DOUBLE YOUR PLEASURE – OR DOUBLE TROUBLE?

By Fred Reinagel

This article presents an alternative way to set up the viol that dramatically improves its rendition of polyphonic consort music. It is based primarily upon the author's practical experience, empirical observation and personal opinion, rather than by justification through scholarly parsing of historical treatises and analyses of iconographic evidence.

The evolution of musical instrument design clearly shows that new technologies and methodologies were and are continually introduced and accepted to improve the esthetic result. Keys were added to woodwinds, valves to brass instruments, and pedals to tympani and harp. In the case of the viol, such improvements include the addition of the sound post, metal overspinning of lower strings, screw bow-hair tension adjustment, the addition of a seventh string, and most recently, the availability of "historic"-appearing machine pegs (see www.pegheds.com). So, it would be hardly revolutionary to propose tying a few additional frets around the neck of the instrument (see footnote: "Doubling vs. Splitting), in order to substantially improve the sonority of major triads. It is not widely known, but a world-preëminent English viol consort regularly uses this technique (which may suggest why they chose their name.) It is one of the reasons they always sound so good.

Thus, this article concerns frets, the number of them, and their placement. The traditional number is seven, and the common placement is exactly one-twelfth octave between frets (equal temperament). My guess is that this is a hangover from the viol's early use in monophonic modal music, and from the fact that later melodic compositional developments requiring chromatic tones could obtain both flats and sharps from the same fret. However, for the performance of polyphonic consort music featuring extensive use of triadic harmonies, this scheme poorly serves the esthetic ideal of pure intonation so prized by the Renaissance ear. We know of this historic preference from the well-documented systems of keyboard instrument tuning in the 16^{th}-18^{th} centuries. Although perfect fourths and fifths (and, therefore, the major second difference between them) are actually quite good in equal temperament, major thirds and sixths are much too wide. As it must necessarily follow, minor thirds and sixths are much too narrow. The only reason that modern ears find equal-tempered sonority acceptable is because we have been "ear-washed" from infancy by its ubiquity. Although we may have learned to tolerate the harmonic insults imposed by equal-tempered thirds and sixths, the slightest drift in tuning (an unavoidable phenomenon with our beloved instrument) will easily push chordal harmonies over the edge into the realm of dissonance. This explains why many listeners complain that viol consort music often sounds out-of-tune.

At this point, I wish to set down a few ground rules for the rest of this article. Since I am essentially advocating the abandonment of equal temperament in favor of some version of meantone temperament for viol tuning, "enharmonic" tones are no longer the same pitch (e.g., $G_{\sharp} \neq A_{\flat}$), and therefore "enharmonic" intervals are not equivalent (e.g., major

third ≠ diminished fourth). I will limit the range of accidentals to single sharps and flats. In a related manner, I will limit the modification of intervals to singly augmented or diminished. When I speak of an upper or lower fret, I am referring to its pitch, not its height above the floor. And finally, I am not addressing the option of slanting frets. That technique produces variations in a given interval's size depending upon string position, and has minimal effect on the middle strings where it is often most needed. On top of that, slanted frets are not stable – they tend to loosen and/or straighten themselves.

Let us consider the fret positions in order. The first fret can be placed to produce either an augmented unison or a minor second above the open string. The interval between these two placements is called a diesis, and increases from zero for equal temperament to very nearly one-fifth of a wholetone for quarter-comma temperament, which is the maximum degree of practical use. The table below shows the tones produced by both fret placements for various instrument tunings. In this and all subsequent tables, pitch increases as the table is read from top-to-bottom, and from left-to-right. The highest string is omitted because it is a duplicate of the sixth string, and a possible seventh string is omitted because it is also a duplicate of another string.

INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Augmented Unison	D♯ G♯ C♯ E♯ A♯	G♯ C♯ F♯ A♯ D♯	A♯ D♯ G♯ B♯ E♯	C♯ F♯ B D♯ G♯
Minor Second	E♭ A♭ D♭ F B♭	A♭ D♭ G♭ A♭ E♭	B♭ E♭ A♭ C F	D♭ G♭ C♭ E♭ A♭

We may make two observations from this table. First, for a given tuning, no tone is the same as any open string. This means that its tuning is not forced by having to be a unison or octave of any open string. Secondly, there is a very good chance that in a given piece, both placements will have to be available. Examples are C♯ and F in the D tuning, and F♯ and E♭ in the G tuning, etc. This argues strongly for doubling the first fret, a practice already adopted by a large number of present-day viol players (by which they have already abandoned equal temperament). This suggests that learning to place the finger on the correct fret of a doubled pair for the required note is not a very difficult skill to acquire.

Next, let us consider the case for the second fret position. This fret can be placed to produce a major second or a diminished third above the open string. The table below shows the tones produced by these fret placements for various instrument tunings.

INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Major Second	E A D F♯ B	A D G B E	B E A C♯ F♯	D G C E A
Diminished Third	F♭ G♭ C♭	C♭ F♭	C♭ F♭ D♭ G♭	F♭

The observations to be gleaned from this table are that the tones produced by the major second placement are necessary for all compositions. The other fret placement would be needed for only extremely rarely encountered accidentals. This would argue strongly for not doubling the second fret.

Continuing with the third fret position, the possible placements above the open string are augmented second and minor third. The table below shows the tones produced by these fret placements for the various tunings.

INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Aug. Second	E♯ A♯ D♯ B♯	A♯ D♯ G♯ B♯ E♯	B♯ E♯ A♯	D♯ G♯ C♯ E♯ A♯
Minor Third	F B♭ E♭ G C	B♭ E♭ A♭ C F	C F B♭ D G	E♭ A♭ D♭ F B♭

The conclusions from this table are quite clear. Beside the obviously required minor third placement, the augmented second placement would be necessary for frequently encountered C♯s and G♯s, as well as D♯s and A♯s needed for the leading tones in the keys of e-minor and b-minor, respectively. Therefore, doubling the third fret would be considered essential.

Moving to the fourth fret position, the table looks like this:

INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Major Third	F♯ B E G♯ C♯	B E A C♯ F♯	C♯ F♯ B D♯ G♯	E A D F♯ B
Diminished Fourth	G♭ C♭ F♭ A♭ D♭	C♭ F♭ D♭ G♭	D♭ G♭ C♭ E♭ A♭	F♭ G♭ C♭

As in the previous case, it appears from this table that doubling the fourth fret would also reap significant benefit, at least for the three most common tunings.

On to the fifth fret position.

INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Augmented Third	B♯ E♯	B♯ E♯ A♯	B♯	E♯ A♯ D♯ B♯
Perfect Fourth	G C F A D	C F B♭ D G	D G C E A	F B♭ E♭ G C

The perfect-fourth placement is clearly necessary. Although it may appear that fret doubling is needed for the A# on a G-tuned instrument, this tone is readily available on the first-position lower fret placement on the A string. Thus, doubling the fifth fret is contraindicated (with the possible exception of a rare C-tuned instrument).

The sixth fret position is virtually the same case as the first fret position, and doubling is necessary as seen from the following table.

