The Genesis of the Duct Flute – an Evolutionary Theory

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This paper can only be theoretical because the process it postulates must have taken place, assuming that it ever did, sometime in Mesolithic period, and must have been complete by the Neolithic period, by which period we certainly have surviving duct flutes (though be warned, the Neolithic is a cultural term and not a chronological one – its date varies by thousands of years from place to place). And so there can never be any evidence to show whether such a theory is either true or false.

The end-blown flute, often called *nay*, is one of the most perfect instruments that has ever existed. It is capable of infinite expression, of a dynamic range from piano to fortissimo, and an almost infinite range of tuning, whether diatonic or microtonic. BUT it is difficult to play. Once one knows how to obtain, and how to maintain the correct angle of incidence between the air-stream and the edge, there are few problems, but this is not easy to learn. Once achieved, by altering the angle of incidence slightly, and by covering the open end more or less with the lips, the range of tuning is infinite. As is well known with flutes, as one blows harder the sound gets louder BUT the pitch gets higher, but this can be corrected as I have just described. And thus in many cultures today, this is the instrument is that played by virtuosi.

The shape of the end varies quite widely from culture to culture today (we can never know what range there was in the Pal æolithic or Mesolithic because we lack surviving examples). Today it can be simply be the end cut off flat, or it can be chipped round the exterior or ground all round the exterior, in both cases to present a sharper edge to the airstream. In a few places, chiefly Turkey, there can be a wooden or other mushroom-like top**.**

Did it have fingerholes right from the beginning? or was it preceded by the harmonic flute, a form that still exists quite widely, for example as the *tilinca* in Romania today. How widely, we really do not know, for any tube that can be blown at one end and stopped with a finger at the other can serve as an harmonic flute, whether of a natural material such as cane, or a piece of aluminium or copper plumber's tubing, as often in Romania nowadays, and such tubes are seldom recognised as a musical instrument unless one happens to see and hear it being played. Even when there is a duct fitted in one end, as in Slovakia today, it may be dismissed as an unfinished duct flute.

It must have been apparent to players that while this instrument has a wide range, other

possibilities were available, and that the shorter the tube the higher the pitch. As and when anybody realised that by burning or cutting a hole partway down the tube one was, in effect, shortening it and so raising the pitch, and then by covering that hole with a finger, restoring the original length and pitch, can never be known.

But how to circumvent the difficulty of blowing the end-blown flute? Well, we have said that the upper end of the end-blown flute is most commonly externally chamfered by chipping or grinding to provide a sharp edge. If one locates that sharp edge at one point only on the tube, and places that sharp edge at the bottom of a shallow dipped edge , as on the Japanese *shakuhachi*, semi-circular, as on Chinese flutes, U-shaped, V-shaped, or a curved or flat-sided U-shaped notch, as on the Peruvian *qena*, this helps to focus the air-stream and to make it very much easier to obtain a good sound. And this why the notch flute is widely used in many areas around the world, especially in South America where the end-blown flute is seldom used. The notch flute still has some of the advantages of the end-blown flute: the open end can still be covered by the lip, though not quite so easily adjustable as with the end-blown flute, so there is still some control over intonation as air-pressure and pitch rises. But it also has some disadvantages in that one does still have to aim the air-stream accurately into the notch.

Using the tongue as a form of duct makes this easier, though most tongue-duct flutes do place the notch at the base of a hole rather than having an open notch. This again makes them difficult to identify, for when found archæologically, most duct flutes have lost their blocks – was the instrument a block-duct flute with a missing block, or was it a tongue-duct flute? We can never know. The existence of the tongue-duct flute was only fairly recently recognised, initially by Ernst Emsheimer and Hermann Moeck. Again there are advantages and disadvantages. Because the upper end of the tube remains open, one does have some control over its area, but less than with either notch- or end-blown flutes.

Incidentally, if you wonder how this process of partially covering the blowing end works, it is based on Helmholtz resonator, or ocarina, theory: that the area of open hole (any hole on the instrument, either end, or lateral holes on the body) determines the pitch; reduce the area and the pitch drops; increase the area and it rises. This is a vital acoustical principle and it applies to all instruments that have a resonating air body, from violin f-holes and lute roses, through all wind instruments, to slit drums.

