

A Practical Guide to Quill

John Phillips

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“Now with subtle insight several makers have discovered that crow quill sounds more like crow quill than Delrin does.” Frank Hubbard, 1975

My first attempt to put a harpsichord in quill, more than forty years ago, was not successful. The feathers were promising (crow), but the jacks were plastic and I had never heard of oiling. In the end, I sheepishly redid the instrument in Delrin. However, the idea that somehow quill *must* work and that it *must* be better than the modern plastics lingered in the back of my mind. After all, quill had satisfied some very demanding musicians for three centuries. Then twenty-five years later, goaded by clients and encouraged by colleagues’ success with quill, I tried it again. Of our last thirty instruments, only three have been voiced in plastic, and many older instruments have been revoiced in quill. Yes, the learning curve has been rather steep, both for us and for our clients, but most of us will now agree that it *does* work and *is* better than the modern plastics.

This brief guide represents the current practices of our workshop. It is intended both for those whose instruments are already voiced in real bird quill and for those intrepid enough to try doing it themselves.

Converting to quill yourself

If your instrument has an historical style action with good quality wooden jacks, it is a good candidate for bird quill. The tongues of plastic jacks are much too slippery to hold bird quill plectra. Other than aspects dealing with the different material, requilling a harpsichord in real quill is fundamentally no different than the same task using plastic.

Getting Started

Tools needed for quill

You may already have many of these tools in your harpsichord kit. A good voicing knife with plenty of sharp blades (the ubiquitous X-acto #11 blade in a #1 handle is ideal, but a surgical scalpel, suitable for plastic, will be too flexible for quill), several hard, light-colored (maple or boxwood) voicing blocks, a small cutting board, a pair of flush-cutting nippers, a pair of smooth jawed pliers, and a small (size 00) watercolor brush are essential for working with quill. The voicing blocks will need more frequent dressing than for plastic since cutting quill plectra to length requires more force and does more damage to the block. (Figure 1)

You will also need an oil to treat and toughen the feathers. Historical sources mention only olive oil for “toughening” quill, but our experience is that it tends to gum up, ruin jack tongues, and go rancid. Its slight acidity cannot be good for the strings. While other oils have been recommended in recent times, we have been found that Ballistol, a highly refined

paraffin oil, is extremely effective for treating quills. It is available at sporting goods stores and from Amazon. A 4-oz container will last for a very long time.



Figure 1. Tools for quill. From left to right; watercolor brush for oil, small jar of oil, smooth-jawed pliers, end nippers, maple voicing blocks, voicing knife, cutting block.

Selection of feathers

If your harpsichord was professionally voiced in quill, you were most likely supplied with a stock of prepared feathers from the same species of bird. Otherwise the first issues facing the harpsichordist or maker, who wishes to put an instrument in quill, will be a choice of feathers and finding a source for them.

17th and 18th century authorities typically recommend crow or raven feathers and less often turkey, goose, or even more exotic birds, for harpsichord plectra. Crow and raven are still excellent choices. Raven plectra give perhaps the quickest response under the fingers, but these feathers can be difficult to obtain. Crow is similar, but the relatively small size of the feathers means you need many more of them. Other good choices include certain seagulls and vultures, condor, swan, and Canada goose (Figure 2). The feathers from these large birds all share the characteristic of having dark brown to black colored shafts. Apparently, the melanin pigment makes these feathers hard and tough –ideal for their reuse as harpsichord plectra. Feathers with white shafts –even those with dark barbs like pelican or eagle– wear out very quickly and should be avoided.

The most significant difference between the various suitable species is their cross-sectional shape. Crow and raven feathers are distinctly arched while vulture and goose are relatively flat. The arched shaped plectra are slightly more difficult to voice and are best held in narrow and curved jack tongue mortises. The flatter plectra will more easily fit in the rectangular mortises originally prepared for plastic plectra (Figure 3).

Although there are subtle but perceivable differences in touch and sound between the various suitable species, in practice the preference of one over the other will be a matter of availability and quality of feathers. We have found that the sturdy black flight feathers from the ubiquitous Canada goose make superb plectra. They are tough and long lasting, rivaling plastic in durability.



Figure 2. Suitable feathers. From left to right; raven primary, two crow primaries, turkey vulture primary, two turkey vulture secondaries, two seagull primaries, Canada goose secondary, and two Canada goose primaries.

Obtaining feathers

There is no need to kill a bird for its feathers. All birds molt every year, usually from late Spring to Fall, depending on the species. Freshly molted feathers can be collected and saved. Only the primary flight feathers are useful as harpsichord plectra, though turkey vulture tail and secondary flight feathers are as large and as stiff as crow primaries and can be used as well. It is possible to buy feathers from harpsichord parts suppliers, including Zuckermann (www.zhi.net/parts/), The Instrument Workshop (www.fortepiano.com), and Marc Vogel

(www.vogel-scheer.de). It is worth noting that many of the recommended species here are protected and it may be illegal to gather, sell, or even own their feathers. That said, Canada geese seem to have permanently settled in to parks and lawns everywhere in North America and are not unknown in Europe. In the late Spring, once the goslings have hatched, these parks and lawns are covered with molted feathers. Don't wear your best shoes when collecting goose feathers. In July and August crows and ravens roost and preen in urban trees, leaving their feathers on the ground. Broken or crushed feathers and feathers which have stood in water are useless. I recommend that the gathered feathers be immediately stripped of their barbs, as described below, and be stored with mothballs in a sealable container.



Figure 3. Tongues punched for raven quill (left) and plastic or Canada goose (right). Jacks by Norm Purdy.

Preparing Feathers

Harpichord plectra are fashioned from the spine (back or top) of the shaft of the feather. The first step is to remove the barbs. Begin by holding the tip of the feather with one hand,

grasping the barbs with the other, and pulling down and away from the top of the shaft. This is a little like shucking corn and is the messiest part of the process (Figure 4). The shaft will be left with the pith exposed on both sides and with some barbs at the tip (Figure 5)

The pith has the consistency of Styrofoam and is covered by a hard, thin membrane on the underside of the shaft. The next step is to remove this lower hard membrane and most of the pith. Do this by laying the shaft on a cutting board and first scoring one side with the tip of a voicing knife (Figure 6), then turning the shaft over and cutting through all the way from the opposite side (Figure 7). The waste material can then be peeled away (Figure 8). The pith should then be carved away to a thin layer, just exposing the dark top of the shaft from the underside. The remaining pith will be useful for holding the plectrum in the tongue mortise. Expect to ruin several feathers learning to prepare them for plectra, so practice on less valuable ones. Resist the temptation to cut the barbs off with scissors; the stubs will get in the way.

