RUCKERS ENIGMA ?

or

fifteen years search for the unicorn.

"...the writer of this document is no journalist, nor is he a scholar, and while he is quite aware of the historical importance of his words, still he is not likely to allow objectivity to nudge him off the pillar of his own perspective." (1)

In the following, I would like to consider some of the design features of the Ruckers instruments, notably those that nobody seems to understand - perhaps I should say to reasonably explain. For my purposes I list

1. The double lower bellyrail

2. The toolbox

3. The "non-glued" bottom

4. The upper bellyrail

5. The upper braces

Since the war, countless so-called Ruckers copies have been made , some of them quite close to the original, but the majority having little more justification than the length of the c, string. The Ruckers were defenceless. The preoccupation of this period with the "French double" and the historical French builder's similar preoccupation with Ruckers has, I fear, led us to believe the French double to be the culmination of the Ruckers design. I don't think that anything could be much further from the truth. But, this attitude has naturally more or less forced us to view the Ruckers through "French glasses", not actually seeing what is really there.

Since the above listed did not coincide with French practice, it was usually simplified. The toolbox was most often omitted as was, often enough, the rearward lower bellyrail. The same holds true for the bias of the upper bellyrail (to be fair, the upper bellyrail of the small Couchet is also not biased). Because these "copies" did not impress me and because I quite frankly did not understand, even at an uninvolved "objective" level (not to be confused with insight), I shied away from the Ruckers as a starting point for my own work. It took me 15 years to get the picture, that is, it took me 15 years to become naive enough to **see** - sight - insight.

"Then she began looking about, and noticed that what could be seen from the old room was quite common and uninteresting, but that all the rest was as different as possible."[(2)]

There has been no lack of written material on the subject of the harpsichord and, more specifically, on the Ruckers. Frank Hubbard's pioneer work[3], although it did establish their historic position and importance, also helped foster this French attitude. Grant O'Brien's monumental book[4] must do a great deal to change this attitude, showing as he does how the instrument was laid out and the step by step procedure. But even he doesn't consider the implications of the listed features or make any attempt to explain them other than to name them. Rather than critique, I would like this to be a supplement to Grant O'Brien's book.

Before considering these "enigmatic" features, I would like first to discuss the order of assembly as I see it. The pinblock was first glued to the cheek, probably laying the cheek on the bench and putting the pinblock on end, weighting it on top perhaps with a heavy object such as a jointer. Then this assembly was glued in like manner to the spine.

I think that the liners were glued to the sides prior to assembly - the bentsideliner is trenailed to the bentside and on those that I have seen, the trenails appear to be inserted from the inside (they are tapered). This would offer a simple explanation why the mitres of most liners (not just Ruckers) don't fit: obviously, a practical craftsman would not make unnecessary work trying to fit both the case mitre and the liners, especially when it is totally unnecessary (perhaps even detrimental) that the mitre joints of the liners fit at all. Besides, if they had go-bars, it would be logical to glue the liners to the sides first. And, gluing the liner to the bentside makes it much stiffer and aids it in retaining its curve. This would be important in a "semi-mass-production" shop.

The bentside and the tail have each the typical lap-joint at the forward end. This would suggest that first the bentside-cheek corner was glued and then the tail was fitted and glued, perhaps both joints at once. The lap-joint being on the tail implies for me placement and not insertion. By comparison, Delin has the same lap-joint at the cheek corner but at the tail the situation is reversed: the lap is on the bentside. I interpret this to mean that the tail mitre was done first, thereby accurately establishing the tail angle and all straight dimensions. With the instrument resting on the bottom (drawing), the bentside could then be marked to length so that the curve (each one was different according to the stiffness and cut of the wood, the temperature, and maybe even the bender's intention) best fit the layout.

Then the instrument could be laid with the spine resting on a flat, sturdy surface such as the workbench and the bentside put on (again, placement, not insertion). In both cases both procedures are

possible but I think that the direction of the lap-joints does have a significance. One could argue that, in the first case, the lap is on the tail for purely structural reasons, making a joint that will not cave in even if the glue should fail. This presupposes the assumption that the tail is the most highly stressed member of the case, a fact born out by the fact that it is also generally the thickest piece of the case. Dove-tailed joints can also be viewed in this light. Delin, again, doesn't seem to have found this important. Personally, I prefer gluing the bentside-cheek joint first so that I can test it, regluing it if it does not pass the test. While on the subject of Delin, it should be noted that he, like most of his contemporary colleagues, was attempting to recapture Ruckers. And probably came closest to it. Realizing that the extension of the compass with its incumbent destruction of the statically sound geometrical shape played an important role, he reduced the compass. His bracing has nothing to do with Ruckers (or anyone else for that manner) but the short brace in the treble between the lower bellyrail and the bentside is the same distance from the spine as a 4 octave Ruckers is wide! The rest in the treble is so to speak the ravalement. He adhered to the "49cm rule".

He also never made a 4' (?) but he applied the force of the 4' to the soundboard by putting a spring under the hitchpinrail. Delin's genius led him to a design that was not a strengthened Ruckers, it was something new and able to approximate the dynamic stressing of the Ruckers but with two 8'.

The rim finished, the lower braces and the keycheeks were installed onto which the lower guide was then glued.

Digressing for a moment, let me look at construction details in Dutch organbuilding. After all, many of our builders did build both. Between the Friesian organs, of the Hinsz and the van Damm for instance, there are differences which at first appear to be only stylistic. Most obvious with Hinsz, the keyplates are trenailed to thelevers (this is often named decorative) but there are other similar details. The trackers are wrapped with linen thread, each loop knotted; if there are any wooden pipes, the ends are also wrapped with cloth, parchment or string even when they are open pipes; all tenons are trenailed; virtually everything is made of oak.

Van Damm, building in the same geographic location but about 100 years later, no longer trenails the keyplates.

He also wraps the trackers with paper like his German colleagues, he makes many parts of pine that were previously made of oak. The reasons for these changes are to be found in the local geographic and climatic history. During Hinsz' time, much of the land was still at

least seasonally under the north sea so that it was actually possible that a country church stood in the water for a time. This kind of humidity was too much for glutine glues as well as for most organic substances, hence the exclusive use of oak since it does not rot. By 1840 however, most of the land had been claimed with dikes, so that Friesland was almost as we know it. Van Damm, as successor of Christiaan Muller, was well acquainted with the tradition **and** with the reasons for it. For this reason, he was able to dispense with or change traditional design features that were no longer necessary. Could there be a similar reason for the dovetailed cases in 18th century Antwerp? Tournay, where Delin worked, is much farther in the south and it is not on the sea. All this wants only to demonstrate that much of what was done **must** be viewed from outside of the shop: **all** aspects of history played a profound role (no different from the present). The historic builders were real people living in a real world and we cannot grasp their work unless we at least try to understand their world.