So what was the next step? Some people, for example in Brazil just put a blob of wax in the top to lead the air to the bass of the notch . But more usually it was a more permanent stopper, to lead the air through a passageway or duct, hence the use of the term duct flute, to the base of the notch, which is

now a little way down the tube. The types of duct vary very widely. Most, as with the tongue-duct are internal: a block inserted to leave a more or less narrow passage for the air. But it can be external, as with the Javanese *suling*, which has a naturally stopped upper end formed by a septum of the cane, with a short section of the circumference cut down to leave a passage between that point and a ring of cane or leaf tied round the head. It can be both internal and external, as with the Burmese *palwe*. One blows into the top, as with a normal duct flute, but an internal blockage, either artificial such as wax or a natural node, forces the air out again through a hole in the wall, but something tied over that hole leads the air to the voicing edge, further down the tube. A better-known example is the American-native so-called Apache flute, far more elaborate examples of which can be seen on many Mexican pre-Columbian codices.

But as I've said, the commonest ducts are internal. They can be in the side, especially in places where side-blown flutes are thought more respectable, as in India where the transverse flute is Krshna's symbol and in our own culture. More often, though, they are frontal, though they can be dorsal, as they often are in Eastern Europe – and especially for longer instruments, which are easier to play with the duct on the player's side of the tube than on the further side, and if the top of the instrument is flat, rather than beak-shaped.

The geometry of the duct is crucial to tone production – ducts that are narrow from roof to floor give a more focussed sound than higher-roofed ones, but the higher-roofed ones can have a fuller but less-focussed tone (very difficult to express the difference in words); this is why original eighteenth-century recorders sound very different from modern ones whose duct is twice the height of the originals that they claim to copy. Also critical is the geometry of the mouth, the distance of the edge from the base of the duct, the width of the edge, and so on. So why is there so much difference in geometries? If one is best, why are not all the same? Simply because there is no such thing as 'best' – each culture has its own conception of what is 'best' and that varies from one culture to another. Returning to the recorder as our exemplar: Arnold Dolmetsch and his son Carl had very different concepts of 'best' from those who played the instruments of Hotteterre and Bressan, and this is why eighteenth-century and modern recorders differ so much in sound (and why the Dolmetsches ruined a number of originals such as those in the museum in Chester by revoicing them according to their own ideas).

Duct flutes are quite widely accompanied by a drone. This can be achieved by multiple tubes fixed together. Most commonly there are two, but in Flores there were often three – these are internal-external duct flutes, with strips of leaf slotted through slits in the bamboo tube to form the external

block. The English double-flageolet was another example – this had a key to cut off the drone if it was not required. The drone pipe can also have one or more fingerholes so that the drone-pitch can be varied, or can provide an accompanying part. The drone can be provided by the player; in Turkey and Romania the player hums a drone, called the *ison* in Turkey, which can be varied as the key changes, and which radically alters the tone quality, something that a geminate flute does not do. Tone can, though, be altered in other ways. In China and neighbouring areas, a hole in the side can be covered by a membrane, just as is done there with the transverse flute. It can even be done with the notch flute. This is an instrument whose semi-circular notch is partly closed by a node; the node is pierced with small holes over which a membrane is placed to add the buzz – even though this membrane is above the air column, it still functions.

Now if all this process, from end-blown through notch-blown to duct-blown, is an evolutionary theory, why, against all Darwinian theory of the survival of the fittest and the disappearance of the unfit, do we still have end-blown and notch flutes all round the world? Well the answer is that while the duct flute is one of the easiest of all instruments to play, because all you have to do is to put it in your mouth and blow, which is why so many of us start our children on the recorder, it is also one of the hardest to play in tune, as all parents with recorder-playing children know only too well. Except by using some very tricky fingerings, there is no way to compensate for variation of air-pressure and thus of musical expression, nor is there any way to produce any microtonal scales, save for those that are fixed by position and size of the fingerholes. This is why Bach's *flauti d'echo* in Brandenburg Concerto no. 4 must have been some special form of the recorder – no normal recorder can produce both a true forte and a true piano; it can vary the volume a bit, but not by very much. In this respect it is like the clavichord, whose wide range of volume over a very small area was much appreciated in its own time, but had to give way to Cristofori's piano which could produce a wider range of piano and forte, a range that widened progressively over its three centuries of development – the early fortepiano was quieter than the harpsichord, a balance problem in some early eighteenth-century double concertos for fortepiano and harpsichord, and an equal but reversed balance problem when people tried to play the same concertos with harpsichord and pianoforte.

So that is the reason why the end-blown and the notch-blown flutes remain in many cultures the professional's and the virtuoso's instruments, while the duct flute is that of the amateur. The amateur finds it easier to play the duct flute, with a musical range adequate to his or her expectations, whereas the professional wants to be able to do the things that the amateur could not accomplish. It is also why

the duct is so commonly used as the basis of the quick pick-up-and-blow instruments such as whistles. The policeman in an emergency, the boatswain giving quick orders, the walker trying to control the dog, may not have the time to set the wind-angle correctly – what is needed is the quick response that only the duct can give.

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