Next, trim the tip of the shaft the point where it is about the width of the tongue mortises in your jacks. Any plectra narrower than this will fall out. The quill end of the feather (the part that goes into the bird) can also be trimmed off, though it can be useful as a handle; it is in any case useless for plectra past the colored part of the spine.

The final step in the preparation process is to soak the prepared feathers in oil for a week, then allow them to air for another few days before using them. Use a tall jar and wrap the top with foil to keep the oil from evaporating (Figure 9). Unfortunately, our recommended oil, Ballistol, has an unpleasant odor, so leave the feathers outside or in an unused space while they soak. The odor will disappear quickly once the volatiles have evaporated. Feathers treated this way will last longer, be nearly impervious to changes in humidity, and require much less frequent subsequent oiling. Prepared and presoaked feathers should be kept in a sealable plastic bag or closed container (Figure 10).

If you are planning to voice a whole instrument in quill, prepare 10 to 20 feathers per register in this manner, depending on how large they are. It is possible to get 15 plectra out of a large vulture primary, while a small crow primary might only yield four plectra. For the incidental replacement of failed quills, it will be useful to keep a dozen prepared feathers of various sizes and strengths on hand to best match the originals.



Figure 4. Removing the barbs, Canada goose primary flight feather.



Figure 5. Canada goose shafts with the barbs removed.



Figure 6. Making the initial cut in the pith.

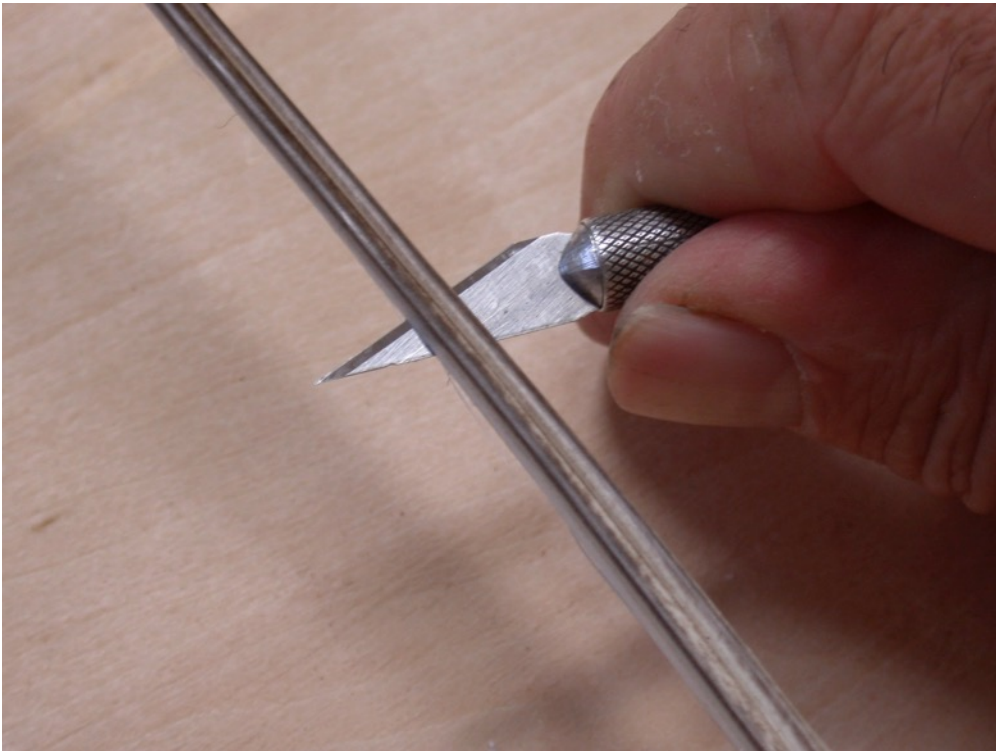


Figure 7. Cutting through the pith from opposite side.

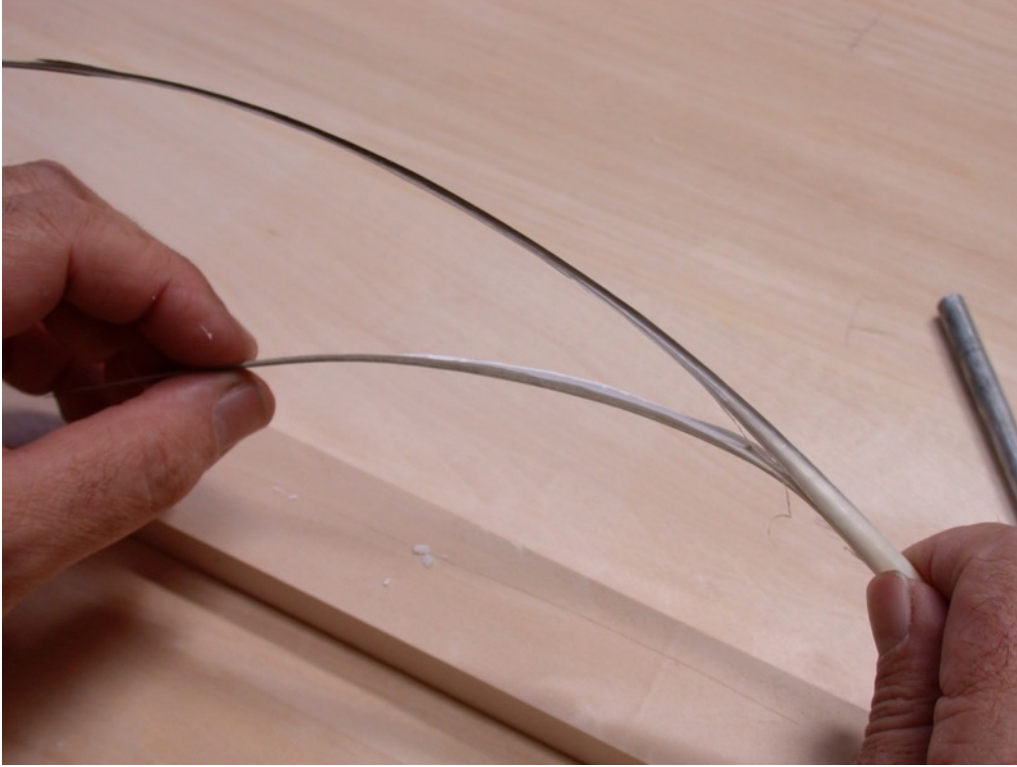


Figure 8. Peeling away the pith.



