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TO QUILL OR NOT TO QUILL?

Top makers weigh in on materials of the trade

According to its makers, Dupont, "Delrin®Acetal Resin Solutions Delrin® acetal homopolymer bridges the gap between metals and ordinary plastics with a unique combination of creep resistance, strength, stiffness, hardness, dimensional stability, toughness, fatigue resistance, solvent and fuel resistance, abrasion resistance, low wear and low friction."[1] Besides its use for keyboard plectra, Delrin is used for food storage/processing, medical devices and various automobile applications. Its cousin, Celcon, is a copolymer version, with both being essentially plastics that respond well over time.[2]

The Morley Experiment

In vol. 1/no. 6 of the *English Harpsichord Magazine*, LeVoi and Williams compared quill, leather and Delrin in terms of their wearing properties.[3] The point was to note how use / playing of an instrument impacts on the plectrum material. First the quality of sound was considered, with quill producing the brightest sound, followed by Delrin (as supplied by Robert Morley and Co., who financed the study) and then leather. At the time, leather was considered a viable option; today it is mainly seen in revival era instruments or in *peau de bufle* registers. (In this article, we will consider quill versus synthetic plectrum as our main options.)

Secondly, wearing and breakage were considered. Plectra were subjected to use by a machine which approximated the impact of playing for a year. Plectra tended to break at their junction with the main body after one year of use.[4] After a modification of plectrum shape to a radius of 1mm, the Delrin plectra lasted the equivalent of three years.

Thirdly, the changes in the "starting transient" due to wear were considered. This refers to the initial sound quality for specific bands of frequency. It was found that quill with harmonics greater than 2.5 KHz have lowered amplitude (volume) due to splitting, whereas Delrin did not have this effect. In addition Delrin is not affected by humidity. The only problem with Delrin is its tendency to break without warning (either visual or auditory), whereas quill will exhibit signs of wear that can be seen and heard before it breaks.

Wraight's perspective

Denzil Wraight has written extensively on quilling. He describes how to deal with natural quill, how to treat quill that has become hardened, and how to oil the underside of the quill to prolong useful life.

Wraight notes that natural bird "quill will not "work harden" with age (as does Delrin). The touch may become lighter after extensive use, e.g. after 6 months, as the tip becomes polished."[5] Untreated natural quill will attain a harder pluck after a short time (as early as 50 plucks). This is because the quill becomes rougher, resists the string more and requires more force to pluck. In addition, new harpsichord strings will cause similar hardening quite early on.

The cure is twofold and involves oiling quills to prevent wear and to soften hardened quills. Firstly, the

underside of the bird quill should be oiled until saturated; this can reduce wear and prevent hardening, keeping the quill "as new" for up to 2000 plucks (6 months, roughly). Secondly, oiling (for 45 minutes) can also solve problems with quills that have already become "hardened". Given some notice, a performer might employ this, rather than resorting to burnishing the quill with one's fingernail or the stem of a quill (as recommended by Tilman Skowroneck[6]), which may help for up to 30 plucks in an "emergency" such as a concert.

According to Wraight, the best oils to use are Ballistol (a relatively inexpensive paraffin oil often used with sporting/gun maintenance) or Vogel's Kielöl; these are preferable to emu oil or grease from one's own skin. Biological oils tend to degrade or breed bacteria, so olive oil, for example, is considered useless in this regard.

Wraight notes that oiling the topside of the quill is less efficacious and may actually cause a stiffening effect; luckily this wears off (should it be mistakenly applied) after some playing. He also looks at other quill issues, such as creaking of the quill tip just before plucking (no cure), type of bird quill (swan is good, turkey not), and climate (humidity changes are not a problem; temperature rises decrease pluck strength slightly).

He recommends oiling a new instrument (often when it's had all new strings) three to four times a year, decreasing to twice in the second year. A clue that it's time for oil is if several quills seem harder all at the same time. He recommends applying oil with a wire, toothpick or tiny brush, avoiding it contacting the tongue, and wiping the excess away after 45 minutes. If a quill still seems stiff after oiling then it may re-voicing.

Tilman Skowroneck's View

Skowroneck gives a comprehensive account of plectra.[7] He starts with the desirable qualities of plectra (regardless of material): a) sturdiness, b) good functioning such that it will not pull strings or get caught, and c) giving a suitable tone. He recommends that players obtain sheets of Delrin rather than buying pre-cut ones.

With regard to sturdiness, material and shape are equally important. There are two main reasons why pre-cut or stamped plectra can break more often. Firstly, Delrin has strong and weak directions/grains, but it's difficult to tell in which direction they have been cut. Secondly, Delrin can have microscopic level damage which makes entire batches weak but which cannot be detected by the naked eye. This can be mitigated when using entire sheets; with entire sheets, one can bend them to determine which is the strongest direction/grain, then cut long narrow strips in the good direction, with a width of about one plectrum plus 1 mm extra material.

