterre (1605-1690/92) redesigned the baroque flute around 1660. He was the first flute maker to add a key to the flute. He added the D♯ key and this flute was first played in Lully's orchestra in Paris (1670). In order to add this key, a seventh hole was bored below the E hole and the fourth finger on the right hand played it. The hole was closed when not in use and was therefore called the closed D♯ key. Hotteterre published the first tutor book *Principes de la Transversiere* for the one-keyed flute (1707). This flute was divided in three parts (head, middle and foot joint). The head-joint had the mouth hole; the middle-joint had six holes and the foot joint had the new added key and seventh hole. They were all joined together with tenons and socket joints.[2]

Figure 1



ONE-KEYED FLUTE [3]

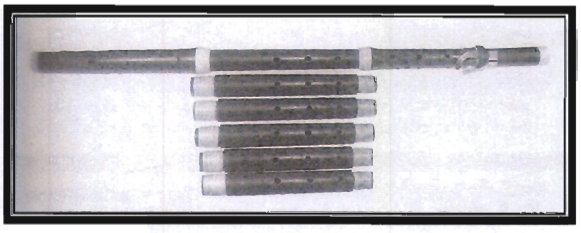
[1] Toff: 43
[2] Toff: 44
[3] Toff: 79

To create a warmer tone to the flute, Hotteterre widened the bore of the flute, making the body slightly conical still keeping the cylindrical head. The flattening effect of the conical bore meant that the finger holes could be placed closer together, which in turn made the fingering easier. He then reduced the size of the finger holes, which brightened the tone, but it also increased the tendency for flat intonation.

This flute was based on a D major scale and had a 2-octave range (d^1 to d^3) and if the flautist overblew he could play up to g^3. These high notes could not be played softly though and were best written in loud passages, otherwise they sounded forced.[4]

The headjoint was sealed at the left side with a cork and by pushing the cork in or pulling it out one could adjust the intonation. Today the international standard for pitch is A440, but in the Baroque period the pitch varied from region to region and the small adjustments of the cork were not enough to compensate for this. Around 1720, Hotteterre solved this problem with his *corps de rechange* (spare body) whereby he divided the flute into four parts instead of three. They were the upper, upper-middle, lower-middle and lower joints. The middle two joints were divided between the six holes and each flute had a set of alternative upper-middle joints of three to six different lengths, which were chosen, according to which pitch they used. This also allowed flautists to perform with keyboard instruments set at different pitch levels.[5]

Figure 2



CORPS DE RECHANGE [6]

[4] Toff: 44
[5] Toff 45
[6] Toff: 79

Shortly after this, a device called the register was designed to regulate the internal tuning of the lower body and the footjoint. The footjoint was divided into two parts with metal tubing lining the inside of the tube. This tubing could be lengthened by about half an inch by sliding it in or out. Quantz changed this idea by dividing the headjoint in two instead. He made the tenon of the lower part longer than the upper and it could be pushed in or out to adjust the intonation. This eventually became the tuning slide we know today. Quantz also added a second key to the footjoint for E♭ (1726), which was meant to distinguish between D♯ and E♭ within the meantone system of tuning.

After all these changes and Quantz's detailed fingering system, the flute still suffered from poor intonation. $b♭^1$, $g♯^1$, $g♯^2$, f^1 and f^2 were particularly out of tune and for these reasons the best keys to play in were G major and D major. Despite this, the flute was still gaining popularity and many tutor books (the first being Hotteterre's in 1707) were printed. Composers began writing more challenging parts for the flute, which enhanced the intonation problems even more and composers and musicians began to lose interest. Its reputation was almost entirely destroyed, but its attractive tone kept it going.[7]

In the middle of the 18th century equal temperament was becoming more standard. The octave was divided into twelve equal semitones. Although equal temperament was not immediately accepted it meant that keyboards could play in all keys. Once the keyboard instruments were playing in all keys, woodwind instruments then needed in-tune chromatic notes to be able to play in all the keys as well. Quantz's complicated cross-fingerings were no longer useful and a chromatic key mechanism needed to be developed. The flute needed to be looked at from a mechanical point of view rather than trying to use complicated fingerings to solve the intonation problems.