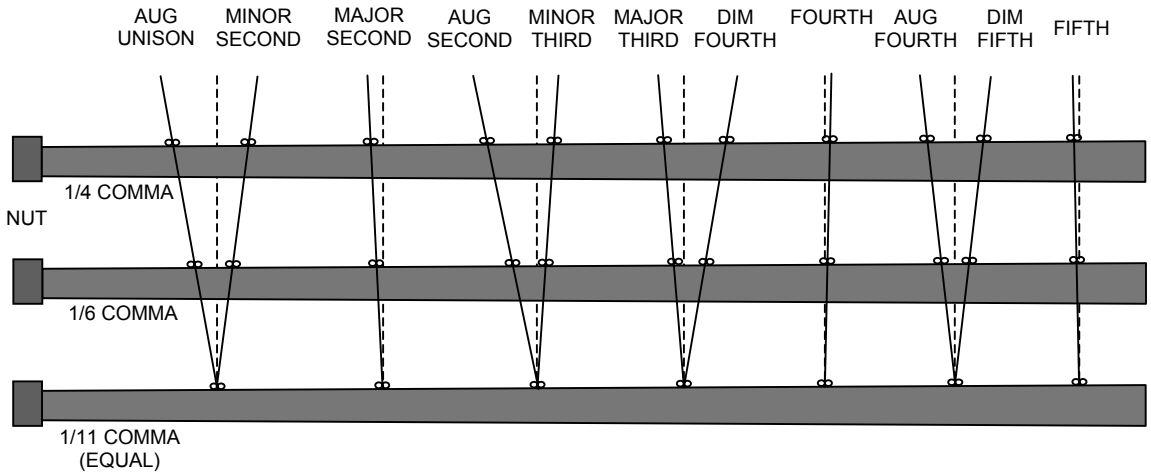
INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Augmented Fourth	G♯ C♯ F♯ A♯ D♯	C♯ F♯ B D♯ G♯	D♯ G♯ C♯ E♯ A♯	F♯ B E G♯ C♯
Diminished Fifth	A♭ D♭ G♭ B♭ E♭	D♭ G♭ C♭ E♭ A♭	E♭ A♭ D♭ F B♭	G♭ C♭ F♭ A♭ D♭

Similarly, the seventh fret position is closely related to the second fret position. The perfect fifth placement is obviously required, but the diminished sixth placement would be needed very rarely, if ever.

INTERVAL	D TUNING	G TUNING	A TUNING	C TUNING
Perfect Fifth	A D G B E	D G C E A	E A D F♯ B	G C F A D
Diminished Sixth	C♭	F♭	F♭ G♭	

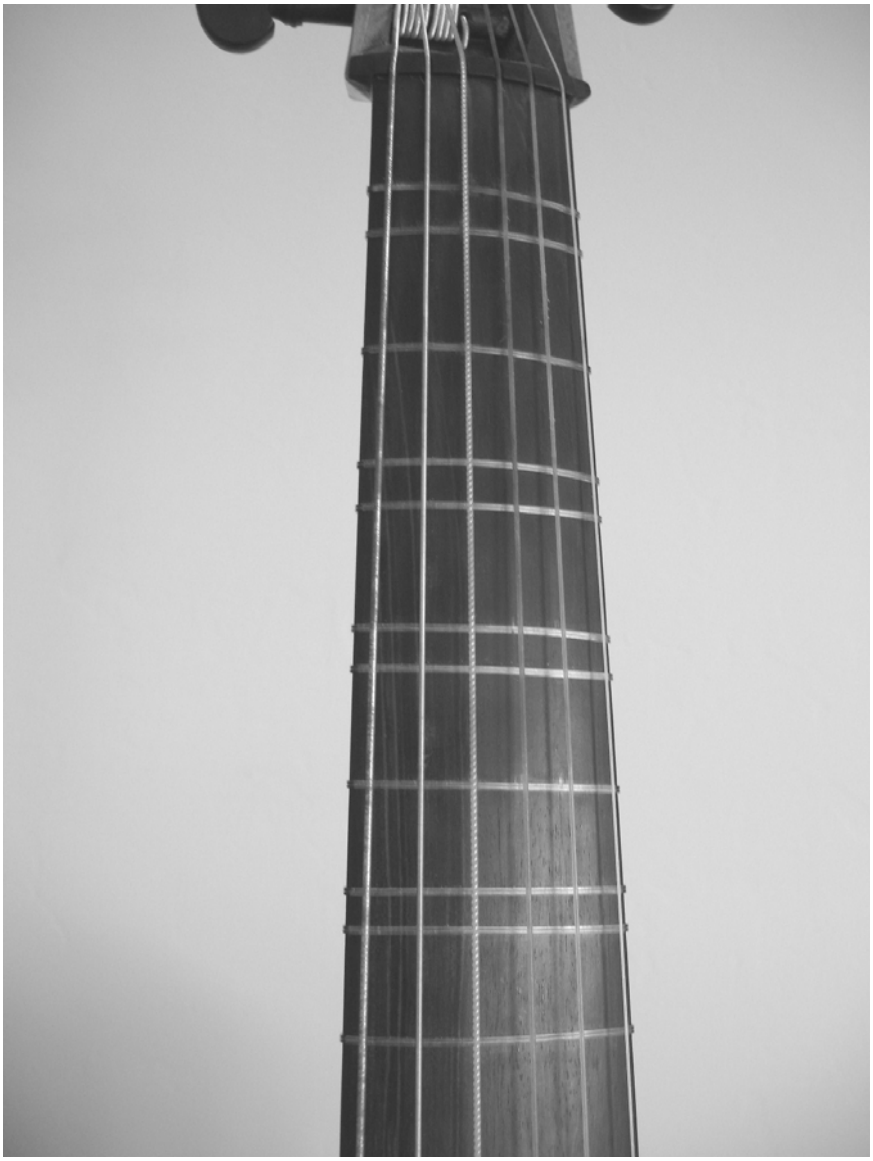
To summarize, by adding four frets, one can obtain greatly improved tuning of virtually all major triads encountered in music written up to and through the early baroque period. The additional benefit is that there is a much greater tolerance for tuning drift before supposedly consonant chords sound distressingly dissonant.