There are two other problems relating to specific types of pre-cut plectra. When plectra are pre-cut with an exaggerated wedge or point, this creates extra stress and therefore breakage. These also fail the suitability test, as they bend very little at the base, with the result that the tips bear the brunt of the pressure, tend to bend downwards (rather than slipping back into place) from an early stage, and break more often. Similarly, those pre-cut plectra supplied with ridges or patterns which have been shaped by a blunt knife or scalpel are often made from over-stressed material.

With regard to **good function**, both the length and shape of the underside near the tip are crucial. The plectrum should not touch the string when that register is off; it must safely slip back

under string, *and* it should not be too short such that it gives inconsistent volume. To test that a plectrum won't make noises when a register is off, one can manually damp the string and release the key very slowly. If slipping is a problem, one can cut the tip diagonally from below, especially with quill.

To test the **quality of sound**, one must consider thickness. Here a player must respond to the instrument rather than making the instrument conform to the player's desired touch. This is an interesting point. Skowroneck notes "If we believe the harpsichord to be a musical instrument and not a tone-processing machine, and if we want to honour the effort of the maker in any reasonable manner, we should listen to what the instrument is willing and able to do in terms of volume and sound quality, and we ought to voice it accordingly."[8] If too thick for the given stringing, the plectra will pull strings out of tune or will make a loud pluck that interferes with and shortens the sustain of the actual tone.

Skowroneck goes on to consider **quill as the ideal material** and the default to which other materials should conform. He notes that alternatives to quill, such as leather and metal, came about in the late eighteenth century because people (much as today) found maintenance a chore. The most common material was raven quill (commonly available because of superstition and over-hunting!).

The main differences between quill and Delrin are discussed next. Firstly, quill is softer but with a fibrous structure along its length, resulting in good springiness. In order to be as springy, Delrin as a material needs to be much harder. The second difference is durability and behaviour in relation to climate. Quills weaken gradually over time, becoming softer, whereas Delrin tends to harden and then break without much notice. Thirdly, quill also becomes softer as humidity rises; this can be a problem, as in very humid conditions, quilled instruments change dramatically and at such times should not have maintenance carried out.

The advantages of quill are next considered, including less obvious action noise and a brilliant tone with more high harmonics — a higher signal to noise ratio, in essence. Quill improves sound projection further away, blends better with other instruments, creates less noise at the end of a sound, and can stand being voiced more loudly than Delrin without sounding forced or making the touch uncomfortably hard. It is important to keep in mind that these attributes can only be expressed if strings are properly fitted and maintained as well.

Skowroneck goes on to describe **how to make plectra from quill**. Raven is the most common, followed by wild turkey feathers (especially in the USA), wild goose, and even gulls as the cheapest collect-it-yourself option (one feather providing enough for one to two octaves.).[9] He counters the myth that raven quill was common because it could be voiced more loudly — this is simply untrue. Neither should plectra always be as hard and thick as possible; rather, one chooses feathers that are large and springy enough to suit the given instrument.

He then tackles the issue of durability, with American wild turkey being beautiful sounding but the least durable, and with raven/crow family feathers being the best sounding though not much sturdier than turkey. Turkey and crow tend to be of just about the right size and thickness for plectra, whereas gulls vary in thickness of feather. He discounts condor as not worthy of the fuss some people make. It's clear he favours gull because of its ready availability and

low cost. He also notes that gull quills are not more susceptible to changes in humidity, as some have suggested. One may need to avoid the sections from the back of gull feathers which are essentially flat, but otherwise it's a matter of choosing the right feather for the job.

In the working life of a harpsichord, he normally has to change about two plectra per week on his main instrument. Twice a year (when central heating comes on and turns off), plectra can become more brittle and weak, and it's worth checking quill tips then.

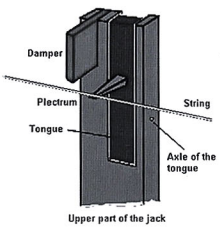

Figure. 1: A jack and its parts[10]

Skowroneck describes how to remove plectra. First one removes the broken plectrum by pushing it back into the mortise (the rectangular cavity where the plectrum fits into the tongue at right angles to it) with a small screwdriver and using pliers to pull it out. If a quill plectrum is weak, then one pulls on the whole plectrum from the front with pliers, pushing it back to the mortise, sometimes with several tries. If it breaks off, then clipping it and using a small screwdriver on the remaining section often works. Next, he describes how to prepare bird quill, eventually getting to the stage of cutting strips, where the process for Delrin is the same as for quill.[11] With quill, the only useful parts are those parts of the feather's shaft with an oval cross-section as in Figure 2. The back of the feather is discarded by being scraped with a sharp knife. Then the shaft can be cut into either four or two long strips. Rather than shaping each individual plectrum, he recommends inserting the strip into the tongue and then cutting it off and shaping it.