Having come this far, I can start with the upper bellyrail, the piece with the least "hidden" meaning. Ruckers' (and Couchet's) upper bellyrail differs from the rest of the world in one fundamental way: it is inserted into grooves in the liners which butt against the pinblock, in some cases running all the way to the nameboard. It does not touch either side of the case. It is fixed in these grooves with wedges. It is also glued and nailed to the lower guide which has already been glued and nailed to the keycheeks. The soundboard is glued and nailed to the top of the bellyrail, but, as stated, the bellyrail is not fixed i.e.. let in or glued to the case walls. Couchet's are vertical, Ruckers' are biased, but this is not a fundamental difference - the important thing is the method of installation. There must be a reason for this and it is not to be found in the room afforded the jacks in the lower guide by angling the bellyrail: the Couchet apparently didn't need this room.

The painting on the soundboard shows two different methods: the motifs were painted in tempera or gouache whereas the arabesques were most probably done with a "Malhorn"[(5)], a clay vessel usually with a quill tip and filled with paint. By closing the filling hole with the thumb, one stops the flow of paint through the quill. The paint is probably on a casein base. So, the two methods were probably done by different persons at different times: the motives on the soundboard prior to installation and the arabesques after the hitchpinrail and the mouldings were installed, perhaps when the case was being painted.

With this bellyrail construction, they were able to fit a soundboard into a case and immediately glue and nail it to the bellyrail. It could then be marked out and removed from the case together with the bellyrail. This has definite advantages. The soundboard will retain the proper width. It is easy to plane to the proper thicknesses by hitching the bellyrail to the edge of the bench and planing from the top (try this yourself!). It has a defined "Klopfton" or pitch and one can listen to the changes in pitch, something which cannot be done with a "naked" board. Because the bellyrail is at an angle, the whole assembly moves toward the front of the instrument as it is removed.

The first "advantage" is the most important: by ensuring that the width of the fitted board will be retained, it was possible to give the finished board to the painter out of the instrument and out of the house. As a sidelight, the angle of the biased bellyrail is such that the board will stand on that end on the bench without tipping, so, perhaps the bias was only an aid to the painter.

One can see that, although the design may have tonal implications (it certainly does), it was certainly not conceived for that reason. It is a very straightforward "workmanlike" but at the same time sophisticated solution to a production problem - so sophisticated in fact that virtually nobody in our time has been clearwitted enough to follow suit.

The double lower bellyrail and the toolbox belong together and I fear that they are not so easily assessed because these features show a far higher level of sophistication and **insight**. In the plan view, both bellyrails together with the spacer between them define the toolbox. The rear bellyrail runs from the cheek between the front bellyrail and the case joint, perhaps the strongest point in the entire case viewed from the top, i.e. in the x-y plane, to the spine at about the position where the first upper brace is fixed, making this position very stiff. Also, in my experience, when in the process of making a rim one tries to correct the bentside with the lower braces or an attempt at prestressing[(6)] is made, the spine has a tendency to flex to the side just behind the normal lower bellyrail. The Vaudry in the V&A in London shows this very nicely with its pronounced bend of the spine behind the bellyrail. So, the rear bellyrail serves a definite structural purpose.

This type of triangulation makes the case very stiff in the x and y directions. Remnants of this are to be found with both Dulcken and Bull. In these cases, the upper bellyrail is dovetailed into the case sides, but the lower bellyrail is let into case only on the spine end. In the treble it is dovetailed into the piece which forms the liner, a piece of the full height between the bottom and the soundboard and run-

ning from the front to the bentside-cheek joint. As a result, the lower bellyrail is shorter than the upper, making a triangulation. Though less effective than Rucker's, this system is also quite stiff. So, obviously, the rear bellyrail is not there to make the toolbox. Of course, one can utilize the available space and configuration to make something as practical as a toolbox, especially when there is such a nice "hole". It is my firm belief that the only thing important about the toolbox is the hole - the **hole** is not for the toolbox, the toolbox is to utilize the hole. The hole has a much more important purpose: it is to weaken (yes!) the spine to the same level as the bentside-cheek corner, thereby establishing a symmetrically flexible case. The tonal implications are mind-boggling, but, apart from that, much better tuning stability is established - at least in theory. This awareness that the case must be statically symmetrical to remain flat and to stay in tune is not the result of chance or the work of naive craftsmen. The enlightened "craftsmen" of today glue the bottom on from front to back, thereby stiffening the case to asymmetry, probably leaving out the hole as well. In the 1640 Andreas (I) Ruckers at Namur, the bottom was glued only to the front lower bellyrail, everywhere else it is only held by trenails. Of course the width of the bottom is defined by the front crosspiece, but for me the analogy of the two horizontal plates being glued to their frame counterparts is too strong to resist. Although it is a one-piece bottom, it thus leaves the case free to flex in the vertical plane. From this it must be obvious that gluing the bottom negates the entire idea. Not making the hole but putting in the connecter between the bellyrails that forms the back wall of the toolbox is equally redundant. Indeed, if you glue on the bottom, you can just as well leave out the rear bellyrail entirely, the spine is much stiffer in the x-y plane anyway. It is then only necessary to ensure the vertical integrity of the spine by the use, for instance, of higher lower braces. The Ruckers purposely made a sort of "hinge" between the "console" and the "organ".

The other very important detail is the time and method of the installation of the upper braces. Two things are immediately obvious: the upper braces are even less cleanly made than the rest of the case and they are nailed but only very lightly (if at all) glued.

Although the Ruckers instruments follow their basic designs very closely - comparison even of Johannes and Andreas instruments show remarkable similarity - the placement of the upper braces appears to be haphazard. Glue runs show that the upper braces were in fact installed **AFTER** the soundboard had been glued in. This can also be observed in Dulcken instruments and even in something as apparently unrelated as the 1787 Broadwood Fortepiano N°.69

belonging to Ian Pleeth, London(6). For me, this is much more concise proof of the tradition link between Kirckman and Ruckers than any amount of biographical speculation.

