THE WINSTON CHURCHILL MEMORIAL TRUST OF AUSTRALIA

REPORT BY DAVID TREDENICK, 2001 CHURCHILL FELLOW - TO STUDY RECORDER MAKING

EXECUTIVE SUMMARY

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OCCUPATION Registered Nurse

PROJECT DESCRIPTION To compare recorder-making methods and devices of two well known makers of hand-crafted instruments.

HIGHLIGHTS The highlight of my trip was to be welcomed into a reputable recorder-maker's workshop (Philippe Bolton, Villes Sur Auzon, Sth of Avignon, France) and receive a very generous account of his methods. Unfortunately, Alec Loretto, who I had arranged to meet in Auckland, had a fall in Switzerland and was unable to return to New Zealand this year. However, there are a couple of aspects of his methods that I know about from previous discussion with him that I wish to compare with Philippe's method. I am now hoping to visit Alec next year.

MAJOR LESSONS These were to do with technical aspects of recorder making such as wind-way design, bore design and tuning techniques. It was also very useful to be able to see Philippe's wind-way cutter, which was the type used by the late Fred Morgan. To my knowledge there are no documented descriptions of any modern wind-way cutters and this report contains schematic descriptions and comparison of two types of wind-way cutters, Philippe's and the type used by Alec Loretto.

IMPLEMENTATION & DISSEMINATION The methods I have learnt will be gradually implemented in my workshop and disseminated by publication in recorder journals and other media such as the internet, and discussion with other recorder makers. In my work as a mental health nurse in a community care unit, I have a firm belief in the therapeutic value of manual skills and I am hoping to be able to use some of the information acquired in this area.

BODY

While in Philippe's workshop, under his guidance, I made a new head joint and re-tuned the body and foot joint of an instrument I'd brought with me, as well as doing some re-voicing and re-tuning on another instrument. The following account is based on my experience and observations in his workshop.

I think of recorder making in terms of gross and fine work. The gross aspects of recorder making include: turning; boring and reaming the wooden cylinders that contain the vibrating air column; cutting the wind-way; making and fitting the block; carving the ramp and window; drilling the finger holes; and cutting the beak. The fine aspects can be divided into two related areas, one of producing the sound and the other of getting the right pitch for each note. These are known respectively as voicing and tuning. Voicing involves the removal of very small amounts of wood, usually of the order of a few micro-grams, from certain areas where it makes a significant difference to the quality of the instrument's tone. One of my goals was to get a better understanding of where and how best to make these refinements. The recorder nomenclature used in this report is shown in Fig a.

- GROSS WORK -

BORING - Philippe's instruments are mostly from boxwood, although he uses pear wood for medieval instruments and he sometimes uses cherry, all of which grow locally. Alec Loretto says he makes instruments in batches of about four, or in the case of sopraninos, two. Philippe says his method is to do a little bit of work on lots of different pieces of wood, to minimize the disturbance to the inner equilibrium of any one piece of wood. (When a piece of wood is cut, it needs to find a new balance of its inner forces.) He says the amount of disturbance a piece of wood will tolerate is related to its elasticity. "Boxwood needs to be worked a little at a time. It needs a long time between boring and reaming" due to its high elasticity, whereas a wood with low elasticity, such as Indian rosewood, may be reamed straight after boring.

For turning and boring he uses a West-German wood lathe with 1000 mm between centers, about 300 mm center height and a lever operated tailstock spindle for boring long holes. The headstock spindle hole is 50 mm in diameter, allowing him to put a billet half way through the headstock for better centering when boring.

Philippe's method of tackling the challenge of boring long, straight holes is to use a combination of a Forstner drill to start the hole and a spoon drill of matching diameter to extend the hole through the billet. Spoon drills, which are probably not commercially available these days, are shaped like a spoon with long, straight sides on a shank instead of a handle. First he turns the end of the billet square using a parting tool, then he uses a spindle gouge to hollow out the centers so that only the circumference of the Forstner bit is acting in the initial cut. The Forstner bit is used to produce a hole with a depth of about four times the diameter.

The matching spoon drill is then gently guided into this hole, pushing it slightly away from the cutting edge so the initial cut is guided by the back side of the drill, not the point. Otherwise the first cut of the drill may push it off center.

One of the highlights of my trip was to see the Continental style parting chisels he uses. English style parting tools (used mainly to cut a narrow, deep groove perpendicular to a turning cylinder) are pointed with two bevelled sides as in Fig b, whereas Continental style parting tools are pointed with one bevelled side, as in Fig c, making them much sharper for less sharpening work. In ten years of turning wood and reading about it I have never seen or heard of the Continental style tool, yet it is such a simple and effective improvement.

REAMING - Reaming recorder bores is complicated by the fact that the taper of the bore is not uniform. Philippe and Alec both use several reamers on consecutive segments of the bore. The advantages of this method, over using one reamer for the entire length of the bore are that: small changes can be made by inserting the reamer slightly more or less; if a reamer needs to be re-made to a slightly different shape, it is easier to make a new segment; and it takes less physical effort to ream a segment at a time, allowing reaming to be done by hand.