Four-keyed Flute

The flute was one of the first woodwind instruments to use additional chromatic keys as opposed to flutes with diatonic notes. There were three flute makers from London who

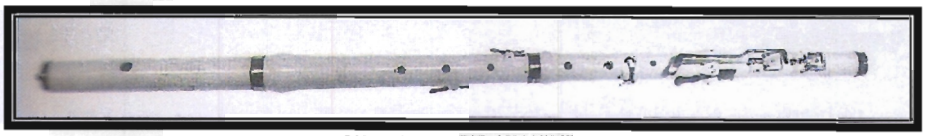
[7] Toff: 45

began to do this (around 1760). They were Pietro Florio (about 1730-95), Caleb Gedney (1754-69) and Richard Potter (1728-1806). The three new keys were G♯, B♭, and F, which improved the flute a great deal. The only cross-fingered chromatic note was c♮ in D major scale, and f^3 sounded much better. Composers had more freedom and could choose different keys to write in. Many felt it was an effort to learn new fingerings and were worried that the mechanism would be unreliable.[8] For this reason, they initially used these keys for trilling and difficult ornamentation and it was only around 1785-1790 that the new mechanisms gained popularity and this flute was preferred to the one-keyed flute.

Six-keyed Flute

In 1774 Florio, Gedney and Potter reintroduced the footjoint. The flute was lengthened by two inches and two more holes were bored in it. These holes were covered by open keys and were controlled with the fourth finger of the right hand. These additions also took a while to be accepted by the public, but in time they were.

Figure 3



SIX-KEYED FLUTE
Clementi & Co. (1802-21)
Ivory with silver ferrules [9]

The four- and six-keyed flutes affected the way composers wrote for the flute and this can be seen most notably in the works of Haydn and Mozart. The flute is used more often in Haydn's works after 1780 as well as in Mozart's later symphonies. The written range used by composers on the flute was initially limited, but later this was extended from d^1 to g^3. This meant that the flute was becoming an important instrument in the orchestra.

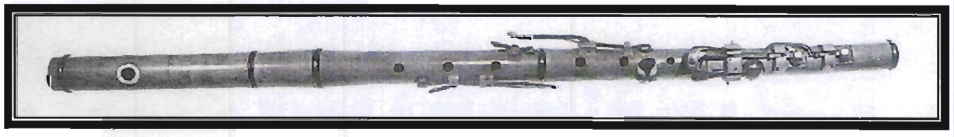
[8] Toff: 46
[9] Toff: 79

Eight-keyed Flute

The changes made thus far in the 18th century led to the development of the eight-keyed flute. This flute was later called the "German", "ordinary", "old system", "simple system" or "Meyer system" flute.

In 1782 Dr. J.H. Ribock introduced a closed key for c^2 and Tromlitz introduced a second F♮ key in 1786. On the previous four- and six- keyed flutes the F key was very difficult to play smoothly, as the player had to move his right-hand third finger sideways from the E key to the F key. It made slurring between F and D or D♯ virtually impossible and would usually sound e in between. To solve this problem, Tromlitz bored another hole on the far side of the tube and placed a closed key over it. It was played with the fourth finger of the left hand and was called the "long f" key because of its shape.

Figure 4



EIGHT-KEYED FLUTE
Rudall & Rose (London 1827-37)
Boxwood with silver rings and keys
Inlaid ivory embouchure ring [10]

In the 18th and 19th centuries, the eight-keyed flute became the standard instrument of choice, but the one-keyed flute was still used well into the 19th century, together with the four-keyed, six-keyed and eight-keyed models. The one-keyed flute was much cheaper than the others and is one of the main reasons why it was still being used. In the 19th century, there was a huge amount of mechanical development in all fields, and the flute was one of them. The flute was not limited to eight keys and some had up to seventeen keys with a range extending down to low g.[11]

---

[10] Toff: 80
[11] Toff: 47

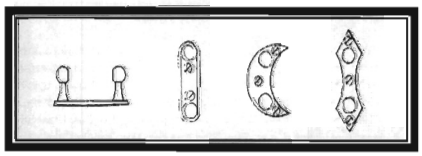
By the end of the classical period the orchestras were getting bigger, which meant more volume and projection was needed from the flute. Flautists were worried about their instruments, as composers were demanding more contrasts in tone colours. Although the woodwinds played less often than the strings, the parts were more exposed and players needed a more soloistic sound. The key signatures were also becoming more adventurous with more sharps and flats added and this made the awkward cross fingerings more difficult. The flute, therefore, underwent several changes in the 19th century, which had a huge effect on the course of flute playing.