What are the implications? The "haphazard" placement would suggest that they were only carelessly fitted but this certainly does not correspond to their importance. For me, the only plausible answer is that they were cut to fit, perhaps even according to a drawing (there is one on the bottom which is not yet glued on). The nail-holes were predrilled and the braces were then put into the case and tapped back towards the tail until there was sufficient tension on the soundboard. This process would account for the "haphazard" positions of the braces since their final placement would depend on the desired tension - prestressing(7). Thus, the response of the board in the case could be individually adjusted. This prestressing would also help to keep the board from caving in behind the bridge, a problem with almost all modern "Ruckers", and their would-be derivatives, the French. This, too, seems to me to be the only reasonable explanation for Dulckens' double-bentside and his other designs in this direction. Here, Dulcken demonstrates a variation of the same concept: with it he was able to prestress the soundboard to the highest possible level, at the same time keeping it separate from the actual case and retaining some case flexibility. And this leads me to another aspect of the same theme.

It is my decided opinion that no Ruckers were made with more than two registers, one 8' and one 4', although there of course could have been more than two ranks of jacks. The case is too weak for more. Obviously intuitively aware of the concepts of mechanical efficiency and equilibrium, they made their cases to exactly the stress level necessary. This is the reason for their great freedom of sound and the reason that the next generations sought to emulate them. Loading the rim with two 8' is not commensurate with the design and must lead to failure - or changes of design (both of which have been amply demonstrated by modern "Ruckers"). Gluing on the bottom or increasing the number of braces or shortening the scale are just examples of what got (gets) changed.

Another short excursion: it has always been stated that the shortened scale in the ravalé Ruckers was a result of the greater compass. And so it may be, but I honestly don't believe that craftsmen like the Blanchet, for instance, were unaware of the weakness of the design. They shortened the scale purposely to reduce the load. Since the case was entirely rebuilt, there was no reason to necessarily keep the distance between the two 8' bridges. The condition is different in those petit ravale instruments like the Marquis de Sade at Colmar. Because the case was not widened, the geometric conditions remain

intact and even the scale remains pretty much the same. The size, position and number and, in the case of the Marquis, the form of the braces was changed, becoming usually larger and more numerous.

Returning to the order of assembly, it can be shown that the upper braces were installed after the soundboard and that the bottom was put on last. Except for the upper bellyrail, all of these elements serve the same purpose, to establish an equilibrium between the force of the string band (the strings are only springs after all) in both horizontal and vertical planes and the mass and flexibility of the amplifier (the case parts and especially the bridges and ribs are also springs) so that the least amount of input results in the highest possible output. Another way of stating this: they made a stiff case weak in the right places so that it was just able to withstand the strings, maintaining a flat board and a stiff outline but at the same time flexing, but not twisting, along a horizontal line behind the gap, running through the toolbox. Fundamentally, maintaining integrity in the x-y plane while remaining flexible in the z direction. By utilizing the inherently weak bentside-cheek corner in the treble and purposely making a similar weakness in the bass, they were able to make a case with sufficient mass at the ends of the strings, at the same time to a certain degree divorcing acoustically the two ends of the string. Both structurally and tonally, this is the antithesis of the earlier instruments like the Theeuwes and many contemporary Italian and German (Burgundian?) instruments with their continuous soundboards and speaking nuts (Doppelsteg-System). In my opinion, it is illegitimate to attempt to establish more than a tradition of "craftmanship" between the earlier builders in Antwerp and the Ruckers. Similar scalings, especially where they are more or less pythagorean, show only that similar wire was used for a similar pitch. What can be established is that the Ruckers introduced revolutionary concepts into the context of the thick-walled case.

Flexibility and even symmetry can be found in thin-walled cases but the concentration of mass and hence the quality of speech is, by design, entirely different: very much like the human voice - quick to speak and quick to attenuate with a marked change of harmonic development across the ambitus, losing more and more partials as it ascends. This, too, is the antithesis of what a Ruckers does (should do, in the case of replicas).

What I hope to have shown is the priority of the concepts of flexibility and symmetry and equilibrium in the Ruckers design. Concepts that are so sophisticated and advanced that we moderns are only just now beginning to realize what they are about. That is not necessarily a disgrace since the 18th century, although only 100 years after, was just as out of touch. Perhaps even more out of touch because of just this proximity and the primacy of the cartesian world

view. It strikes me as strange that we moderns are quite prepared to accept notions such as number symbolism or religious symbolism that **presuppose a level of knowledge** necessary to recognize these allusions although to view man in an intermediate position between "heaven and earth", of necessity an animal but by virtue of his capacity of reason striving, however unsuccessfully, to become god-like is very foreign to our (enlightened?) way of thinking. Art in general abounds with examples of "wrong" quotations, reversed details and purposeful disfigurement to remind one of this. An example in our context could be the leaving out of one notch on one key-plate of an instrument to demonstrate that no man-made artifact can be perfect (godly). Some have also come to realize the the methods of design were based on divine numbers such as the Golden Section. What we are not prepared to accept is that their way of "seeing"(level of knowledge) enabled them to see the whole instrument at one time, in given conditions, that they were perhaps even able to "see it move". In any case, it is obvious that we have been looking at the wrong things or have been looking too closely.

Modal analysis is a good case in point. It can represent the soundboard (or any other surface) in any given grid and show how it moves for any chosen frequency on a monitor. Or, it can print out the overtone spectrum in percentage of the strongest single partial. With this tool, one can analyze a given, as good accepted instrument and so "define" what a good instrument does. And one can, with some practice, recognize the characteristics of a given builder or type. But all of this is retrospective: it does not tell what to do so that the "right" things happen or even what the right things are, it only shows what this or that type does in this or that isolated window.

In other words, it shows us what a "good" (whose definition?) instrument does when seen out of a given perspective but it cannot tell us if this "doing"[8] is even relevant. Quite apart from the fact that every piece of wood is different which in itself makes quasi-macroscopic analysis questionable, the analysis is of the "deformed" instrument with all the local stresses inherent to this deformation. During the building process we must judge unstressed, undeformed parts in view of their subsequent deformation. In a manner of speaking, we must foretell the future. With this tool, we can actually see it move, but only as an observer, watching a special case, a piece of the past, be it Ruckers or our own. What is missing is involvement.