Figure 9. Soaking feathers in Ballistol.

Turning feathers into plectra

It is best to start making plectra from the tip end of the prepared feather, taking advantage of the natural taper of the shaft. The plectra taken from the tip are the weakest and can be used for the 4-foot or treble of the 8-foot registers. The middle of the feather will work for the bulk of the 8-foot registers. The thickest part of the feather near the quill end can be used in the bass of the 8-foot registers. Experiment to discover what works best for your instrument.

If you are replacing a failed plectrum, you will need to search your feather supply to find one whose stiffness closely matches the one you are replacing or those around it. You may need to cut a bit off the tip or even from the middle of a spare feather to find a section which is stiff enough, particularly if your failed quill is in the tenor or bass.

The first step in making a plectrum is to trim the tip of the shaft to fit into the tongue mortise, using your voicing knife. Imagine a plectrum about 1/2" (10-12 mm) long and shaped like a pre-cut plastic plectrum. (Figure 10) Gradually taper the tip in thickness leaving some pith at the base of the plectrum and none at the tip (Figure 11). Try inserting the trimmed tip into the tongue from the back, being careful to brace the tongue from the front with your finger or voicing block. If it is too wide, lightly taper it from each side (Figure 12). Keep trimming the sides and the bottom until it will fit in the mortise and be more than long enough to reach the string (Figure 13). "Fitting snugly" is the operative concept here, as forcing a quill into the tongue can break the tongue or make it impossible to remove the quill later. The width of the plectrum at its finished length ought to be as wide as possible, consistent with getting it into the tongue. The slight taper in width will ensure that it stays in place. Once the quill is securely inserted in the tongue, cut off the remaining shaft with a pair of nippers leaving about 2 mm projecting at the back of the tongue (Figure 14).

A replacement should match the overlap of the rest of the register, whether by formally "ghosting", or estimating by eye. Because quill is much tougher than plastic and you are cutting across its fibers, you will need to press harder with the knife than you might expect. Brace the voicing block on something stable (a table, your knee, but not your harpsichord) when cutting. Try to make the cut parallel to the front of the jack and at about a 60° angle when viewed from the side (Figure 15). The first cut will be the most difficult because you are removing the most material. Successive trimming will take less effort. Once the correct length has been achieved, check that the width is the same as the surrounding plectra.



Figure 10. Shaped tips on presoaked Canada goose feathers.

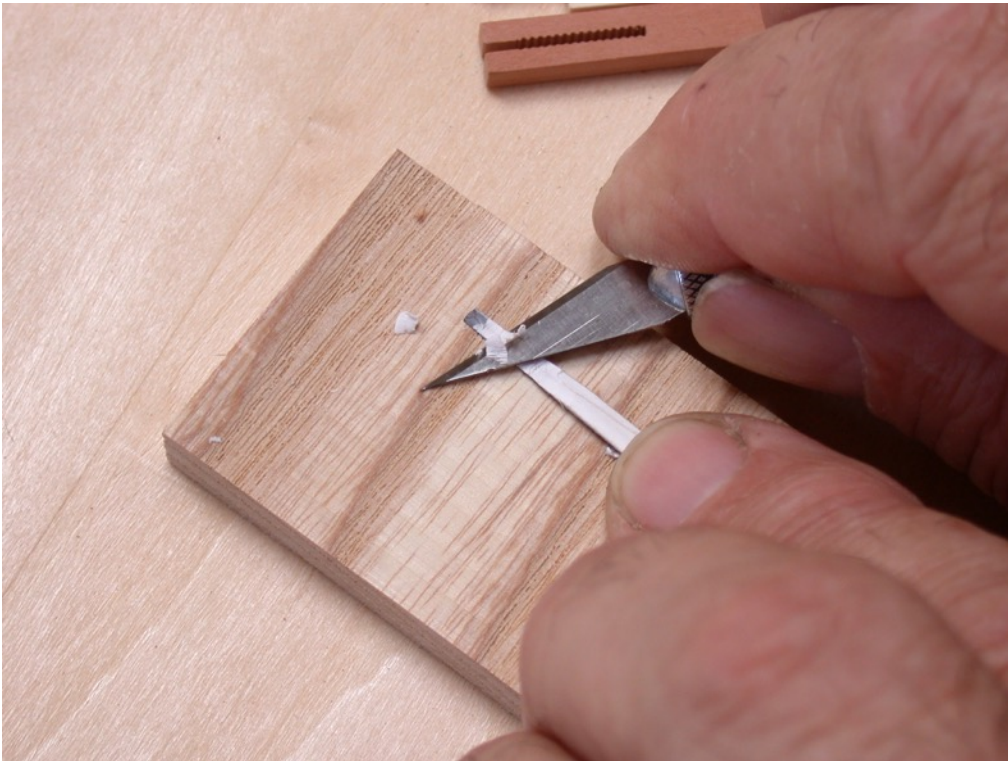


Figure 11. Thinning the underside of the tip of the shaft. This feather is not pre-soaked.



Figure 12. Trimming a side of the end of the shaft.