The steel Philippe uses to make reamers is called 'Stub' steel but this appears to be a brand name that is not available in Australia and I don't know the composition of this type of steel. Ordinary bright mild steel seems to work well. His method of making a reamer is to turn a tapered cone

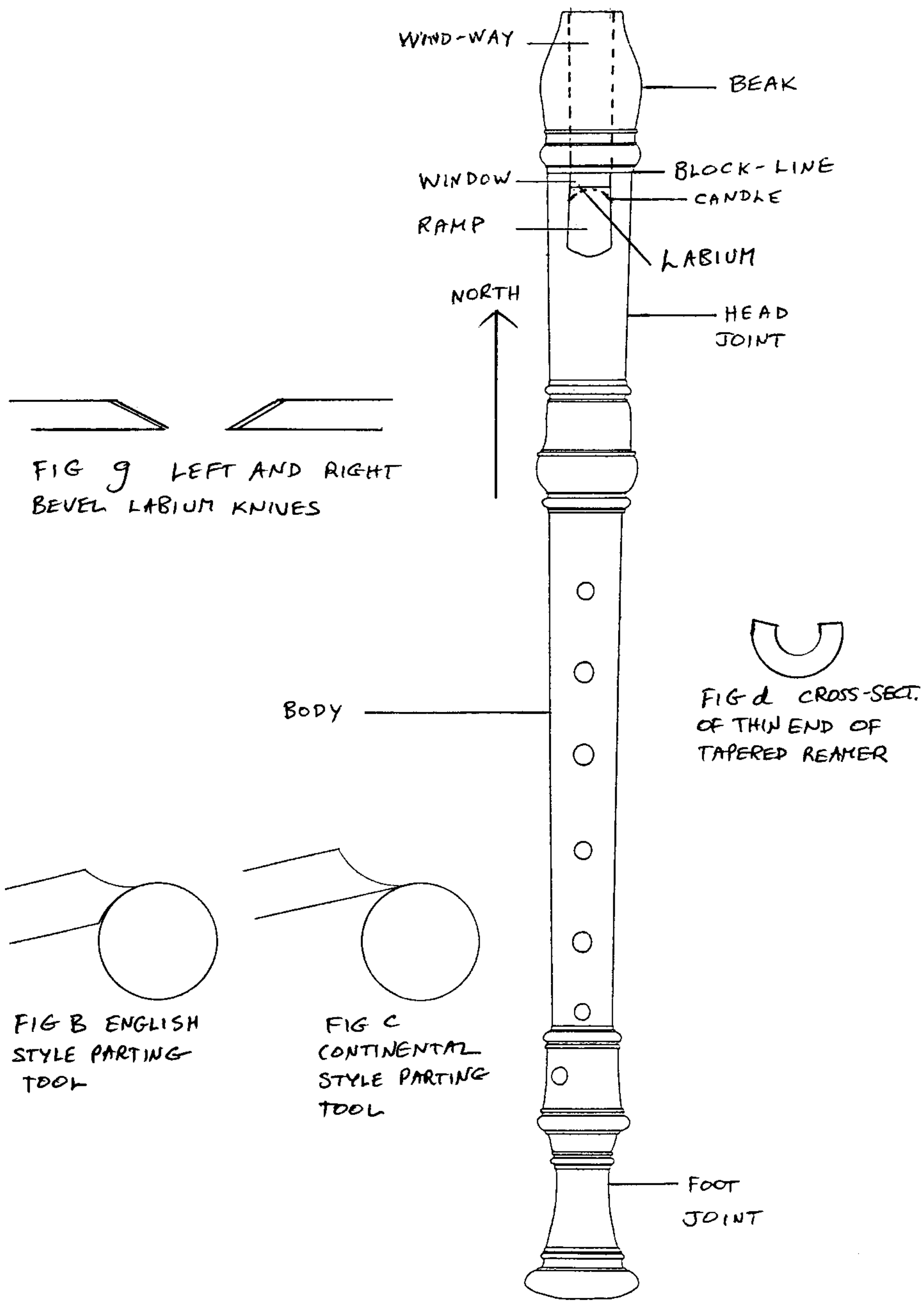

FIG g LEFT AND RIGHT BEVEL LABIUM KNIVES

FIG d CROSS-SECT. OF THIN END OF TAPERED REAMER

FIG B ENGLISH STYLE PARTING TOOL

FIG C CONTINENTAL STYLE PARTING TOOL

FIG a RECORDER NOMENCLATURE

corresponding to the desired bore shape, accurate to within about 0.1 mm for an alto, and leaving a suitable length of shank. He then drills a hole axially through the tapered section, then hack-saws off slightly less than half the metal from one side of the tapered cone. He then mills a cutting edge along the appropriate side of the remainder of the tapered cone and grinds a little relief following the cutting edge. This produces a reamer as in Fig d showing the cross-section of the thin end of the taper.