Up until now so-called scientific analysis has not brought us any closer to a good instrument. Indeed, it actually has proven that each of the parameters it has attempted to isolate either cannot be isolated or that the parameter does not have the (hoped-for) wondrous effect. Although we are too conceited to admit it, this is really

a very great deal. It is exactly this isolation that is detrimental. Our insistence on it shows us to be the unenlightened ones, living in the "dark ages" of reductionism, while modern science is returning to holism. We all know that a case deforms under stress but we have been trained to view this as "bad" and have endeavoured to keep the case from doing so. Instead, like the Ruckers, we should see all the forces involved as "living forces" in balance and that the "deformed" case is the normal desired condition. And there is something much more fundamental to be learned from all of this: that our "knowledge" can become all too easily a filter - a system of preconceived notions that **predetermine** what we see and "understand", effectively keeping us from seeing and understanding

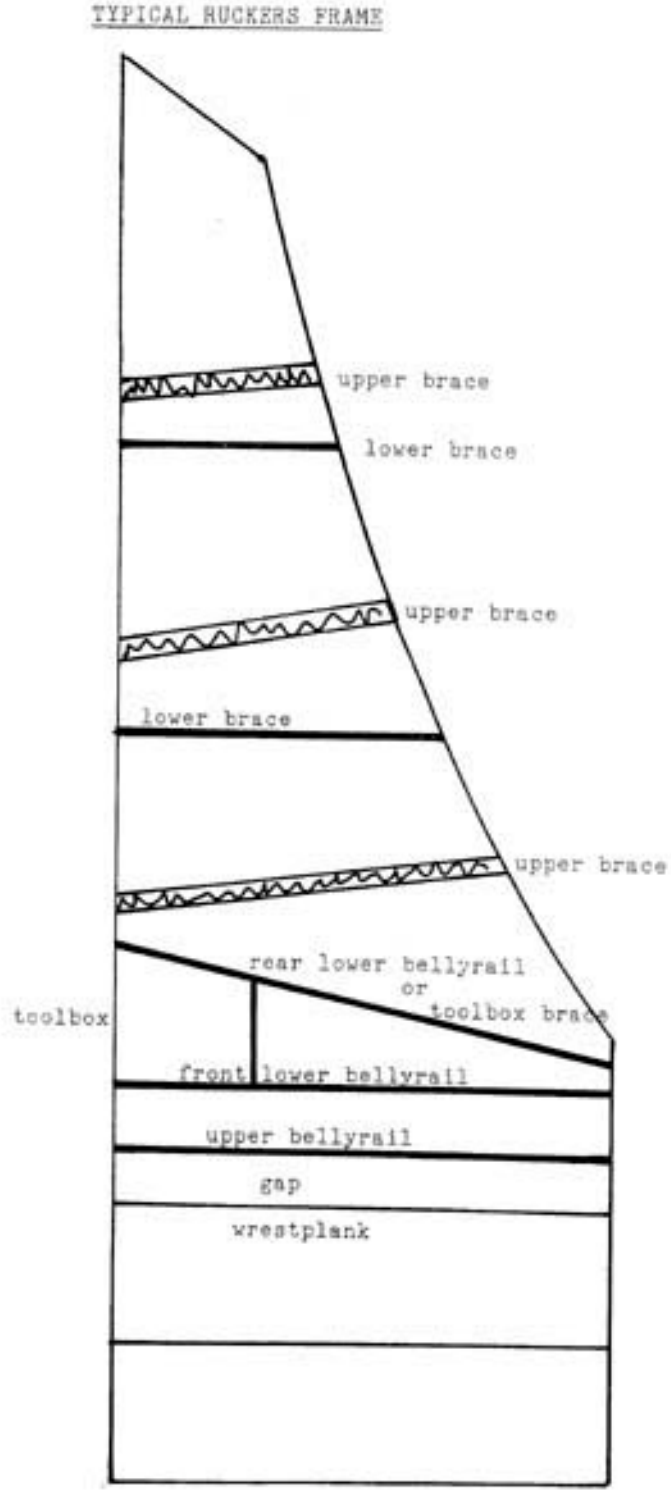
- insight.

At the risk of appearing pompous out of all proportion, I would like to give credit and thanks to those who helped me to find my way: Derek Adlam, Ewald Bauer†, John Challis†, Johann Victor Gruol†, Lewis Hayner, Eberhard Heinemann†, Ernst Leuze, Christopher Nobbs, Richard Rensch, Rainer Schutze†, Jean Tournay, George Balch Wilson. And to Jean Tournay, Chris Clarke, Chris Nobbs and Matthias Griewisch for their untiring and critical listening to my thinking-out-loud.