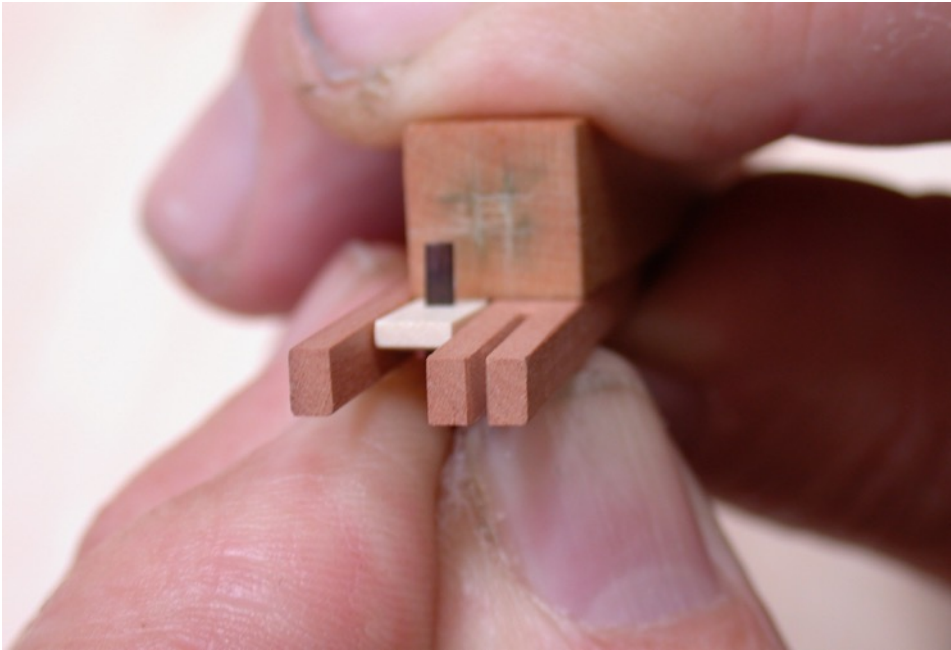


Figure 13. Inserting plectrum into the tongue. Note that the front of the tongue is braced with the voicing block.

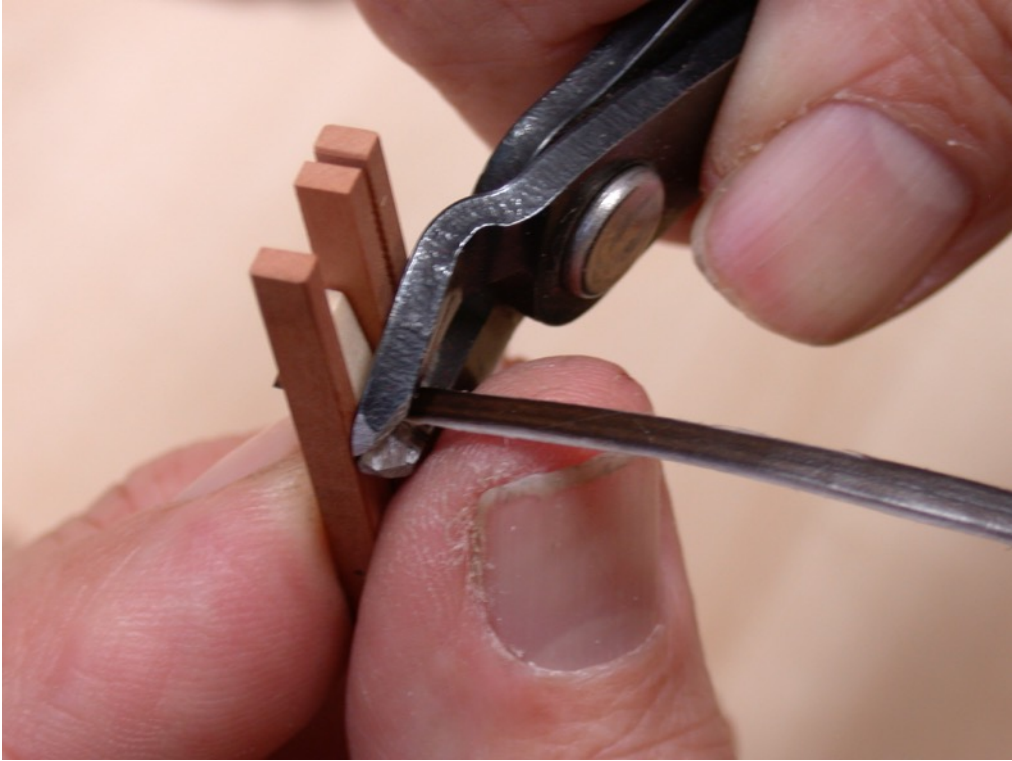


Figure 14. Cutting off the shaft with side nippers.

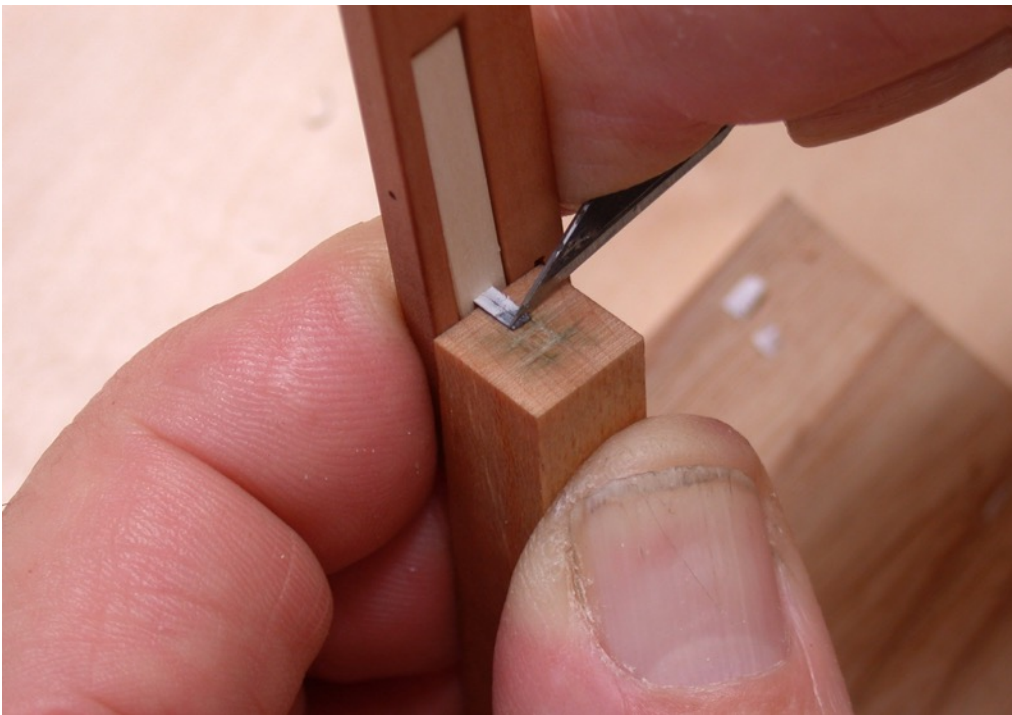


Figure 15. Cutting a plectrum to length.