Figure 5

FOUR-KEYED FLUTE BY CLAUDE LAURENT (PARIS 1818)
Crystal glass, interior surface cut in concave,
diamond-shaped facets, silver tenons, sockets, and keys. [12]

Claude Laurent, a Paris flute maker, made a flute out of glass in 1806. Because the tube was delicate it needed special mechanisms. Silver tenons and sockets were made for the joints and the springs were lengthened to strengthen them. Most importantly, however, a new design was used to mount the keys. In the past, the small woodwind instruments had used metal "saddles" and the key rotated on a screw-headed pin held in a metal bearing. On the glass flute, Laurent attached the keys by mounting them on silver posts that were then attached to metal plates, which were screwed to the glass tube. Makers of wooden flutes used this idea to prevent the keys from moving sideways.

Figure 6

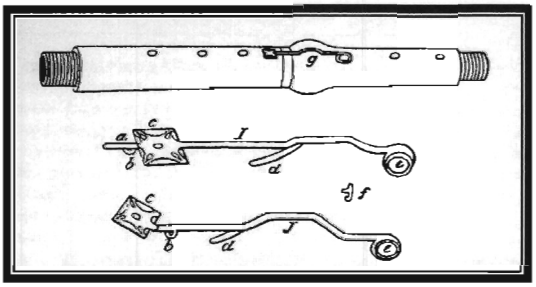


SILVER PILLARS AND PLATES [13]

[12] Toff: 79
[13] Toff: 49

Furthermore, in 1808, Reverend Frederick Nolan patented a device to improve evenness of intonation. It consisted of open-standing keys applied in two ways. The first was a single lever on a linked pair, whose touchpieces were rings that surrounded the finger holes. This was the first known development for simultaneously closing an open key and a regular hole with the same finger. This method was used in highly mechanized instruments later in the century. The second was the ability to close a connected key while the immediate key stayed open. This was done by sliding the finger off the key while still keeping it on the shank (stem). [14]

Figure 7



NOLAN'S RING KEYS [15]

[14] Toff: 49
[15] Toff: 50

Appendix C

The Boehm Flute

In the 19th century, there were two different groups of thought. The first group wanted to keep the traditional systems with additions if necessary (old system) and the other group wanted to start over and develop a new fingering system that was able to control these keys. Theobald Boehm was the leading figure in the latter group.

Boehm initially made the simple system flute of that time, but he made a few changes to the normal designs. He designed tuning slides, hardened gold springs and he also mounted the keys on screwed in pillars. By 1829 he was experimenting with longitudinal rod-axles to connect the keys.

Around this time, he was touring Europe as a flautist and performed several concerts in London around 1831. He met a flautist named Charles Nicholson. He was amazed by Nicholson's full, strong tone due to the fact that the tone holes on his flute were slightly larger, which helped the tone and intonation.[16]

Boehm thought that the simple system flute had too many problems. He began to redesign the flute and was influenced by three earlier inventions. Firstly, he wanted to use larger tone holes, like on Nicholson's flute. He also wanted to design keys that could control tone holes that could not be reached and finally, he wanted to use the ring keys invented by Reverend Nolan. Boehm's main aim was to fix all the acoustical problems while borrowing inventions from other flute makers.

Boehm's first design was made in 1831 by the London firm of Gerock and Wolf. The flute had a cylindrical bore with a "parabolic" headjoint (curved). There were just two differences to the original eight-keyed flute. The fingering in the left remained the same, but the A hole was moved down to its correct acoustical position and an open key for the third finger in the left hand was used to reach it. The E, F, F♯, and G (right hand) were

[16] Toff: 50

respaced further down the tube and were controlled by double-jointed ring keys, which allowed the first finger of the right hand to close two holes instead of one. This resulted in F♮ to be produced instead of F♯ like on the old system flutes. The F♯ was now played with the third finger of the right hand by using another ring key.[17] This F-F♯ device eliminated the primary D major scale of the simple system flute and is the first example of the development towards the modern flute. This radically changed the fingering system as the modern flute has a primary scale of C major (as you lift one note you get one diatonic note higher with no cross-fingerings).[18]