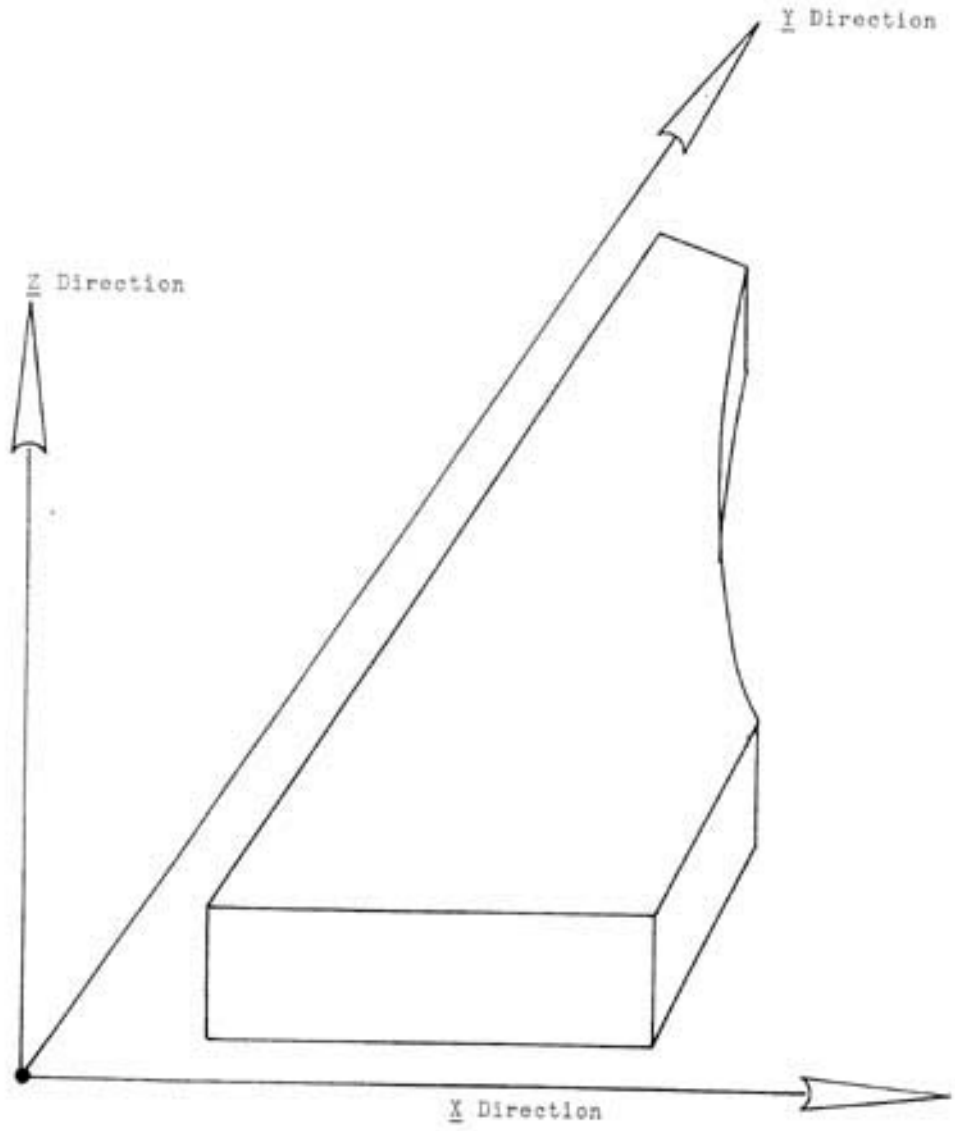
Lauffen, im Mai, 1991

William John Story Jurgenson

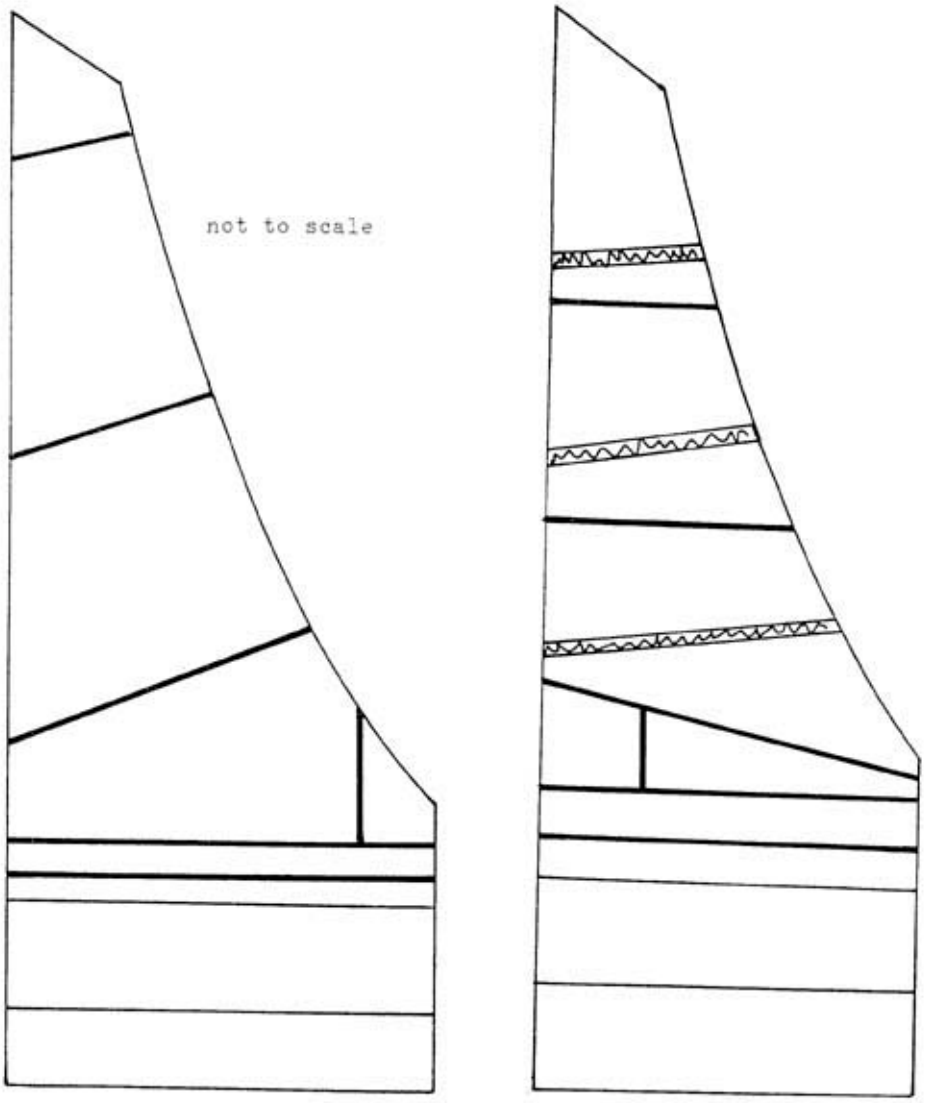
Picture 1: Typical Ruckers Frame



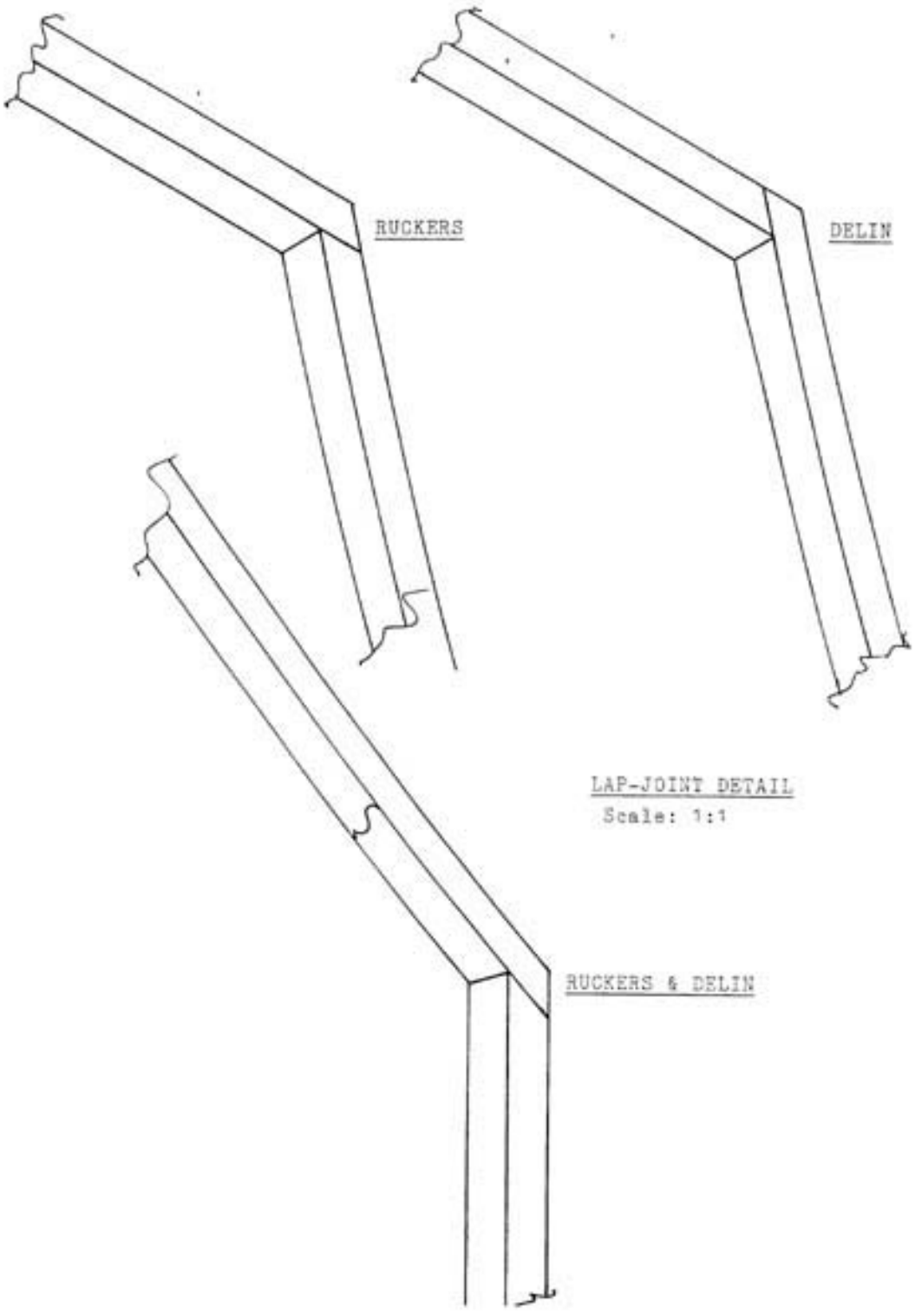
Picture 2: Mathematical Coordinates



Picture 3: Comparison of frames of A. Ruckers, 1640, Namur and Albert Delin. All of Delin´s braces are 17x110mm; Ruckers lower braces are 18 or 19x76mm but this upper bellyrail is 16x130mm and the upper braces are of the same thikness, 17mm but of different widths: 35, 41 and 33 mm from front to back.



Picture 4: Lap point detail



GLOSSARY

1. Upper bellyrail: the piece behind the action onto which the front edge of the soundboard is glued.

2. Lower bellyrail(s): The first and second lower braces behind the keyframe(s); O'Brien calls the rear lower bellyrail the toolbox brace.

3. Liner: The battens glued to the case walls onto which the soundboard is glued.

4. Upper brace: A batten fixed to the underside of the liners.

5. Keycheek(s): Used here to designate the doublings of the case walls to either side of the keyboard, of the same height as the lower bellyrail and butting against this.

6. X, Y and Z directions: Mathematical functions; x and y are functions of the two-dimensional plane, z is the third dimension.

7. Stringband: the unit of all strings together.

8. Trenail: Also treenail, a conical wooden peg.

APPENDIX I

O'Brien, p.73:

"The initial reduction was probably carried out using a plane. The final thinning and finishing of the soundboard was, however, done with a furniture scraper. A scraper works more slowly than a plane, removing only a small amount of wood with each stroke, and is very useful in an accurate finishing of the soundboard. Furthermore, the scraper is virtually insensitive to the direction of the grain of the wood, so that the soundboard cannot be damaged in the final thinning, as might happen when accidentally planing against the direction of the wood.

"Used on a softwood such as spruce, a scraper produces an immediately recognizable effect. Although removed to the same extent as the harder summerwood in planing and sanding operations, the springwood, because of its soft spongy nature, is slightly compressed in the scraping operation. Left to 'relax' for a day or so, or if dampened slightly, this compressed wood rises above the summerwood, and stands proud in ridges along the soundboard. This slightly ribbed texture is one of the most distinctive features of a genuine Ruckers soundboard.

"Before the soundboard was painted, it was sized to fill the porous wood and to prevent the paint from running away along the grain of the wood. The material used as a size is not known, but was probably something readily available in the workshop such as diluted glue or shellac. The subsequent chemical breakdown of the organic material in the size, together with the discoloration of the wood itself, has contributed to the present mellow amber-brown colour of the surface of the Ruckers soundboards."

op.cit.p.l01:

"As with the virginals, the soundboard wood was probably initially reduced in thickness using a plane and then the final adjustments were made with a scraper. The final finishing using a scraper gives the characteristic ribbed texture of the soundboard surface in Ruckers instruments, and in those of a number of other sixteenth- and seventeenth-century Flemish makers (see pp. 73-4).