Quilling an entire instrument

If you are converting an instrument from plastic to quill, the first step after removing the old plastic will be to wet the quill mortice of each tongue with a drop of hot water to undo any distortion it may have suffered from the plastic plectra. Use a small watercolor brush or even a toothpick to apply the drop of water, avoiding getting it anywhere else.

In setting up a whole instrument with new plectra, I usually begin the process by quilling, ghosting, and voicing of all the c's of all the registers. If a full re-regulation is required, I also set the heights and stagger of these notes. This not only establishes guideposts for the voicing levels, but also gives me some idea about the stiffness of the feathers required in all registers to achieve this. The set c's then serve as models for choosing the stiffness of the intervening notes.

I have found that a good average length for most types of feathers is about 4,5 mm for 8-foot registers and 3,5 mm for the 4-foot, including the overlap past the strings. The stiffness of the available feathers and the accuracy of the marking out of the nuts will help determine the best plectra lengths for the instrument at hand, so some experimentation will be in order. If you are converting from plastic to quill, the main difference in set-up for the two materials will be that quill plectra usually can be shorter than has been usual for plastic. When the voicing is complete, you may find that the key-dip can be reduced because the quill plectra will complete their plucks more quickly. In general, I would recommend a full re-regulation if an instrument is converted from plastic to quill.

Because of the inherent stiffness of quill, the amount of overlap past the string is crucial. Our shop standard is an overlap of 0,40 mm (.016") between the "ghost" and "on" positions for all registers. This is set with a brass shim inserted between the "on" end of the jack slide and the case and cutting the length of the plectra to where they just graze or "ghost" their string (Figure 16). In our instruments, this shim may be found at the bass end of the upper manual register (holding it in its "on" position) or in the tool kit of singles. Such a shim can easily be made from a length of .016" (0,40 mm) \times 1/2" (12,7 mm) brass strip, available at any good hobby shop or hardware store.

Begin quilling at the top of the 4-foot with your weakest feathers, or the tips of the stronger ones, and progress to the 8-foot registers as you work your way down the feathers. Constant comparisons to the adjacent c's will guide you in your choice of feathers. Once each register is quilled, you can set the ghosting position and cut all the quills to length.

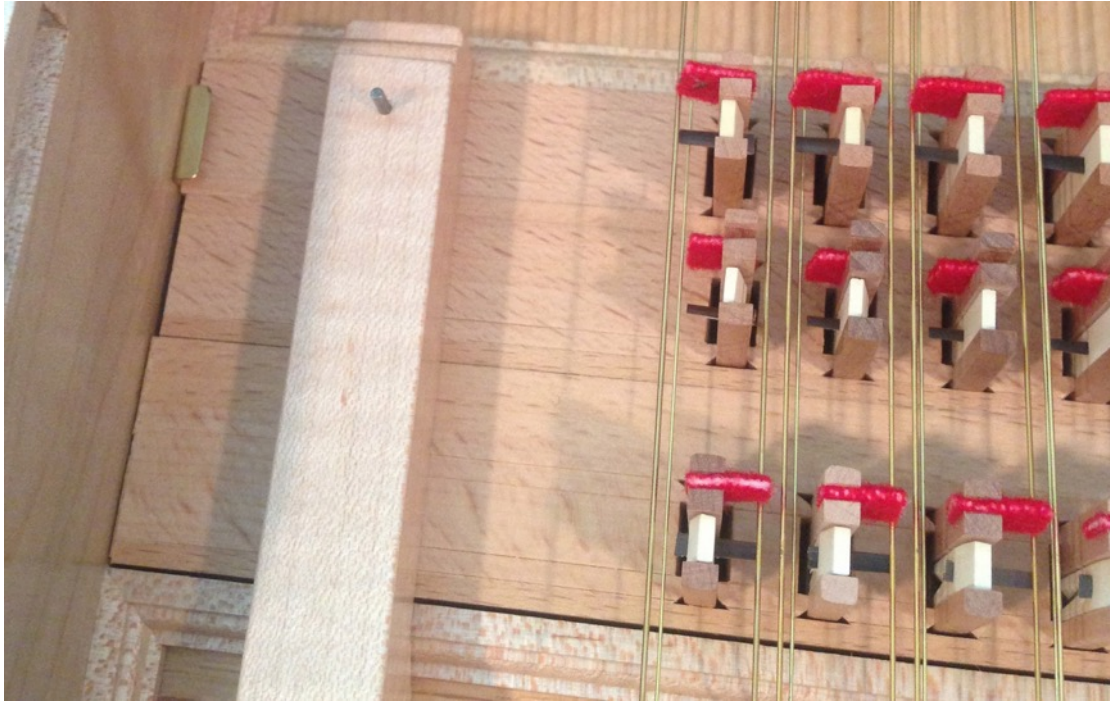


Figure 16. Ghosting shim in place at end of back 8-foot jack slide. The plectra are Canada goose.

Voicing

Test the new plectrum without further cutting. If you have chosen the feather well and have shaped the plectrum correctly, it should be only slightly louder than its neighbors. If it is softer, carefully back it out of the tongue with your smooth jawed pliers and save it for a different spot on the instrument. (Figure 17) If it is much too loud, remove it and save it for the deep bass. If your experience has been that this will be too loud even for the bass of the lower manual 8', remove the plectrum and discard the rest of the feather as useless.

