



# The Wire Connection

By Andrew Hartig

## Buying a Wire-Strung Instrument

### Introduction

When I first decided to add cittern to my repertoire and purchase an instrument almost fifteen years ago, I had no idea what qualities (aside from price!) would make a desirable and quality wire-strung instrument. Since that time, I have had many opportunities to perform, research, discuss with luthiers, and even build my own instruments, and discovered some of the most significant features of these instruments. For the uninitiated, it might be easy to assume that a cittern is just an early type of flat-backed mandolin or that an orpharion is just a flat-backed wire-strung lute. However, this is no more true than that a lute is just a round-backed guitar! What follows is a list of some of the significant features to consider when buying or building a wire-strung instrument.

### Soundboards and Backs: *When Flat is Not Flat*

The tops and backs of citterns, *Cithrinchen*, and English guitars, and the backs of bandoras and orpharions all appear to be flat but are not. The musical historian and theoretician Mersenne probably described this arching best when he described the bandora thus: "As for the back, it is flat, or at least it is not so convex as [it is on] the lute."<sup>1</sup> These archings are subtle but important to the overall structure and sound of these instruments.

The slight arching found on the backs of these instruments is usually found in both the lateral and longitudinal directions, creating a shallow "doming" or convex "dishing" of the back. Sometimes, as in the case of carved citterns and *Cithrinchen*s, this is carved directly into the back much like on a violin, including the "guttering" around the edges, which assists the back in resonating and allows it to function in some respect like a speaker cone. In other cases, the back is made up of multiple strakes, which are bent and glued on a form (in much the same manner as for a lute). This arching of the back is important for creating some structural stability to the instrument and possibly even helps to focus the sound and assist projection.<sup>2</sup>

On instruments with floating bridges (such as on the cittern, *Cithrinchen*, English guitar, and members of the viol and violin families), the soundboard arch plays an important role in counteracting the downward pressure of the floating bridge. The floating bridge creates sound by "pumping" the soundboard: the strings run directly over the bridge and attach to the end of the instrument, creating a direct downward pressure on the bridge and, therefore, the soundboard. By contrast, this arch is not present—nor necessary—for lutes, bandoras, or orpharions,<sup>3</sup> which all have their bridges attached directly to the soundboard, and in which the sound is produced by

"rippling" or "rocking" the soundboard via the torque exerted by the strings attached to the bridge. While surviving *Cithrinchen*s seem to be unique among plucked instruments in having their tops fully carved as on violins, in most cases the relatively small soundboard arching necessary for plucked instruments with floating bridges is produced by simply bending the soundboard wood laterally over arched braces.

### Peg Heads and Shafts: *Size Does Matter...*

Wire has a much greater density than gut,<sup>4</sup> which is why note-for-note wire strings are thinner in diameter than gut strings. This same quality makes wire far less stretchy than gut strings, meaning that wire strings come up to pitch far faster than gut strings do. Because of this difference in the way the strings behave when tuned, pegs for wire-strung instruments are historically different from pegs for gut-strung instruments. Or, to put it another way, not just "any old peg" will do!

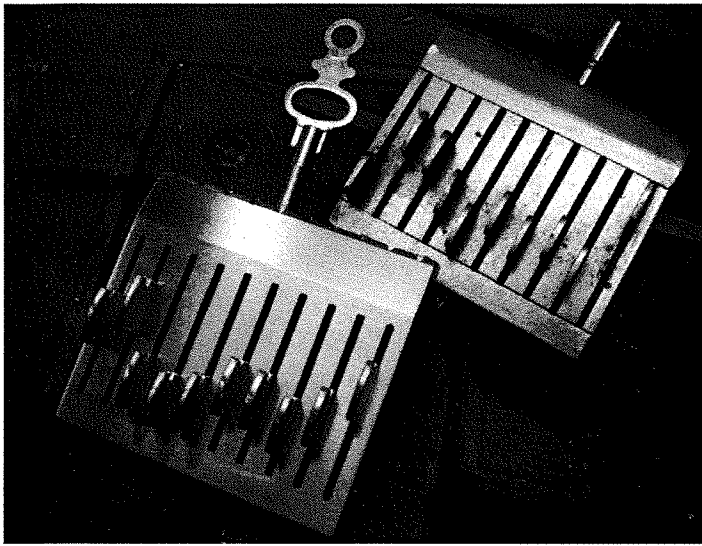
When looking at surviving historical wire-strung instruments, one discovers that in most cases the heads of the tuning pegs are larger than they are on those for lutes. Whereas lutes usually have peg-heads around 15-16 mm (5/8") wide, wire-strung instrument peg heads often approach the neighborhood of 21-22 mm (7/8"), on average. This greater peg head size allows for greater leverage (and hence greater control) when tuning, giving one greater ability to fine-tune.