The test of a reamer is whether it produces shavings or compacted wood fibers, the former leaving the most acoustically effective bore surface.

Joint sockets are bored as required while the head and foot joints are still in the lathe.

Philippe reams his billets in a vice with three jaws that holds the work in a triangular grip, driving the reamer by a steel rod through a diametrical hole through the shank.

After reaming, the joint is put back in the lathe, held in the self centering chuck as it was for boring, and the bore surface is polished. This is done using a stick of dowel, about 12 mm diameter, with a kerf about 25 mm long cut in the end of it. A short strip of very fine abrasive paper, 400 grit, is passed through the kerf and rolled around the end of the rod, then the billet is rotated at high speed and the rod is passed along the bore surface to get the smoothest finish possible. This method ensures uniform removal of material from the bore.

OUTSIDE TURNING – This is done between centers using conventional spindle turning techniques. Working between centers ensures the outside of the joint is turned concentric with the bore. To drive the work Alec uses specially made wooden tapered plugs, one for each different size of joint to be turned. When the plug's fibers are raised by wetting it before insertion, it gives strong torque transmission. Philippe uses a wooden 60 degree center that fits all normal size joints but does not offer strong torque transmission.

At this stage the tenons are turned, ensuring the tenon fits loosely into its socket until the waxed cotton or silk thread is applied. If the tenon exerts pressure on the socket before the thread is applied, it may split the socket. When turning the head joint, the area that will eventually become the beak is left thick until after the block is fitted to reduce the risk of splitting the head in the process of fitting the block. The diameter of the head at this stage needs to correspond exactly with the wooden side packing used to hold the head in Philippe's wind-way cutting jig.

Before finishing the outside turnery, any fine defects are filled with superglue and powdered sawdust. The surface is then sanded, while rotating at high speed, with abrasive paper starting with 240 grade then progressively finer grades, up to 400 grade. Then the surface is polished with a cloth with a few drops of linseed oil and some pumice powder sprinkled on it. Next it is polished with tripoli powder in the same manner. Then it is further polished by a handful of wood shavings, clasped around the outside of the joint and moved along it, still rotating at high speed. Next it is taken out of the lathe and buffed on a cloth wheel loaded with a very fine jeweller's abrasive powder. At this stage the joints are soaked in a bucket of linseed oil for a few days.

WINDWAY CUTTING – Cutting the roof of the wind-way requires great care and the methods of Philippe and Alec have some interesting differences. Philippe uses a lever actuated 'slide cutter' (Morgan, 1982) that he bought from Fred Morgan, and Alec uses a device designed by himself and two engineers, Paul Whinray and David Whitehead. Schematic illustrations are shown in Figs f and e respectively.