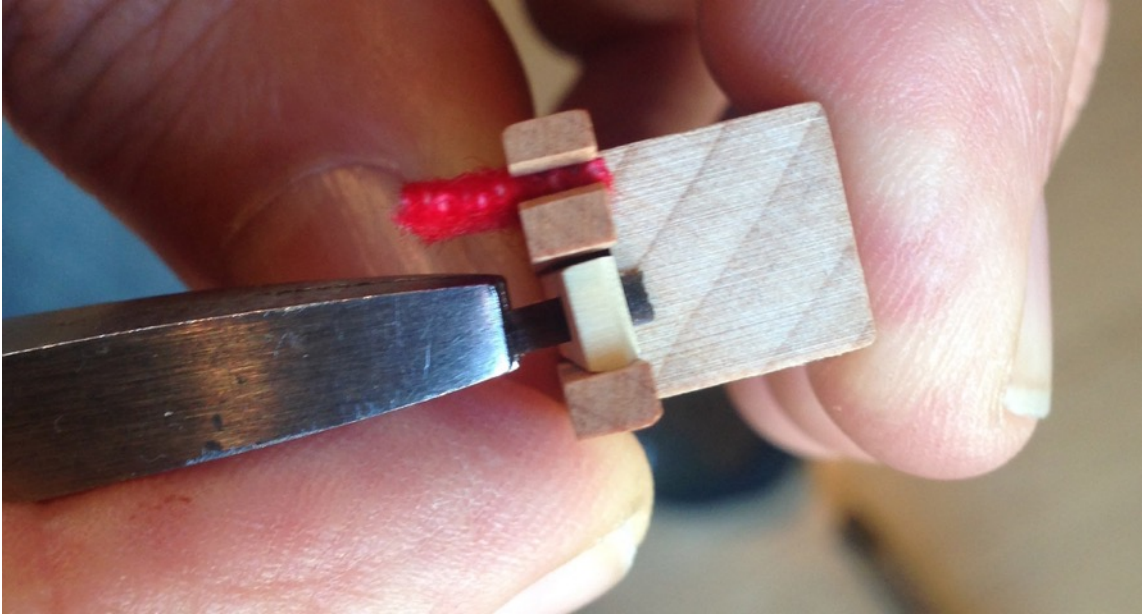


Figure 17. Removing a Canada goose plectrum using smooth-jawed pliers. Note that the back of the tongue is braced with a voicing block.

I find carving to be the best approach for the initial steps of thinning quill, since the material peels off naturally in layers (Figure 18). Begin cutting close to the tip and work back towards the tongue with each successive cut, producing a nice taper in thickness towards the tip. As I approach the desired volume, I switch to scraping, being careful to avoid the very tip of the plectrum so that no roughness is introduced there (Figure 19). It is a good idea to always finish the underside of the very tip with a light skewed cut to remove any fibers which will catch on the string when the note is released and cause the jack to hang (Figure 201).

As a rule, the less cutting or scraping necessary, the better. Ideally there should be some pith present for about half the plectrum's length and the cutting at the extreme tip should not go much past the ribbing which connects the pith with the hard back of the shaft. Further cutting will make the plectrum more susceptible to splitting, especially on the 4' (Figure 21). With thicker quills, an unpleasant clicking sound added to the ictus of the attack will inform you that you have cut this quill too far. These will usually need to be replaced.

As with plastic, it is usually possible to make a quill plectrum louder by pushing it further into the tongue and re-cutting it to the correct length. In this process always brace the front of the tongue (Figure 22). Pressure against the back of the plectrum will cause it to move forward in a convenient series of clicks. One click is often just enough to account for one or two scrapes too far in thinning. This technique, as well as moving plectra, is crucial to maintaining evenness of voicing.

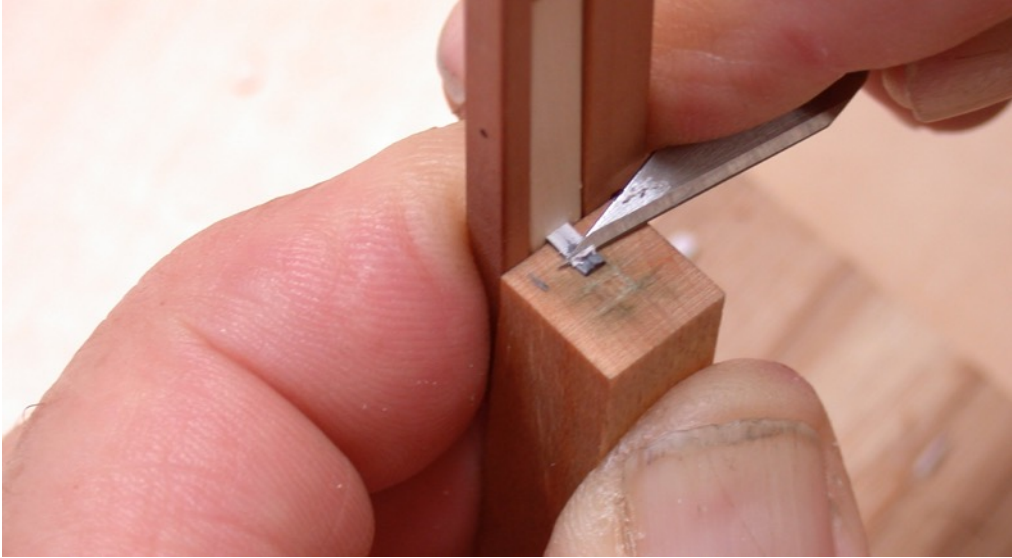


Figure 18. Carving underside of a Canada goose plectrum.

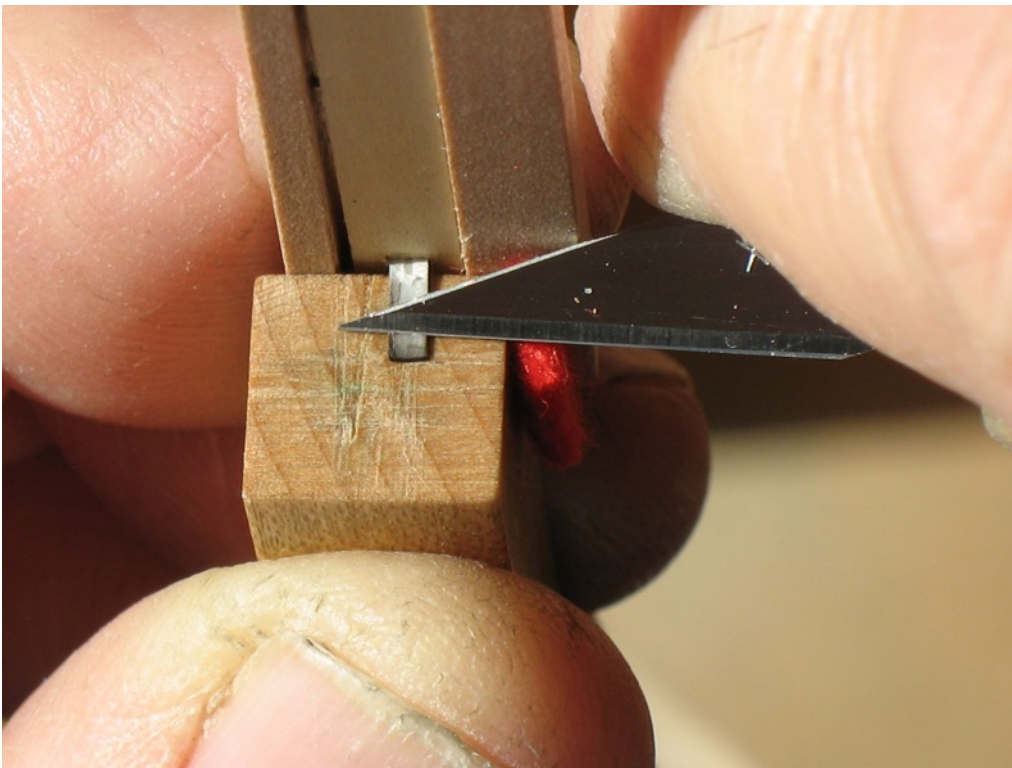


Figure 19. Scraping underside of raven plectrum



Figure 20. Slicing the tip of a Canada goose plectrum to remove any roughness or fibers.