"After the final tapering to thickness, the upper surface of the soundboard was sized as a preparation for the soundboard painting. The material or materials used to size the soundboard have become a rich golden-brown colour and have produced a fairly shiny surface. The coloration is probably the result of the degradation of the organic matter in the size preparation. It seems likely that the material used was a simple, easily accessible material commonly found in the workshop, and not a complex special preparation. Gum arabic,

egg white ("lair), or varnish might have been used, but most likely and readily available materials were thinned shellac, or a glue size made by thinning down the glue used for gluing the instrument together. Since the surface of the soundboard is not sticky when touched by the moistened finger, it seems likely that the final size was not glue or gum arabic, although the ribbed texture of the surface seems to indicate that a water-based size was applied initially. Perhaps the board was first gluesized and then, when this had dried, it was given a final coat of thinned shellac."

Much can be said for the use of the scraper and it has a long tradition with luthiers as well as with ebenists. These are applications in which the use of a plane is usually no longer possible: contoured surfaces like the belly of a violin or very heavily figured wood such as burl veneer. These are allied trades, albeit usually with a higher level of workmanship than is to be found in Ruckers harpsichords. The level of workmanship to be found in Ruckers instruments is one of quick but competent carpentry and it is not at all commensurate with the fussyness of the scraper. To my mind, this is the most important "evidence". The "ribbed surface texture" can certainly point to the use of a scraper but a dull plane or even a sharp one whose cap is too close to the cutting edge will produce a similar surface. Sandpaper, although quite extraneous in this context, can also do so. The ribbed surface does, however, point to one very important thing: the soundboard was definitely sized with an aqueous medium. An alcohol-based medium such as shellac does not raise the grain in the described manner. Besides the above mentioned glue and gum arabic, there is also the possibility of casein or waterglass. All of these are painting mediums and are to be found as a size both in painting and in instrumentmaking, even where painting is not involved. Different schools of violin-making have used each of these separately or even one on top of the other. Sacconi[9] states that Stradivari used waterglass as a sealant, applying a gum arabic size onto that. Tiroleans such as the Klotz used glue and in Bohemia as well as Venice there is a tradition of casein as a base coating. I have found glue size on an Italian harpsichord of about 1600 as well as on several south German clavichords and virtually all of the south German and Viennese pianos which I have restored. Apart from the action, every part, inside and out, of the 1814 Nanette Streicher at Stuttgart is sized with glue. Organbuilders did the same. It has been my own experience that sizing prior to assembly helps to stabilize the wood dimensionally and makes the gluing itself much easier. I size all sufaces of all pieces, except perhaps very narrow ones such as soundboard joints, prior to gluing, leaving them to dry sufficiently, usually overnight, sometimes for days or even weeks. In this way the wood reacts much less to the moisture of the glue during the final

gluing process. It also changes the elasticity of the soundboard, rendering it more homogeneous and that would correspond to Grant O'Briens statement about the action of the board (see footnote 8). Glue sizing makes it possible to increase the weight and even the stiffness without increasing the thickness of the soundboard.