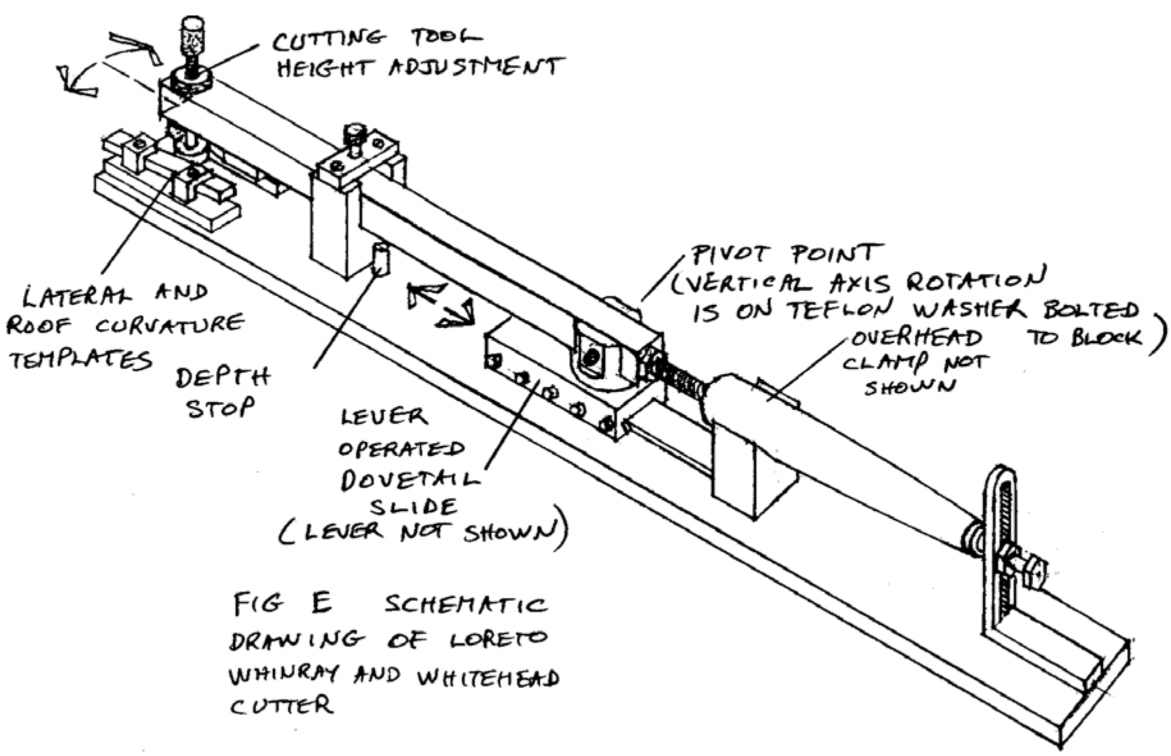

FIG E SCHEMATIC DRAWING OF LORETO WHINRAY AND WHITEHEAD CUTTER

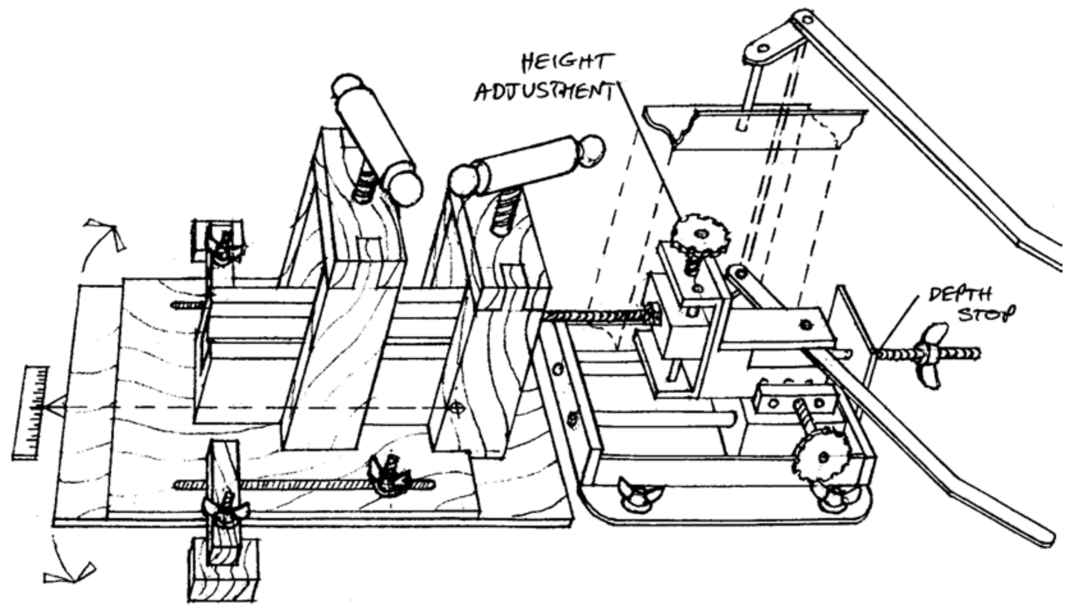

FIG F SCHEMATIC DRAWING
OF MORGAN / BOLTON CUTTER

The device used by Philippe and Fred Morgan, cuts the wind-way with side taper by manipulation of the jig and lateral curvature from the shape of the cutter edge, but with no longitudinal curvature. This is later done by hand, using a template and files and scrapers. Philippe's argument in favour of his device and method is that it provides the opportunity to observe the effects of the changes he is making to the longitudinal curvature of the wind-way. All makers agree that this longitudinal curvature is an important factor in producing a high quality instrument. In Philippe's device, the jig that manipulates the recorder head is of his own making. He says that in the end you use the tool that you're happy with, and that works for you.

The device used by Alec has a long pivot arm mounted on a sliding block. The short end of the pivot arm holds the cutting tool and the longer end rests in templates that control the side taper and longitudinal curvature of the cutting strokes. As in Philippe's machine, the lateral curvature comes from the shape of the cutting edge. The ratio of the length of the template arm to the length of the cutting arm provides a four to one reduction of any dimensional error in the templates and wind-way height adjustment. This level of accuracy is an attractive feature because dimensional changes in this area of less than 0.1 mm will have significant effects on the performance of the instrument. Both types of cutters cut on the pull stroke.

When turning the head joint, the grain direction is tested. Philippe cuts the wind-way roof against the grain for two reasons. Firstly, it means that when finishing the wind-way roof by hand, he is working with the grain, and secondly, when cutting the ramp he will be working with the grain. Alec cuts the wind-way roof with the grain to produce the smoothest finish off the cutting tool. Technically speaking, the wind-way is being scraped because the cutter is perpendicular to the wood, but in common parlance it is called cutting.