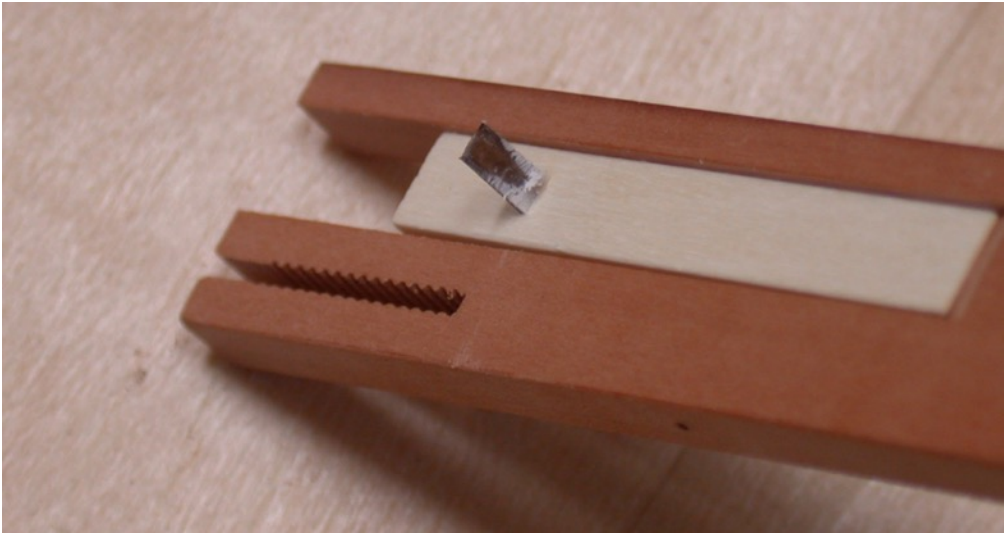


Figure 21. Finished 4-foot plectrum in Canada goose.

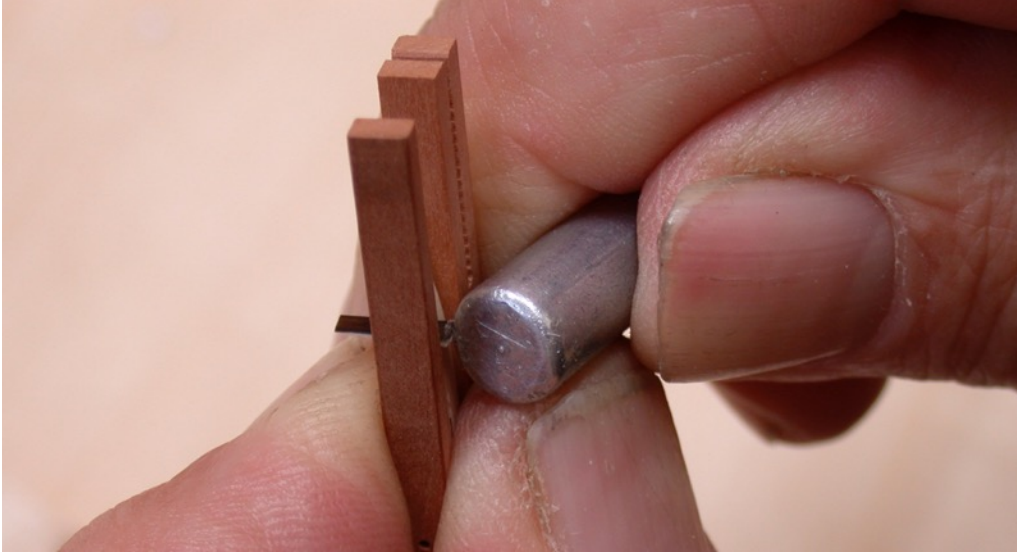


Figure 22. Pushing plectra further in the tongue using the handle of a voicing knife to increase volume. Note that the front of the tongue is braced with my left forefinger.

If you are satisfied with the voicing level and sound quality of your plectrum, give it a “slow test”; that is play the note, let the string sound die, then lower the jack as slowly as possible. It should not hang on the string. If it does, the most likely culprit is a nub or bit of roughness at the tip, usually caused by a worn voicing block or a dull knife. This can usually be removed with a careful skewed cut with a sharp voicing knife. You may need to try this more than once. Other causes for hangers –tight springs, binding jacks, low dampers, etc.– may be corrected as with a harpsichord voiced in plastic.

Voicing an entire instrument

The general procedure for voicing an entire instrument is basically the same as for plastic. All the c's were set first in the process of choosing feathers. With all the intervening notes quilled and ghosted, I start voicing with a C-major triad up and down the compass in all registers to make sure that the volume levels and balances are correct for the instrument. Then, starting with the back 8-foot register, I then fill in the remaining naturals, checking both adjacent notes, and in other triads. Finally, I fill in the accidentals and move on to the front 8-foot and 4-foot, always checking for balance both across the compass and between registers. If the quills are well chosen, this whole process can take as little as a half hour per register. A final step is a “slow test” for every note.

At this point try to play the instrument to test the balance between registers and the evenness of voicing, and to make sure everything is working correctly. There will always be something which will need further attention. I find that such attentive listening can be sustained for only an hour or two. Stepping away from the instrument for a while will be much more productive than struggling with jaded ears.

A freshly quilled instrument using presoaked feathers should be played in a bit before any additional oiling. Our new instruments are oiled after a month or so of playing, right before they are delivered. If the quilling was done with dry feathers, it ought to have its new plectra oiled at least twice; once when the first pass at voicing is complete, and again a few days later. As with an individual replacement quill, the voicing is likely to become louder after the first oiling.