Apart from that, Remy Gug[10] refers to the use of "salts" such as sea salt, alum or vitriol for the preparation and "hardening" of wood and to one obscure source by Bernard Palissy mentioning that "salt" "donne ton à toutes choses - I1 aide à la voix de toutes choses animées, voire à toutes espéces de métaux, & instruments de musique"-'und gibt allen Dingen Klang - Es fodert die Stimme aller Lebewesen, ja sogar aller Sorten Metalle und Musikinstrumente'.

Whether or not the presence of salt crystals in the wood of old instruments can be attributed to this or perhaps to a sizing with waterglass (also natrium or potassium based) remains to my knowledge to be proven. For my purposes it is not important. What is important is, as I have stated above, the use of an aqueous medium as a sealant which for that reason could not have been smoothened after drying, thereby partially removing the surface texture. For this reason, it seems unlikely that shellac was applied directly onto the size although I, too, think it highly probable that it was used. One other reason can be stated against shellac as a paint base: one cannot write on it with inks like sepia, at least as long as they are alcohol solutions. However, it was and is standard practice to use a very thin shellac as a fixative and protective coating for tempera or gouache, regardless of their painting medium. It gives the paint a gloss it does not have itself, sealing the surface and making it easier to clean. It also lends a translucence and depth to the colors. Therefore, the presence of shellac is indeed highly probable, but not as a size.

Summing up, the ribbed surface does not necessarily prove the use of scraper and I for one do not think that its use is very probable. It does prove the use of an aqueous medium as a size, probably glue, onto which the painting was applied. This was afterward fixed with a thin shellac, probably after the board had been installed, together with the whole case. Indeed, since the arabesques were done after the soundboard had been installed, the fixative must have been applied afterward as well [11].

APPENDIX II

O'Brien, p.l00: "The Ruckers apparently paid a great deal of attention to the thickness of their soundboards. After the planks were glued together, the soundboard was carefully and accurately planed to thickness to give it the correct flexibility and weight in each section of its area. Fig. 6.5 shows the thickness of the soundboard of the 1640b AR double-manual harpsichord. The soundboards of Ioannes Ruckers harpsichords are even more strongly tapered, being about 4.3mm thick under the tenor part of the bridge and less than 2mm in the treble [8].

"8(). The difference in the thickness of the soundboards in Ioannes and Andreas harpsichords may be the reason that Andreas often used a stiffening bar glued to the bentside liner to increase rigidity of the soundboard there, since, being too thin, it was otherwise too flexible in the area of the stiffening bar."

Obviously, the "stiffening bar"(I like the term apron) is to stiffen the soundboard: but, since he used it repeatedly, the above would seem to imply that AR didn't know what he was doing. From what I have written it must be understandable that I cannot buy this.

Comparison of the bentside curves of IR and AR instruments shows that IR had a tendency to follow the bridge more closely, sometimes being closest to it somewhere near the middle of its length, not far from c^2. ARs bentside is farthest from the bridge at this point. Clearly there is some design intention here. By making the bentside straighter it is stiffer and the would-be disadvantage of the too wide area of soundboard can be turned into an advantage: with the apron, he can individually control the actual width and the vocal character of the tonal registers. As well, he can locally increase the mass of the liner, thus locally enabling the tone to sustain longer. This can be seen in the muselaers where the apron is, as a matter of course, present and in non-Ruckers instruments as well. The Delin at The Hague has one, for instance, although here it could be understood as a corrective measure. This is the eeriest extant instrument from Delin in which the soundboard is not at an angle to the spine. If he kept all other parameters the same except for direction of the grain, then the soundboard would, indeed, be too thin in the tenor. However the very irregular thicknessing along the bentside liner in the 1711 Donzelague or Dulckens feathered additions to the underside of the soundboard along the same(leaf springs?) seem to indicate a clear intention toward an uneven vocal character in the tonal registers. And Donzelague is much closer to Ruckers than one would at first assume.

At the risk of beginning(?) to be boring, I repeat, there is more to it than meets the eye. Let me quote a good friend:

"As I think you know I have always believed that the best of the old makers knew what they were doing and how to achieve what they intended, even if they would not have been able or even have found it desirable to express this in a modern way."(ll)

APPENDIX III

O'Brien, p.222: "...The dampers in Ruckers instruments have the typical 'mouse ear' shape, which presents an angled edge to the string, and maintains its shape and position because of its conical form. ... In harpsichords, when a register is disengaged, the dampers come away from the strings and leave them undamped and free to vibrate, or to be engaged by another set of jacks. (As mentioned in Chapter 6, it is essential in Ruckers double-manual harpsichords that the dampers leave the strings entirely when the register is disengaged. With only one set of strings used in common by both keyboards, the dampers of the jacks belonging to one manual would otherwise cause interference when the jacks of the other manual were in use...)

"In those instruments with two set of unison strings, if the player disengages one of the 8' sets of strings, it is left undamped while the other set of strings is sounding. But because the sets of unison strings are physically very close to one another, and both are sharing the same bridge, the acoustical coupling between the two choirs is very strong. What this means is that if one of the sets of strings is disengaged and left undamped, then it will vibrate in sympathy with the set of sounding strings. ... Duarte, writing to Huygens in 1648 (see Appendix 17), '... But they have a better tone because the unused string which is not played moves of its own accord, producing such a sweet quiet tone through the principal sound, which does not occur when all three strings are play'd together.'