Both makers place the wind-way roof with the annual growth rings running vertically because wood tends to split perpendicularly to its growth rings. Cutting the wind-way weakens one side of the piece of wood. If the growth rings were horizontal, the natural place for the wood to split would be the weakened wind-way side, which would render the instrument useless.

Before clamping the head into the wind-way cutter, a slot about 3 x 8 mm that is the start of the window, is milled in the drill press, which is fitted with a compound table. (Philippe has a separate mini-mill for milling reamers.) A 3mm hole is drilled at the north end of the head joint, exactly opposite where the wind-way will be cut, in wood that will eventually be removed to form the beak. Philippe's system of clamping the head joint in the jig necessitates the use of two identical wood blocks, previously mentioned, on either side of the head joint as packing. One of about a dozen cutting tools of varying widths and curvatures is then chosen. The lateral curvature for the baroque alto head we made was 29 mm radius, and for a renaissance instrument the cutter radius is half the radius of the bore. The cutter is then screwed into the slide block to a position where its sides are vertical, then clamped with a locking nut. The depth of travel of the slide is adjusted so the cutter protrudes about 5 mm south of the block-line, so it will be able to cut the "candle" shaped underside of the ramp, where the cutter radius converges with the bore radius.

The cutter slide is then adjusted laterally so that the corner tips of the cutter are both in contact with the bore at the block-line. The cutting edge is then slid to the north end of the head joint and tested for central alignment. If necessary, it can be adjusted by rotating the angle of the top-plate on the jig base. The central alignment of the cutter at the block-line then needs to be re-adjusted with the lateral slide.

When the cutter is centered along the length of the intended cut, the height of the cutter is gradually raised while levering the cutter back and forth. As soon as the two initial side cuts come together below where the labium is to be formed, the cutter depth stop, which controls cutter penetration into the head joint, is adjusted so the cutter will no longer go past the block-line. The distance between the tip of the 'candle' and the labium should be about 1 mm. When adjusting the depth stop the cutter location can be seen through the 3 x 8 mm slot that will become the window. Cutting is then continued until the wind-way is cut away to the desired height.

Philippe often takes the head joint out of its jig to measure the progress of the cut. This is done with a telescopic bore gauge, by comparing the horizontal bore dimension with the vertical bore dimension at any point along the wind-way. The locating pin and its corresponding hole in the head joint ensure it goes back into the jig in the same position.

The step (vertical distance between the underside of the ramp and the roof of the wind-way) that he aims for is 0.7 mm for a soprano, 0.8 mm for an alto, 0.9 mm for a tenor, and 1.0 mm for a bass. His intended wind-way heights at the blowing end are 1.2 mm for a soprano, 1.2 to 1.3 for an alto, and 1.4 to 1.5 for a tenor. His gauges for measuring wind-way dimensions when voicing are made from a set of harp strings with increments of about 0.03 mm. These enable him to choose the diameter that best suits the instrument. They are not used progressively from one string to the next.

After the wind-way is cut, some preliminary cutting of the ramp is done to provide better visibility of the south end of the wind-way, but this should not be nearly finished yet, so as to maintain adequate strength for fitting the block.

FITTING THE BLOCK - The block starts as a square section, about 50 mm long, of Florida cedar, or Virginia cedar, from the juniper family. Philippe's method of making the block is similar to Fred Morgan's method, described by him in 1982. "Recorder blocks are easily and accurately made by turning the large and small diameters of the bore of the beak at each end of the block of cedar of slightly more than the beak's length. The wind-way is then marked out, slightly oversize to ensure a close fit, the excess wood planed away and fitting begun. As the new block is gently tapped in, the wood of the bore slightly compresses those areas of the block that touch it. This makes those places visibly shiny, so they can be scraped away, and the block will then go in a little further. After this is done several times, the block will go right in. There is no great danger of splitting the head, but care must be taken not to go too fast.”

The grain on the block is chosen to be able to cut towards the window as this makes it easier to do fine work on the wind-way exit. The annual growth rings should run vertically to give maximum stability to the wind-way floor, by minimizing moisture absorption. Philippe uses a small engineer’s square clamped on top of the block as a guide when planing the waste off either side of the wind-way floor. This is done with two shoulder planes, one dedicated for each side of the floor, so that the blades are always flush with the respective sides of the planes. The underside of the block can be rounded in a vice. All Philippe’s vices have soft jaws of cork, covered by leather, bonded to the existing jaws. The block ends are clamped on the jaws and coarse abrasive paper is drawn across the block, while pulling both ends of the paper down. The width of the abrasive strip is slightly less than the length of the block.

Sometimes, depending on the quality of the block wood available, it can be difficult to read the shiny spots that need scraping off. If so they can be highlighted by brushing talcum powder on the block before it is pushed into the bore. A varnish made from shellac is applied to the ends of the block, when finished, to minimize moisture absorption. The name and address of a supplier of block cedar that has been treated for maximum dimensional stability is listed in CONTACTS.