Figure 8

BOEHM 1831 MODEL

Gerock & Wolf, London [19]

In 1832 Boehm worked on the size and placement of the tone holes. He placed the holes in their correct acoustical position and made them as big as possible and he used an open-keyed system, which resulted in a much clearer and stronger tone.[20]

Figure 9

BOEHM 1832 MODEL (Munich 1849)

Cocus with silver rings [21]

To be able to use the open-keyed system the holes needed to be rearranged again. His flute now had fourteen holes that had to be played by only nine fingers.[22] He used

---

[17] Toff: 51
[18] Toff: 52
[19] Toff: 80
[20] Toff: 52
[21] Toff: 80
[22] Toff: 52

Nolan's ring keys along with his own horizontal rod-axles. This new system allowed the fingers to stay in their natural positions for all notes from d^1 to b^3 except for the little finger in the right hand. Boehm aimed to keep as much of the old system fingering as possible.

The public first saw his new flute in Munich concerts in November of 1832, and later in Paris and London. It was not initially accepted in London and Germany because of all the new fingerings and the new "open" tone and he had only sold one in London by 1833. Paul Camus (First flute of the Opera Italién) introduced the new flute to France in 1837 and with the help of some colleagues it slowly gained popularity.

Those colleagues made a few changes to the flute to make it easier to play, while still keeping Boehm's invention. Auguste Buffet, a Paris flute maker who later helped Klosé adapt the Boehm system for the clarinet, did not like the axles on both sides of the flute and moved them all to the inner side. He thought the rod connecting the F♯ ring to the G and B hole covers was over crowded, so he attached the E and F rings and the G cup to a single axle, with the F♯ ring mounted to a loose sleeve through which the axle passed. A lug was then soldered to the sleeve and a similar lug was pinned to the axle above the sleeve. The B♭ ring-B cup mechanism and the C♯ cup and touchpiece were attached to loose sleeves threaded on a fixed rod.[23] The B-B♭ sleeve carried a third lug that lay on top of the other two, together forming a clutch. Buffet also applied the rod and sleeve device to the footjoint keys and he used needle springs instead of flat leaf springs to improve the mechanical action.

Victor Coche and Buffet worked together and made a few changes to Buffet's 1839 patent. He brought back the closed G♯ from the old system flutes, as many flautists disliked the open G♯, though this did not last. Coche's greatest achievement was the

[23] Toff: 53

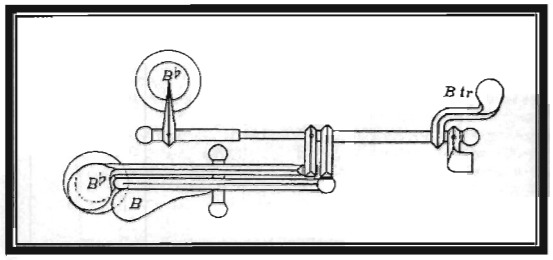
addition of the trill key for C♯-D♯ in the second and third octaves. Buffet then connected this trill key with Boehm's D trill key in a common sleeve.

Vincent Dorus (flute professor of the Paris Conservatoire and soloist of the Operá) came up with a better solution to the G♯ key. He made a ring key for the A hole and joined it to the open G♯ key with a divided sleeve and clutch. When the ring key was pressed down it closed the G♯ key, but it could be opened on its own by attaching a lever to the part of the sleeve that supported the G♯ key. The fourth finger of the left hand controlled this lever. The only problem with this was its dependence on two opposing springs of different strengths. This resulted in some awkward fingering, but it was a good transition to the Boehm flute for those who were reluctant to learn new fingerings.

These changes increased the public's interest in the Boehm flute. This model was introduced to the Paris Conservatoire in 1838 and the next year Cornelius Ward and Signor Folz (London Flautists) started using it and John Clinton (professor at the Royal Academy of Music in London) claimed to use the Boehm flute in 1841. Richard Carte and George Rudall used it two years later. In 1939 Boehm found an interest in the steel industry and he closed his factory and contracted Rudall and Rose in London and Clair Godfrey in Paris to manufacture his flute.

