'A modern maker strives to recreate the properties of the classic recorders and to overcome some of the minor defects that they exhibit.'

Neville Fletcher, Australia

One might reasonably ask the question 'what makes a really good recorder?' and the answer is rather complicated. The recorder must be able to be played in tune in all registers, the tone should be pleasant and smoothly graded across the compass for both soft and loud playing and the notes should begin and end smoothly.

But there is rather more to it than that, as great makers such as Fred Morgan knew. I am not able to unwrap all the 'secrets' of his craft, for many of them have been handed down by tradition and are not known explicitly, but let me write a little about the things that we now think we do understand.

The general shape of a recorder is related to some particular tradition – Bressan or Ganassi, for example – and the aim of a modern maker is to create an instrument that will produce the traditional sound of that style.

Fred studied some great collections of these instruments in detail, and detailed scientific work was done by John Martin.[1] But while studies of particular instruments do set the general parameters of the design, the final result will depend in detail upon the wood that is used and upon hand finishing and adjustment.

What can we say about these matters? First, the wood. I can remember seeing stacks of wood blocks in Fred's workshop, each perhaps four centimetres across and about the length of a recorder, and with a hole bored along the middle. This old wood had been carefully selected and shaped, and then remained in the stack for several years before being made into an instrument. What are the important things about this process? Of course, every piece of wood is different and the central hole disturbs the moisture balance and elastic stress throughout it, so time must be allowed for everything to settle into a new equilibrium with an indoor environment. If this is not done, then the wood may warp or even crack later in its life as a recorder.

Choice of the wood is also very important, because the sound of the recorder involves the air inside the bore vibrating backwards and forwards along the bore, and we need a surface as smooth as possible so that sound energy is not needlessly wasted in travelling round minute roughnesses in the wood – and by 'minute' here I mean hundredths of a millimetre. This also says something about the finishing of the bore when the instrument is complete, and about the use of bore oil to maintain the smoothness.

When the wood is matured, the next step is the detailed shaping of the recorder, and here many subtleties emerge. Some are largely decorative, like the raised rings on the outside, though these also serve to strengthen the whole structure, but others are vital to the sound of the instrument.

The bore, as we know, is generally smoothly tapered towards the foot of the instrument, but this tapering is not precisely uniform in a really good instrument. Instead, subtle changes allow for careful adjustment of tuning in a way that is different from simply positioning the finger holes. Thus, for example, a slight widening of the bore halfway to the foot will lower the pitch of the bottom note of the instrument but raise the pitch of the note an octave above. A widening of the bore near the foot of the instrument, in contrast, raises the pitch of both these notes.
So a skilled maker uses these adjustments as part of his general strategy.

How about the finger holes? Well, here we have a dilemma, for there is no such thing as a scale that is perfectly 'in tune'. All are compromises. If all perfect fifths are exact, as in Pythagorean tuning, then major thirds will be too sharp and minor thirds too flat to be really in tune.

If we are playing music from an earlier area, which is usually the case, it is better to compromise the fifths a tiny bit and get the thirds in tune, giving meantone tuning; but there is then a real misfit between G sharp and A flat. We might, alternatively, use the modern equal temperament where everything is compromised slightly. Fortunately, the player can adjust the pitch a little, though usually at the cost of a loudness adjustment.

Finger hole position itself is a compromise, since the holes need to be fairly evenly spaced for finger convenience; but opening them must produce in some cases a semitone rise in pitch, and in other cases a whole tone. Much of this can be fixed by changing the diameter of some of the holes or by undercutting some of them – a small hole in a given position produces nearly the same effect as a larger hole further up the bore – but the pitch shift is a little different in each octave and there can be tonal consequences too.

This is where bore adjustments come in. The thickness of the walls of the finished instrument is also very important, since each finger hole is a small tunnel, and the effect of it upon the pitch depends upon the length and diameter of this tunnel. Even a closed hole affects the pitch of lower notes, since it acts as a local widening of the bore.

Finally, the head, the window and the lip. The head is generally nearly cylindrical in bore and the window nearly rectangular, but the precise geometry of the windway and the window has an immense effect on sound production.

Details are too complex to go into here,[2] but it is found that the blowing pressure must be adjusted for each note so that it takes about half of the period of the sound vibration for the airstream to travel across the window and meet the lip. Since this distance is fixed, this means that the player must use higher breath pressure for high notes, and this makes them louder. There is some latitude in the relation, so that the breath pressure for a high note can be reduced a little to make it softer, but if the reduction is too great the note will slip to the lower octave. Skilled players learn to make these adjustments automatically.

Design features that are in the hands of the maker, however, are the size of the window – a large window makes a louder note but generally a less flexible sound, the sharpness of the lip and the exact shape and direction of the air jet as it leaves the airway. This last item is controlled largely by the small chamfer cut on the plug that defines the lower edge of the airway.

If the jet impinges exactly symmetrically on the lip, then the sound will emphasise odd harmonics at the expense of even tones to give a sound a little like that of the panpipes. Usually the jet is offset a little to give a richer sound. In a transverse flute, of course, all these adjustments are under the control of the player and can be changed for each note, but the recorder maker must devise a fixed geometry that best satisfies all the requirements.

As with violin making, some of the old masters built, by trial and error and by inspiration, truly great instruments, and the music of the time was written to exploit their particular qualities.

A modern maker therefore strives to recreate the properties of these classical recorders, to overcome some of the minor defects that they exhibit, and perhaps to extend slightly their range or flexibility.

Fred achieved all of these things in the wonderful instruments that he built.

1 MARTIN, John. *The Acoustics of the Recorder.* Moeck Verlag, Celle 1994.

2 FLETCHER, N. H. and ROSSING, T. D. *The Physics of Musical Instruments.* Second edition, Springer-Verlag, New York 1998, chapter 16.