"... Although the classical way of cutting the dampers is much more efficient, virtually all modern builders use flag dampers with a horizontal lower surface. Jacks with this type of damper tend to be thrown back up by the heavy bass strings, or the shape of the dampers becomes distorted and the dampers lose their effectiveness. But even if less efficient, these dampers always remain in contact with the strings when the register of jacks is disengaged. The use of this type of damper seems to arise because most modern musicians are also unable to accept the sound of unplucked strings vibrating in sympathy, even though the problem really only arises in single-manual harpsichords with two 8' registers. ..."

Again, I am very grateful to Grant O'Brien for making such an unusually strong case for the <u>undamped</u> unused string. As he has made sufficiently clear, the 'mouse ear' damper must be cut this way and it is not restricted to Ruckers or even to the seventeenth century. Delin - again - used them as well on all of his extant harpsichords which are exactly of the type in which "the problem" arises: single-manual with two 8' sets of strings. The sympathetic resonance greatly aids the buff stop on his instruments which works on the longer left string and I think that Pierre Donzelague also put his buff

on the second manual which plucks the longer string in the 1711 instrument for the same reason: the lower-manual 8' can be disengaged, thus undamped. Donzelague used flag dampers. So did Dulcken, but his string centers are so close together that the dampers cannot possibly rest on the strings when the jacks are disengaged, regardless of what type they are.

And this is the point I think must be made: flag dampers **do not** automatically mean that they always must rest on the strings or that they must be straight on the lower edge. It is less a question of cutting style and more one of material. Modern boxcloth is too firm for the purpose, it cannot deform softly enough to the string and this is the reason that dampers made from it have a tendency to bounce off the bass strings. Besides, for the same reason it damps too radically, either making noises of its own or producing an ugly suddenness. Contemporary literature points out that the musical quality is equally defined by the beginning and the end of the tone as well as the silence between the tones. Soft cloths such as sometimes can be found on old key frames make the best dampers, those which don't bounce, quitely silencing, not strangling the tone.

Flag dampers therefore cannot mean a different aesthetics than 'mouse ear' dampers. Luckily, 'mouse ear' dampers show us what is really intended. Flag dampers can be cut to work in the same manner and in my opinion flag dampers were more generally used for the simple reason that they were easier to make. Certainly not because they are capabIe of making 'unmusical' sounds.

Footnotes

1. Another Roadside Attraction, Tom Robbins 1971 p3

2. Through the Looking-Glass, Lewis Carroll, J.M.Dent & Sons, London 1871, 1954, p.l22

3. Three Centuries of Harpsichord Making, Frank Hubbard, Harvard University Press, 1965

4. RUCKERS, A harpsichord and virginal building tradition, Grant O'Brien, Cambridge University Press, 1990

5. "Malhorn, Model und Patrone" by Ulrich Schießl in MALTECHNIK, Juli 1981, Callwey Verlag, Munich

6. private communication from Christopher Nobbs, London, the restorer of this instrument, 1991. And who has also observed the same in the 1773 Tschudi and Broadwood harpsichord N°686. It should be remembered that Tschudi supposedly was trained by H. Tabel, who claimed to be the rightful heir to the "Ruckers Tradition".

7. I am greatly indebted to my good friend Rainer Schuetze for his insistence on prestressing. Although I think he viewed this as a shop secret and never actually told or showed me how it was done, he was quick to reinforce my ideas.

8. O'Brien, opus cit. p.l00: "...Preliminary research on the vibrations of harpsichord soundboards show clearly that the soundboard is acting as a acoustical radiator and not an acoustical resonator. This means that the soundboard is acting as a whole like a large piston driving the air up and down. In this way the soundboard converts the energy of vibration of the string into sound energy around the instrument. **The extent to which the soundboard area breaks up into small sections with nodes and antipodes is insignificant**.(bold face print mine W.J.) Therefore since the soundboard is not a resonating system, the velocity of travel of the waves in the soundboard is not an important acoustical factor, and hence the difference in the velocity of a sound wave in the radial and tangential directions in the soundboard wood is not important." I am very grateful to Grant O'Brien for taking this very important stand, too much nonsense of the pseudo-scientific variety has already been published.

9. Il Segreti di Stradivari, Simone Sacconi, Libreria del Convengno, Cremona

10. "'Gesalzenes Holz' im Instrumentenbau" by Remy Gug in Das Musikinstrument vol. l-2/1988, pp. l98-202 Verlag Erwin Bochinsky, Frankfurt am Main

11. Private communication from Derek Adlam, Welbeck, Nr.Worksop, Nottinghamshire, 1991: "...If proof is needed of the order in which soundboard decoration motifs and arabesque / borders were painted, then the 1638 Edinburgh transposer should confirm. A number of the blue lines cross the stems of flowers. Unfortunately the blue paint in this instrument proved to be more fugitive than the rest, suggesting to me a different medium, so casein for the flowers and perhaps gum arabic for the smalt."

Required Reading

Zen And The Art of Motorcycle Maintenance, Robert M. Pirsig, William Morrow & Co, New York, 1974

Further Bibliography

1. "A propos d'Albert Delin" by Jean Tournay in "La Facture de Clavecin du XV au XVIII Siècle", Université Catholique de Louvain, 1980

2. Archives Dulcken, Jean Tournay, Schneider Verlag, Tutzing, 1987

3. Gödel, Escher, Bach: an Eternal Golden Braid, Douglas R. Hofstadter, Basic Books, New York, 1979

4. Flatland, Edwin A. Abbott, Dover Publications, New York, 1952

5. i six nonlectures, e e cummings, Atheneum, New York, 1962

6. I Remember America, Eric Sloane, Funk & Wagnalls, New York, 1971

7. a Museum of Early American Tools, Eric Sloane, Funk & Wagnalls, New York, 1964

8. Diary of an Early American Boy, Eric Sloane, Funk & Wagnalls, New York, 1965

9. The Elizabethan World Picture, E.M.W.Tillyard Chatto & Windus, 1943; Penguin Books Ltd. 1972

10. Die Akustik des Cembalos, Edward L. Kottick, Kenneth D. Marshall & Thomas J. Hendrickson in Spektrum der Wissenschaft vol.4/91, this is the German edition of Scientific American in which the article was originally published 1990.

11. Modalanalyse eines Cembalos, D. Stehle in Das Musikinstrument vol.38/1989, pp.42-43

12. L'Oreille et la Vie, Alfred Tomatis, Editions, Robert Laffont, S.A. Paris 1977 et 1990

Epilog

THE ROAD NOT TAKEN

Two roads diverged in a yellow wood,
and sorry I could not take both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that, the passing there
Had worn them really about the same,

And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood,
and I-I took the one less traveled by,
And that has made all the difference.

from Mountain Interval by Robert Frost, Holt, Reinhart and Winston, New York 1916