Boehm's flute had only one thumb lever, which controlled B♮ and B♭, and it was played by the first finger (right hand). Giulio Briccialdi (1818-81) came up with an alternative fingering for B♭ using the thumb. He added a second thumb lever, which was placed above the B lever and it was sprung so that when it was pressed down it would close the B♮ hole as well.

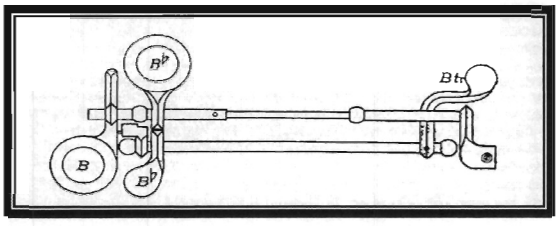
Figure 10



BRICCIALDI'S B♭ THUMB LEVER [24]

This made it much easier to play in flat keys. Boehm later moved the B♭ lever below the B lever, as it made more sense to move the thumb up to change to the upper note (B). Briccialdi's lever, however, is the predominant one used today.

Figure 11



BOEHM'S B♭ THUMB LEVER [25]

The Boehm flute was manufactured in the United States in 1851 and was very popular in France and England. It won first prize in the Industrial Exhibition of All Nations in the UK in 1851, the gold medal at the Paris exhibition in 1855 and first prize at the General German Industrial Exhibition in 1855. In Germany, however, where Boehm was from, the flute took much longer to gain acceptance. The main reason was the inconsistency with the aesthetic standards that demanded a wooden flute in the traditional woodwind choir, as well as lack of teachers, as Boehm's best students had immigrated to the United States. By the early twentieth century the Boehm flute was still uncommon in Germany, Italy and Russia, due to the fact that they still refused to accept the new fingering system.[26]

---

[24] Toff: 56
[25] Toff: 56
[26] Toff: 57

Appendix D

Other Nineteenth Century Flutes

In France, the Boehm flute was adopted quite quickly with only a few minor mechanical changes. In other parts of Europe, flautists went about things differently to repair the problems of the old system flutes. The Germans continued working on the traditional conical flute (Boehm's system is cylindrical) and in England, several completely new designs were made along with important changes to the Boehm system. The only one of these models used today is the Guard's model (1867).

Most variations on the simple system flute kept the conical bore and many flautists liked the subtle tone and original fingering system. Flute makers merely added keys and renamed them and called them "new" models. Jean Louis Tulou made a footjoint similar to Boehm's 1851 model. In Germany many flute makers added a brille (spectacles), which was a device that had two rings and a vent on the upper joint. It improved the intonation of c^2 and $c\sharp^2$ and Rudall & Rose later used this device.

For a detailed description of the most important 19th century flutes please refer to Nancy Toff's "The Flute Book" (page 57 to 59).

Appendix E

Modifications to the Boehm system

By the end of the 19th century flute makers accepted that the Boehm flute was there to stay and only small mechanical changes were made so that the player could adapt easily. Any additional keys were merely supplementary keys, which did not change the basic mechanism but solved some technical problems. Other changes were to do with materials and techniques of construction.[27]

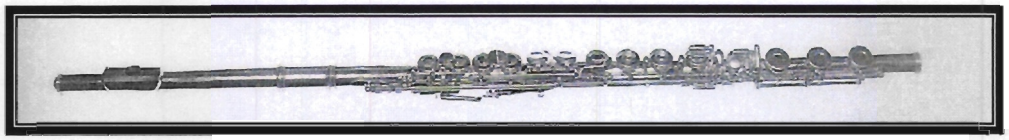
The Borne-Julliot flute was the most different to the Boehm system. Djalma Julliot was a French manufacturer and Francois Borne was a professor at the Toulouse Conservatory. They both invented so many gadgets that they could not all fit on the flute. It was all over the top and too much. The only device that lasted was the split-E or split-G device, which fixed the sharpness and problematic production of e^3.