A second factor to consider is the size of the shaft of the peg. A peg with a large diameter shaft will create a larger excursion of the string over the course of a single revolution than will a peg with a smaller diameter shaft. Wire-strung instruments, for the tuning reasons mentioned above, do better with pegs that not only have larger peg heads but have thinner shafts.<sup>5</sup> To illustrate this point, consider a theoretical peg shaft diameter of 10 mm versus one of 5 mm. To calculate the total excursion of the string over the course of one rotation, one simply calculates the circumference of the shaft using the formula  $\pi(D)$ . Using this formula yields the following (rounded) results:

$$\pi(10) = 31.4 \text{ mm}$$

$$\pi(5) = 15.7 \text{ mm}$$

From this one can see that a shaft that is twice the size in diameter has twice the string excursion per revolution of the peg. Or, seen another way, each increase of 1mm in diameter causes the string to travel 3.14mm more per full peg rotation, which significantly decreases one's ability to fine tune—especially with wire strings that



Preston tuner [right] and modern copy by Martina Rosenberger [left].  
Photo courtesy Martina Rosenberger.

come up to pitch more readily. For this reason, thinner peg shafts are preferred (or thick ones should be avoided).<sup>6</sup>

Some later instruments, notably the English guittar, handled the issue of fine tuning through the use of a “watch-key” tuning system instead of pegs. [See photo.] In this system, each string is looped onto a post that travels up and down a finely threaded screw turned by a watch key. The post in this way moves very gradually along each screw, allowing for fine tuning. Some guittars even used early geared tuners (similar to our modern guitar tuners) that use the same concept of converting peg rotation into a smaller movement of the tuning post.

### Frets and Scallops: *Fixing Fishy Intonation*

Another significant thing that sets wire-strung instruments apart from gut-strung ones is the issue of frets. Since wire is so much harder than gut, wire-strung instruments have always used some sort of metal fret, as gut frets would wear through too quickly. While lute players may set their own frets and therefore intonation, wire-string players must rely upon the placement of the frets by the builder, which, depending upon the ability of the luthier, can present its own pitfalls.

The first issue is one of general intonation. While frets may be set to theoretically correct positions, the placement of the nut and bridge will be slightly different than the theoretical or calculated positions because the strings stretch under the pressure of the finger when fretted. For instance, Peter Forrester has noted that for historical citterns the nut is usually 1-2 mm closer to the bridge, and the bridge 2+ mm further from the nut than their theoretical positions would dictate.<sup>7</sup> In this way, players of fixed-bridge instruments are completely at the mercy of the maker for proper intonation, so time spent by the builder to make sure that the instrument does indeed fret in tune is critical.

On the other hand, instruments with floating bridges allow the player some degree of adjustment in the intonation by changing the precise location of the bridge, so this is well worth experimenting with. In regard to surviving historical instruments, luthier Andrew

Rutherford notes that “Some old guittars have very eccentric fret positions. You have to move the bridge around to find the best location, and sometimes the open strings need to be a bit out of tune in order for the fretted strings to be in tune. If the frets look equally spaced, that’s less of a problem.”<sup>8</sup>

A second consideration for the buyer is the type of fret used. Surviving citterns and orpharions all use “scalloped” frets wherein a strip of brass backed by a wedge of hard wood is set flush with the surface fingerboard,<sup>9</sup> and the wood remaining between the frets is removed in order to create a shallow recess or scallop. On the other hand, later instruments like the English guittar use frets much closer to our modern “crown” frets and do not have any scalloping.

While modern frets could be used as a cost-saving measure on earlier instrument copies, there are possible reasons to consider using wedge-backed frets with scallops. Peter Forrester has previously described some of the different scallop types used on historical instruments.<sup>10</sup> [See illustration.] While the third type, used from the end of the 16th century onward, seems to function in the same manner as modern fretwire, the two other types suggest the



Historical fret scallops. Illustration courtesy of Peter Forrester

possibility of having greater control over the intonation by exerting more finger pressure to change pitch. Regardless of which type of scallop a maker may have used, it is important to note that scallops should be neither too shallow nor too deep. Historical instruments use scallops in the 0.5 to 1.5 mm range. Scallops that are too shallow require the player to exert excessive force in order to fret without buzzing, while scallops that are too deep can cause any inadvertent finger pressure to pull the strings out of tune.

### Temperament: *Not All Tuning Systems are (or Should Be) Equal*

A related consideration to fretting is the type of temperament employed. While many lute players today use equal temperament, the higher harmonics of wire strings sound more out of tune than gut strings when equal temperament is used. Historical citterns used meantone temperaments, generally approximating 1/5 or 1/6 comma. The same was probably true for orpharions and bandoras.<sup>11</sup> In other surviving wire-strung instruments, some sort of just intonation appears to have been used, at least for some frets.