Living with quill

Optimally, well-chosen and well-cut quill plectra in the middle of the instrument should last for a year or more. With minimally attentive maintenance, it should be possible to keep a quilling going indefinitely, replacing plectra only as they fail.

The main maintenance requirement for quill is to keep the plectra oiled. This is a bit like tuning; you do it when it becomes necessary; as when a few notes suddenly become quite loud or when the whole instrument begins to feel and sound scratchy and uneven. How often you will need to oil will depend on how much you play and on humidity conditions. For presoaked quills, every four to six months is about average for most musicians. A much-played institutional instrument will need oiling more often (as well as quill replacement). Necessary oiling should not be put off for long, as irreversible damage to the quills will result. As a natural material, quill is somewhat hygroscopic and will be slightly stiffer in dry weather than in wet. Proper oiling will do much to mitigate this. Presoaking the feathers in Ballistol virtually eliminates it. Although quill does not work harden, wear due to lack of oil can make a note pluck louder.



Figure 23. Oiling the underside of a Canada goose plectrum.

The oiling process is quite simple. A small (00 size) artist's watercolor brush is used to apply the oil. It goes on the undersides of the plectra from the tip to about half way down its length towards the tongue. You will need to remove each jack to do this. I would recommend that you hold the jack with the plectrum pointing down for a moment to allow the oil to penetrate the quill without seeping into the tongue. I find it useful to place the jacks of each register face down on the folded back lid flap, with the plectra hanging over the edge, until all the plectra for that register are oiled, then putting them back in the instrument and moving on to the next register. Of course, you will need to pay attention that the jacks do not get out of order and that you return them to the register facing the correct direction. The amount of oil necessary is infinitesimal; one half-depth charge of the brush should do two octaves. Much of the minor unevenness which may have crept into the voicing will vanish with oiling. The oil is absorbed into the matrix of the feather, toughening it and making it stiffer, as well as lubricating it and preventing undue wear (Figure 23).

Since oil does not penetrate the top surface of the quill, oiling the tops of quills is at best a more temporary solution to scratchy quills. If you are about to play a concert and lack the time (maybe an hour) for a thorough underside oiling, by all means oil the tops, at the tips.

Unless your spare feathers are presoaked, a newly replaced quill should be given a healthy coat of oil on its underside and allowed to sit for a few minutes, face down, with the plectrum overhanging a flat surface. Repeat this with a more modest application of oil after a day or two. Do not be surprised if it has gotten a bit louder in the process. The presoaked replacement plectra should not require any further oiling.

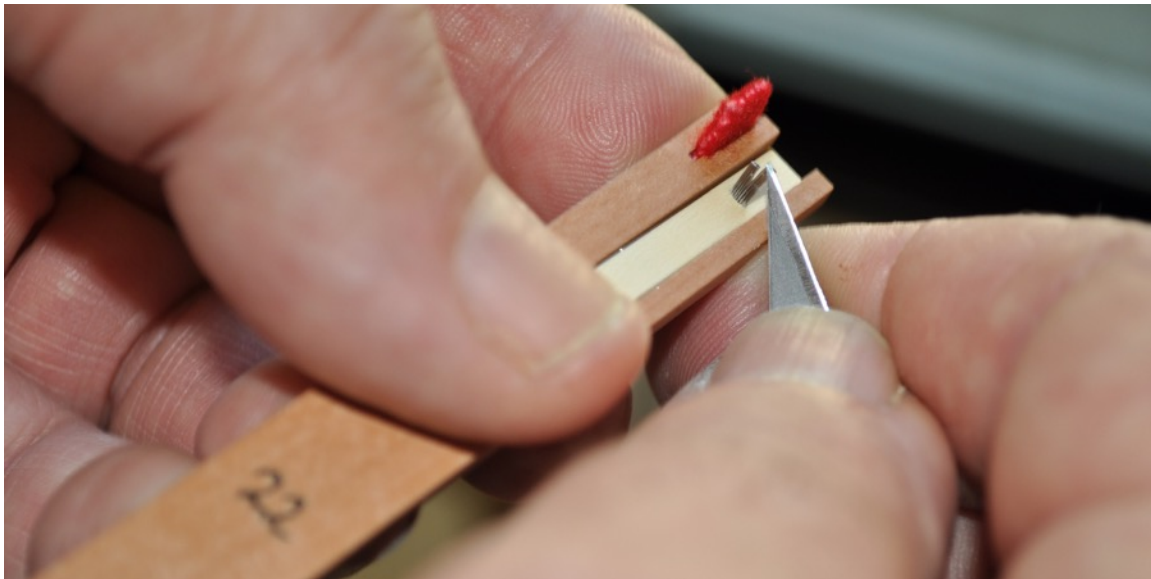


Figure 24. Split quill, Canada goose.

It is worth being vigilant about the general voicing level, being particularly attentive to soft notes, as these will indicate incipient quill failure. Heavily used instruments will gradually get softer, particularly the registers which get used the most. This is the opposite of plastic where the plectra work-harden and stiffen with time and use. If a quilled instrument is left

unplayed for more than a week or two, the voicing may seem uneven when it is opened again. Play it for 20 minutes before reaching for a knife or the oil. Usually it will return to its pre-abandonment state.

Some plectra are bound to fail eventually. A suddenly dull note means a lengthwise vertical split (Figure 24). A note getting softer every day is usually a horizontal split. Often, there will be a brown spot on the top of the plectrum, right where it leaves the tongue. Eventually they will need to be replaced. Suddenly loud notes mean that it is time to oil. The inevitable unevenness that creeps into the voicing can be easily corrected with a scape or two of a voicing knife. Try pushing the plectrum of a soft note through the jack a click, as described above. If there is no change in volume, then it needs to be replaced.

With practice, these become trivial tasks. Our musical ancestors would have found cutting a plectrum for their harpsichord no more onerous than shaping the nib of a writing pen. They say that Bach could be ready to play in 15 minutes. Surely some of this time must have been spent tuning.

John Phillips, May 2020

Further reading:

Denzil Wraight (<http://www.denzilwraight.com/quilling.htm>) This is an informative and well-reasoned analysis of the effects of oil on quill. Dr. Wraight first recommended Ballistol for use with quill.

Tilman Skowroneck. Harpsichord Voicing:
<https://skowroneck.wordpress.com/2008/03/08/voicing-complete-pdf/>