After the block has been fitted, the preliminary lowering of the platform that will become the wind-way floor begins. This is done by scraping the platform evenly until some light from the inside of the bore can be seen through the wind-way. Finishing the wind-way floor is part of the voicing process.

THE RAMP - After the block is fitted to the head joint, the ramp and window can be shaped. First the slot milled to start the window is enlarged by filing its sides out to meet the vertical sides of the wind-way. (It is better to leave some wood at the sides of the window rather than file until the window wall is flush with the wind-way wall and risk filing into the wind-way wall. The remaining wood can be filed off after the ramp is finished and visibility of the sides is better.) Philippe uses Japanese chisels and knives which have laminated blades to cut the ramp and its sides. The cutting edge is of very hard and somewhat brittle steel, supported by a layer of soft steel. The sides and corners are cut with a pair of left and right bevelled knives, shown in Fig g. The ramp is cut with a 9 mm or other suitable sized Japanese chisel.

FINGER HOLES - These are marked out with vernier calipers and drilled in the drill press. The joint is held in a vice with padded jaws. The type of drill bit used has a smaller helix angle, or a straighter spiral, than a conventional twist drill, producing a cleaner cut. The thumb hole position is found by using a tape measure to ensure it is exactly opposite the finger holes. The longitudinal finger hole line is drawn with the joint held between centers in the lathe using the tool-rest as a ruler.

THE BEAK – At this stage the beak is cut. Philippe does this using a coping saw, with chisel and scraper to finish, while the head joint is held in the padded vice. The size of the mouth-piece is an important aesthetic factor for the player. The thinner the mouth-piece, the more pleasant it is to use, but if too thin, the wind-way may split along one of the sides of the roof. About 5.5 to 6.0 mm is his usual mouth-piece thickness. This stage marks the end of the gross work.

- FINE WORK -

VOICING - The fine work of voicing and tuning is doubtless the most challenging aspect of recorder making. Philippe's process begins with scraping and filing the wind-way roof curvature, holding the head with the roof on the underside in the vice. His assortment of scrapers are custom made from pieces of hack-saw blade and some files are custom made. One useful file is shaped like a rifler file, but has metal cutting teeth for fine removal of wood.

The longitudinal curvature is gauged by a template made according to directions from Marvin (FOMRHI Comm No 532). It is about 100 mm long and has a 2 meter radius. This means the middle of the wind-way roof of an alto is about 1.5 mm higher than the ends. All work inside the wind-way is assisted by a small light on a flexible lead that can be passed along the bore, illuminating the area. For the instrument to work well, the curvature needs to be regular and even, with no ridges, or dents. The wind-way roof is finished with progressively finer abrasive paper hooked into a stick of wood about 6 x 6 x 150 mm with a small kerf cut in the working end.

Philippe says the wind-way floor (top of the block) needs to be lowered only far enough so that the view from the blowing end is almost a clear view through the bore, but the light is being refracted from inside the bore, in effect giving a small halo of even thickness. The wind-way floor has a slight longitudinal concavity, with the middle being about 0.1 mm lower than the ends.

The ramp is cleaned up at this stage and the sides of the window may be trimmed until they form a uniform surface with the sides of the wind-way. I asked Philippe about the final thickness of the labium and he said it was something he could not quantify. For him it was more an intuitive thing. Alec says this thickness should be about that of a sharp pencil line.

About this stage the window exit chamfers are cut with finely sharpened chisels, using a flat chisel for the block chamfer and the left and right handed bevelled knives for the wind-way roof chamfer. The chamfers are cut at an angle slightly more than 45 degrees, and a width of about 1 mm, though the optimum dimensions depend on the overall wind-way configuration. Philippe uses a small nasal surgical mirror, about 12 mm in diameter, to inspect the chamfer on the wind-way roof.

Philippe said the voicing process consists of ensuring that the curvatures of the wind-way roof and floor are regular and even, the ramp and wind-way roof are as smooth as possible, the chamfers are absolutely clean, and the vertical sides of the ramp have no ridges or irregularities. He says: "In finishing work you need to be looking at all these points at once. I do quite a bit of work with abrasive strips glued to wood. It's often trial and error… seeing something that doesn't look quite right and fixing it and seeing the change in the instrument… no ridges or wooden fibers, angles perfectly clean and things like that. I always find it very difficult to finish an instrument. It's easy to get it to where it's almost perfect, but to get it just right is very difficult. I like to voice an instrument a little bit at a time. Perhaps I get to know the instrument better between each time I work on it."

One of the basic principles of voicing is to only make one change at a time, so as to be able to see what effect it has. The chamfers can be cleaned with a strip of 1200 grade abrasive paper, about 4 mm wide and 100 mm long. To clean the top chamfer this is passed through the window and underneath the wind-way roof and out the blowing end, then gently drawn across the chamfer a few times. The bottom chamfer is cleaned in a similar manner with the block removed. When working on the block platform after blowing the instrument, it is best to remove the moisture with a hair dryer.