Although more studies need to be done to understand just how early wire-strung instrument makers went about setting fret locations,<sup>12</sup> the modern buyer at least needs to be aware that there are differences in fret placement. For players anxious about playing in a meantone temperament or for builders who are anxious about setting frets in one, perhaps Peter Forrester’s advice can be of some reassurance: “[A]ny movement of a fret position from equal temperament towards meantone results in better chords.”<sup>13</sup>

### Conclusion:

While the above list is not exhaustive, I hope that one can begin to see some of the important features of wire-strung instruments. It is important to be knowledgeable about these differences when buying (or making) an instrument, as these small but important

changes have a significant effect upon the way in which the instrument both sounds and plays. So whether you are buying an historic or a newly built instrument, be sure to consider arching, pegs, and fretting.

<sup>1</sup> “Quant à son dos, il est plat, ou du moins il n'est pas si convexe que celui du Luth...” Mersenne, Marin. *Harmonie Universelle: Livre second des Instrumens à cordes* (1636), Proposition II, p.53. Text available on-line: [http://www.chmtl.indiana.edu/tfm/17th/MERHU3\\_2\\_TEXT.html](http://www.chmtl.indiana.edu/tfm/17th/MERHU3_2_TEXT.html)

<sup>2</sup> Suggestion from Peter Forrester (private communication).

<sup>3</sup> Though it should be noted that the instrument in Frankfurt Historisches Museum, believed to be by Tielke, does have a lateral soundboard arch; however, this causes the bridge to be much higher under both the treble and bass courses, exerting much more torque on the soundboard than is typical for fixed-bridge instruments. It is not known why this arching was used. For some additional information on this instrument, see Segerman, Ephraim, Comm. 407, “Orpharion news.” *FoMRHI* No. 27, April 1982. Available on-line: <http://www.fomrhi.org/pages/fomrhi-027>

<sup>4</sup> Wire is on the order of 5-6 times denser than gut. A brief comparison of approximate densities: nylon: 1.12 g/cm<sup>3</sup>; gut: 1.36 g/cm<sup>3</sup>; iron: 7.8 g/cm<sup>3</sup>; brass: 8.6 g/cm<sup>3</sup>.

<sup>5</sup> One note of caution: A thinner shaft is liable to break if too thin and can even twist around its center axis when turned. This can be mitigated to some extent by using a harder wood for the peg.

<sup>6</sup> Peter Forrester has collected a sample of peg sizes based on the largest diameter of the largest peg holes in some historic wire-strung instruments. Peg shaft diameter for these range from 6.0 mm for citterns to 7.4 mm for the Campi ceterone. Since the shaft continues to taper as it makes its way into the pegbox, the actual shaft diameter where the string crosses it is less than the above values.

<sup>7</sup> Some of this information is explained in Peter Forrester’s notes to “What makes a good cittern?” in *Lute News* 57 (April 2001), pp.14-15, also available on-line at <http://cittern.theaterofmusic.com/articles/good.html>

<sup>8</sup> Rutherford, Andrew. “Re: EGs.” Private communication. 10 June, 2010.

<sup>9</sup> The hard wood wedges serve two purposes: One is to bear the brunt of the force of the wire so as to minimize fret wear; the second is through color-coding to indicate diatonic note positions. For more on this topic, see my column, “Who’s Afraid of the Diatonic Cittern?” *LSA Quarterly*, Fall 2011.

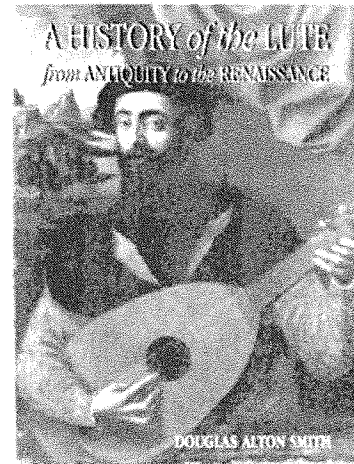
<sup>10</sup> Forrester, Peter. Comm. 466, “Some notes on cittern fingerboards and stringing.” *FoMRHI* No. 32, July 1983. Available on-line: <http://www.fomrhi.org/pages/fomrhi-032>

<sup>11</sup> Since there are very few surviving instruments, there is very little data to go on. The Palmer orpharion uses some sort of meantone temperament approximating 1/6 comma or a mix of meantone and equal, (see the Fretting section on <http://www.cittern.theaterofmusic.com/old/palmer.html> for more details). The small orpharion in the Frankfurt Historisches Museum currently has something close to equal temperament, but it appears that the current fretting is not original. The Rose instrument at Helmingham Hall, which has a more “even” fret spacing, uses some sort of meantone temperament, possibly 1/8 comma.

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