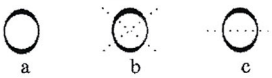

Figure 2 (cross-section of feather shaft and possible cuts)

The first adjustment is to the plectrum width so it can fit through the mortise in the tongue, usually by tapering one end of the strip slightly with small pointed scissors, and refining this with a sharp knife. With Delrin, the plectrum needs to be supported against a small piece of wood so that a scalpel can be scraped across it. Then the strip is pushed from the back of the jack into the mortise of the tongue, as in Figure 3, with the concave surface of quill up or the smoothest side of the Delrin on top.

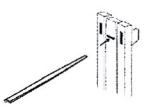

Figure 3: plectrum fitting into rear of mortise.

The back is trimmed with scissors, leaving a few millimetres for adjustment, and then the length of the front is cut roughly to length. It can then be scraped on its underside, removing material in a uniform fashion and sometimes checking the length again, before trimming the tip at an angle so the top side is slightly longer as in Figure 4.

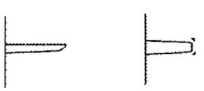

Figure 4: angled cut in plectra; cutting off of corners

The last step is cut off the corners, a vital step for quills in order to prevent slipping. With Delrin this cut improves

the sound, making it more refined. Delrin can slip out of plastic jacks; this requires the Delrin to be only slightly thinner than the mortise and with an angled tip to create the friction needed to hold it.

Skowroneck makes some further observations – that quill is a commitment but it is worth learning how to maintain it. The main technique is cutting or scraping the underside of the quill, trying to keep the surface smooth by occasionally varying the angle of scraping.[12] Material should be removed from the stiffer areas so that plectra can bend evenly throughout. He notes that when voicing an entire register, one must avoid having some areas louder or softer than others, especially with instruments such as 18th-century French harpsichords, where the bass tends to overpower the tenor.

Quill plectra can stick to the string on returning, and this can be mitigated with a little grease (from one's forehead!) or by smoothing the tip with a file. Freshly voiced quills often receive a groove from the string cutting into them, which can cause creaking and a forced tone; before this softens with time, one can rub the top surface or apply grease. He does recommend light olive oil (but only a tiny amount).

He acknowledges that there are times when quill is not the best material to use, due to the shape or size of the mortise; usually these are where plectra are shorter than 3mm, where they are mounted at an exaggeratedly upward angle, where they are played by a lot of different players (schools), or when they are played by those with an aggressive touch.

Morley, Wraight and Skowroneck show a range of perspectives and we hope in subsequent issues to continue considering quill materials.

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1 Online, "Dupont," Accessed 14 July 2012, <http://www2.dupont.com/Plastics/en_US/Products/Delrin/Delrin.html>

2 Online, "Polyoxymethylene", Accessed 14 September 2012, <http://en.wikipedia.org/wiki/Polyoxymethylene>

3 M. R. LeVoi and R.P. Williams, "The Wearing Properties of Harpsichord Plectra," *The English Harpsichord Magazine* 1, no. 6 (1976). This can be read freely at www.harpsichord.org.uk

4 For a year the approximations were based on the assumptions that a standard piece of music has approximately 500 notes per minute, spread mainly over the middle two octaves, and that over a year an instrument is played one hour a day for 300 days.

5 Denzil Wraight, "What the Harpsichordist Needs to Know About Quill Plectra," dated 4 June 2012, Online, accessed 14 June 2012, <www.denzilwraight.com/quillbasic.pdf>.

6 Online, Tilman Skowroneck, "Harpsichord Voicing", <http://skowroneck.wordpress.com/2008/03/08/voicing-complete.pdf/>

7 Online, "Tilman Skowroneck: Harpsichord and Early Piano", Accessed 2 September 2012, <http://skowroneck.wordpress.com/2008/02/28/voicing-i/>.

8 Online, "Tilman Skowroneck: Harpsichord and Early Piano", Accessed 2 September 2012, <http://skowroneck.wordpress.com/2008/02/28/voicing-ii/>.

9 Online, "Tilman Skowroneck: Harpsichord and Early Piano", Accessed 2 September 2012 <http://skowroneck.wordpress.com/2008/02/28/voicing-iii/>. In fact Skowroneck does not recommend ordering feathers from dealers at all, but just collects them on the beach.

10 Graphic from Online, "Plectrum", accessed 14 September 2012, <http://en.wikipedia.org/wiki/Plectrum>.

11 The graphics here also appear in the voicing chapter (Chapter X) of Martin Skowroneck's book *Cembalobau* (Bochinsky, 2003).

12 Online, "Tilman Skowroneck: Harpsichord and Early Piano", Accessed 2 September 2012, <http://skowroneck.wordpress.com/2008/02/28/voicing-vi/>.