BORNE-JULLIOT SYSTEM FLUTE (1900)
Silver with gold springs, split E, left hand F# key, C# trill key.
Side keys for duplicate G# hole and C hole.
Extra right-hand levers for left-hand keys [28]

Alex Murray also built a flute that was very different to the Boehm flute called the Murray flute. In 1948, Murray brought the open G♯ and D♯ back. He also added the split-A mechanism, which is similar the split-E. He made many reversals of the thumb key and kept changing his mind. He added roller keys to the footjoint and experimented with rectangular keys. In 1967, when Murray was teaching at Michigan State University, he organized to have the W.T. Armstrong Company of Elkhart Indiana build a prototype for his latest model. In 1972, Armstrong made fifty Murray flutes and six flutes called

[27] Toff: 59
[28] Toff: 80

the "multiple options" flute. Today they are only available on a custom basis from Jack Moore (flute maker who worked closely with Murray) and they will probably never be very popular.



MURRAY FLUTE (1971)
Armstrong prototype (built by Jack Moore)
Silver plated metal [29]

There were several more common French patents in the early twentieth century. In 1902, Thibouville-Lamy & Cie. issued a patent for three trill keys from c^1-$c\sharp^1$, d-c, and b♭-b. Cornélie Villedieu Laubé issued a patent for the addition of a trill key that improved several existing trills and permitted a new trill from g^3-a^3 when used together with the upper c-d trill key.

In 1913, Louis-Fernand Vigués reversed the right hand fourth finger touches for $c\sharp^1$ and c^1 keys in order to facilitate the c^1-d^1 trill. A second lever for the fourth finger on the left hand was also added, which controlled the C♯ key, and created c^1-$d\flat^1$ and $c\sharp^1$-$d\sharp^1$ trills. This was impossible on the Boehm system. Two other trill mechanisms made several difficult third register trills easier.

In 1926, Charles B. Gage patented the Gage Articulated B-F♯ device. This made it easier to slide between the Briccialdi B♭ lever and the B♮ lever. It never gained popularity, but the Haynes Company introduced an almost identical device in 1981.[30]

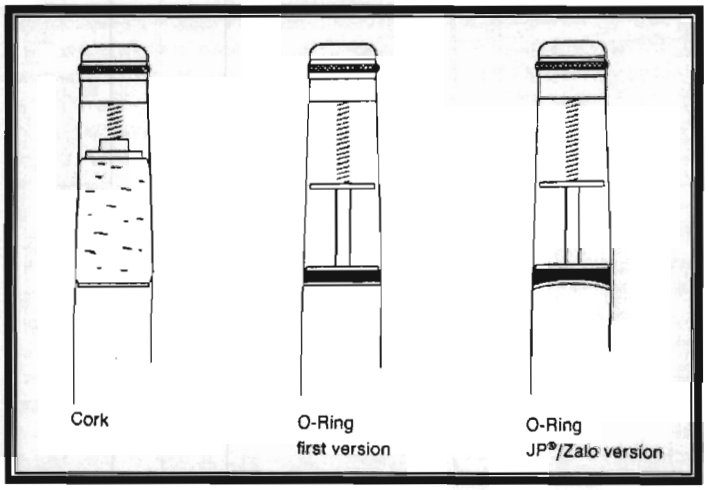
More recently, the acoustics of the flute rather than the mechanics have been developed and a number of new "named scales" have been introduced. The term "scale" refers to

[29] Toff: 80
[30] Toff: 60

the exact mathematical measurements for tone-hole placement. Each system has slightly different ideas on how to help the player adjust individual notes. Albert Cooper introduced the Cooper scale, which is probably the most famous one. Various Cooper scales can be found on Powell and Brannen Brother flutes as well as the Cooper flute itself. W.T. Armstrong offers its own "Armstrong Scale", Jack Moore lists William Bennett's scale as an option, and Haynes has the Deveau scale.

The biggest development on the headjoint recently is the O-Ring, which is the replacement for the ordinary cork stopper. The cork is still very reliable, but the O-Ring is made of a synthetic rubber called neoprene. It can seal tightly and never needs to be replaced. Rudall, Carte & Company originally used the O-Ring early in the century. Leslie Eggs (English headjoint maker) altered it to suite the silver flute, and James Pellerite imported it to the United States.