As part of the voicing work the finger holes are polished by a small die grinder using a felt wad loaded with beeswax. Under-cutting the finger holes is a good example of how voicing and tuning are related. The inverted funnel shape of the finger holes, produced by undercutting, greatly improves the volume of the instrument, while increasing the size of the holes in this manner will raise the pitch of the affected notes. (Philippe says he is obsessed about getting nice loud low notes on his instruments.)

TUNING – Philippe's general rules of tuning are that to make the octave smaller, make the bore smaller half way between the window and the first open hole of the note in question (the note hole), or widen the diameter of the bore around the note hole, and to make a lower register note higher, move the hole up the bore, by cutting on the north side and to raise the pitch of a higher register note, increase the size of the hole. "Hole size has more influence on the upper register and hole position has more influence on the lower register. In effect, this means it is often more fruitful to work on the north side of the hole after the initial undercutting. When making changes to the bore diameter, they need to be of the order of about 0.5 mm in an alto to have any effect. It is better to work on the lower b flat on an alto instead of the b natural for the simple reason that b flat can be changed by altering hole 5. To raise the pitch of high e and f on an alto (the third harmonics) reduce the bore size at the north end of the foot bore, near the socket. This can be done by adding wax for an individual instrument, but for a design this would entail making a new reamer.

Philippe introduced me to a number of very useful tuning aids. These were: a diagnostic chart of effects of bore changes; a computer program to calculate note pitch with any bore and finger hole configuration; a program to convert an instrument design from one pitch to another; and a blower with a pressure gauge to monitor air pressure when tuning.

Adrian Brown (1989), in his excellent book "The Recorder – A Basic Workshop Manual", explains a very useful system of charting possible bore changes. One such chart on the instrument we re-tuned is shown in Fig h. The bore diameter and finger hole positions are charted across the top of the page, then the effects of passing a piece of plasticine about 5mm in diameter by 20 mm long on a thin wire through the bore are monitored. This effectively reduces the bore diameter at the location of the plasticine. It may either cause the note to go sharp or flat, or have no effect at all. It may also cause a burble, or a stronger tone. All of these effects are recorded throughout the length of the bore and charted. This chart can then be used for diagnosis of problems in a particular instrument, or to see where to alter the bore to improve tuning in a design. Philippe says: "Look for isolated points, that is, those that affect one note, to make changes. If a change affects a and c, then try to find another place where that change affects only a."

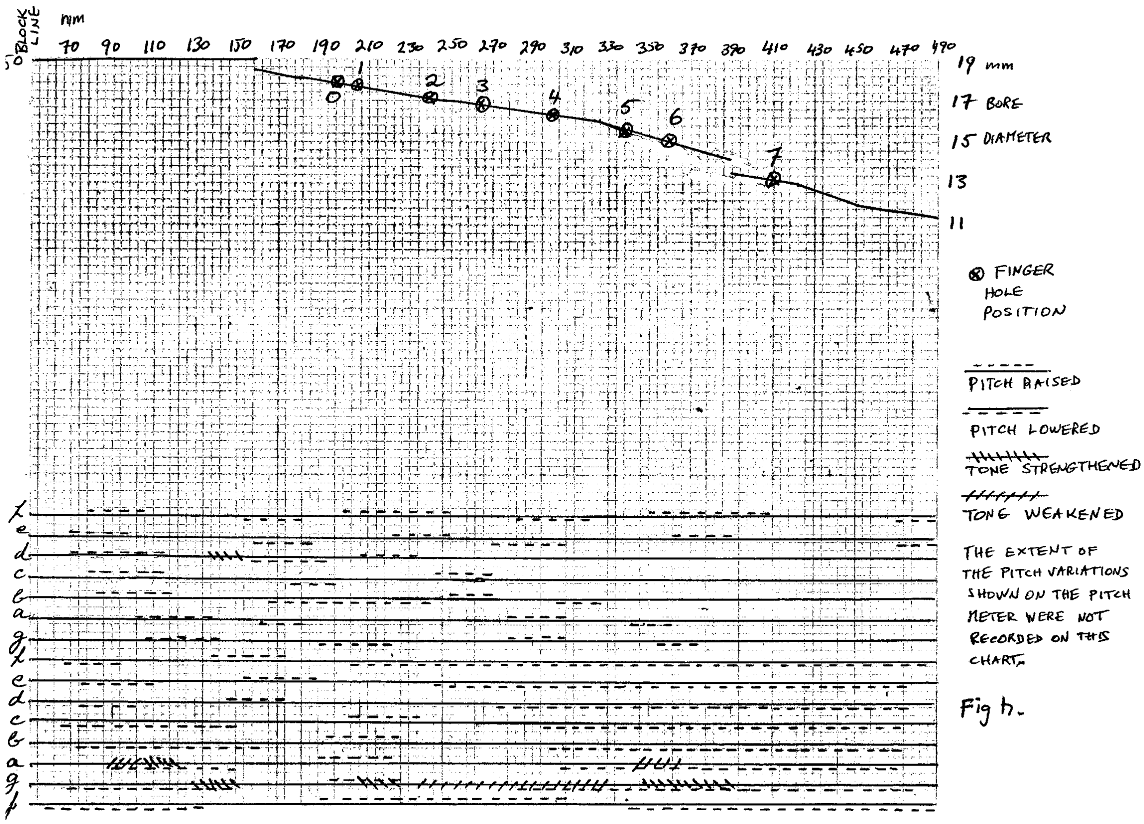

Fig h.