Figure 12



O-RING [31]

Other adjustments have been made to the size and shape of the embouchure hole, materials of the tube construction and manufacturing techniques. These manufacturing developments have allowed flutes to be made on a large scale and student model flutes are much more durable. For example, David Straubinger and others have made synthetic pads, which last longer than the skin-covered felt pads.

---

[31] Toff: 7

All of these changes have made the modern flute what it is today and although there will always be small changes made to improve the instrument's durability, intonation and timbral flexibility; it is basically the best it can be.[32]

[32] Toff: 61

BIBLIOGRAPHY

1. Baines, Anthony. 2001. 'Pipe and Tabor', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrell. London: Macmillan. XIV

2. Baines, Anthony. 1991. *Woodwind Instruments and Their History*. New York: Dover Publications, Inc.

3. Baines, Anthony and La Rue, Hélène: 'Pipe and Tabor, §1:Description', *Grove Music Online* (Accessed 17 August 2007), http://www.grovemusic.com

4. Bate, Philip. 1969. *The Flute*. London. Ernest Benn Ltd. New York: W.W. Norton.

5. Brown, Howard Mayer / Palmer, Frances: 'Aerophone', *Grove Music Online* (Accessed 23 September 2007), http://www.grovemusic.com

6. Brown, Howard Mayer / Frank, Jaap (with Raoul F. Camus and Susan Cifaldi): 'Fife', *Grove Music Online* (Accessed 29 August 2007), http://www.grovemusic.com

7. Fitzpatrick, Horace. 2001. 'Gemshorn', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrell. London: Macmillan. VII

8. Fletcher, Neville. 'Silver, Gold or Platinum?' Published in *The Flute* (August 1996)

9. Geiringer, Karl. 1943. *Musical Instruments Their History from the Stone Age to Present Day*. Great Britain: Unwin Brothers Limited.

10. Global Trees Campaign: 'SoundWood Instruments and Woods-Woodwind', (Accessed 18 December 2007), http://www.globaltrees.org/proj.asp?id=46

11. Hunt, Edgar. 2001. 'Recorder', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrell. London: Macmillan. XV

12. Kenyon de Pascual, Beryl: 'Flageolet, §1: 'Single Flageolet', *Grove Music Online* (Accessed 19 August 2007), http://www.grovemusic.com

13. Larsen, Grey. 2003. *The Essential Guide to Irish Flute and Tin Whistle*. U.S.A: Mel Bay Publications, Inc.

14. Liggins, David: 'Ocarina', *Grove Music Online* (Accessed 24 January 2007), http://www.grovemusic.com

15. McKinnon, James. 2001. 'Panpipes', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrell. London: Macmillan. XIV

16. McLean, Mervyn: 'Nose Flute', *Grove Music Online* (Accessed 20 August 2007), http://www.grovemusic.com

17. Meylan, Raymond. 1988. *The Flute*. London: B.T. Batsford Ltd.

18. Montagu, Jeremy (I,II)/ Mayer Brown, Howard/Frank, Jaap/ Powell, Ardal (II): 'Flute, §II, 4(i): The Western Transverse Flute: To 1500' *Grove Music Online* (Accessed 17 August 2007), http://www.grovemusic.com

19. Nettl, Bruno/Levine, Victoria Lindsay (I;II,2;IV;V,2), Elaine Keillor (II,1;V,1), 'Amerindian music, §III, 4: 'Aerophone', *Grove Music Online* (Accessed 20 August 2007), http://www.grovemusic.com

20. Powell, Ardal. 2002. *The Flute*. New Haven and London: Yale University Press.

21. Schechter, John M. 2001. 'Kena', *The New Grove Dictionary of Music and Musicians*, ed. S. Sadie and J. Tyrell. London: Macmillan. XV

22. 'Shakuhachi', *Grove Music Online* (Accessed August 2007), http://www.grovemusic.com

23. Thrasher, Alan R: 'Di', *Grove Music Online* (Accessed 20 August 2007), http://www.grovemusic.com

24. Toff, Nancy. 1996. *The Flute Book*. New York and Oxford: Oxford University Press.

25. Waterhouse, William (2): 'Flageolet, §2: Double Flageolet', *Grove Music Online* (Accessed 19 August 2007), http://www.grovemusic.com