Two useful computer programs for tuning are one by Philippe, based on the work of the acoustician, V Mahillon, and a French MSDOS program called Resonants. Philippe's program will convert bore dimensions and finger hole sizes for an instrument in one pitch to another, for example, a = 440 to a = 414 cycles per second, and is based on bore surface area. The Resonants program is only available in French, in MSDOS, but it allows the user to key in any bore dimensions in a number of conical segments, place different sized finger holes in any position along that bore, and it will indicate the resulting notes and their harmonic analysis. This program will be very useful to analyse a recorder plan before starting to make the instrument. Details of the supplier are listed in CONTACTS.

Philippe sometimes uses a mechanical pressure gauge in conjunction with the electronic pitch meter that he often uses to verify what his ear tells him. The pressure gauge reads 0 to 100 mm of water and the air supply to the gauge comes from either the mouth of the maker blowing the instrument or a small organ blower which is almost silent. When using the blower, a valve made from a water tap is used to control the air pressure, and the gauge is fitted between the valve and the instrument. The recorder is connected via a rubberized membrane over a pipe end, with a hole slightly smaller than the diameter of the beak cut in it. Plasticine is used to cover the finger holes. Because the blower air is colder than a person's breath the instrument should be tuned so that on the blower it is about 15 cents below the correct pitch for the player's breath.

The steps previously outlined produce high quality recorders when applied with great care and experience. Philippe also pointed out that to succeed as a recorder maker, the aspiring artisan also needs a range of instruments to offer potential customers. His range includes about twenty different recorder models, from Medieval to Baroque in various pitches, mainly A = 415 or A = 440.

Alec Loreto also points out that when he and his contemporaries started making recorders, the market was more tolerant of variations in quality. These days, he says, new makers need to produce instruments comparable with highest standards, which have risen greatly in the past twenty years, before they can expect to sell them.

For me this amounts to a big challenge, and I'm glad I'm not dependent on selling my recorders for my income. It has so far proven to be a fascinating and rewarding hobby and my visit to Philippe has shown me many ways in which I can improve the quality of my instruments.

CONCLUSIONS

My visit to Philippe has been a valuable learning experience with the following highlights:

- Seeing the type of wind-way cutter used by the late Fred Morgan with the opportunity of comparing wind-way cutting between Philippe's method derived partly from Fred Morgan and the Loreto method;
- To be able to observe a master craftsman at his work, to see his patience, perseverance, and dedication.
- Learning about the Continental parting tool and seeing such a simple and significant improvement to the type of parting tool used in English speaking countries;
- Finding out about several ways of improving the tuning of my instruments – particularly the Resonants program and the diagnostic charts described by Adrian Brown;
- Observing Philippe's method of voicing, in particular the longitudinal curvature he uses on the wind-way roof and floor;
- Watching his method of boring and reaming the billets to make joints.

The information learnt on this trip will be disseminated in the journal of the Queensland Early Music Society, perhaps some other early music journals, probably in the journal of the Australian Musical Instrument Makers Association and on the Recorder Home Page on the inter-net, and definitely in the Churchill Trust's Home Page. I will also be making it available to fellow amateur recorder makers I have met through early music.

Recorder making is a specialised and uncommon skill. Many makers are precious with their knowledge, but Philippe and Alec have both been very generous with their knowledge and one of the most important things I have learnt on this trip has been that I also need to be as generous wherever I find the opportunity.

At some time I will be discussing Continental and English style parting tools with other wood turners to find out why we in Australia use only double bevelled parting tools and whether any of them share my views on the advantages of the single bevelled parting tools.

CONTACTS

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REFERENCES

Bolton, P. (1996) Resonants – A Program for calculating frequencies. *Woodwind Quarterly* 11: xx-xx

Brown, A. (1989) The Recorder – A Basic Workshop Manual, Dolce Edition, Brighton, GB.

Lander, N. Recorder Home Page, www.iinet.au/nickl/recorder.html

Marvin, B. The Fornication of Recorder Windways, Comm 532, *FoMRHI Quarterly* (Fellowship of Makers and Researchers of Historical Instruments, Honorary Secretary: Jeremy Montagu, 171 Iffley Road, Oxford OX4 1EL, UK).

Morgan, F.(1982) Making recorders based on historical models. *Early Music,* January pp14-21.

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