But where to put all these frets? The following figure, drawn to precise relative scale, shows fret placements for various degrees of regular ("meantone") temperament with respect to equal temperament (dotted lines).



Although quarter-comma temperament produces absolutely pure major thirds, perfect fourths and fifths are noticeably out of tune, and the widely spaced doubled frets can cause some tactile confusion. I prefer fifth-comma temperament (about halfway between the sixth- and quarter-comma fret placements shown) because the fingers are not fooled, the error in fourths and fifths is just barely noticeable, and the major-third error is only

30% of its equal-tempered value. This is a considerable improvement over the only 50% reduction in major-third error realized with sixth-comma temperament. The photo shows my bass fretted for fifth-comma.



To summarize the placement of frets for the proposed 11-fret meantone setup, let me delineate the sequence of tones up the fingerboard on a D-string (a string common to all the tunings considered in this article): D (open string), D♯, E♭, E, E♯, F, F♯, G♭, G, G♯, A♭, and A. It can be seen that this is a straightforward and sensible progression of tones.

A remaining question is that of the tuning of open strings. Simply stated, the fourths must be equally widened slightly so that the interior major third achieves the desired improvement in sonority. For fifth-comma temperament, that would result in a third just barely noticeably wider than pure, rather than the grossly mistuned equal-tempered major

third. To aid string tuning (as well as checking fret placement), a multi-temperament electronic tuner would be very useful. As an alternative, an equal-temperament tuner with an indicator showing pitch deviation in cents can be used. The following table shows deviations from equal temperament, referenced to the A-pitch, for various regular temperaments.

	SIXTH COMMA	FIFTH COMMA	QUARTER COMMA
A#	-11.4	-16.4	-24
D#	-9.8	-14.1	-20.5
G#	-8.1	-11.7	-17.1
C#	-6.5	-9.4	-13.7
F#	-4.9	-7	-10.3
B	-3.3	-4.7	-6.8
E	-1.6	-2.3	-3.4
A	0	0	0
D	1.6	2.3	3.4
G	3.3	4.7	6.8
C	4.9	7	10.3
F	6.5	9.4	13.7
Bb	8.1	11.7	17.1
Eb	9.8	14.1	20.5
Ab	11.4	16.4	24
Db	13	18.8	27.4
Gb	14.7	21.1	30.8

After carefully tuning open strings and adjusting fret placement, it is good idea to check all fret-stopped tones that are unisons or octaves with open strings for perfect agreement.

All regular temperaments can be achieved with perfectly straight frets that are theoretically perpendicular to the neck. "Well" temperaments, such as Vallotti, can be only poorly approximated with single frets. Ideally, Vallotti would require frets that are slanted, curved, and discontinuous (see Elizabeth Liddle's Appendix in Alison Crum's *Play the Viol*). When playing with Vallotti-tuned keyboards, I use sixth-comma temperament which is identical for all "white-key" tones, and only slightly off (toward being more consonant) from most "black-key" tones.

What is required to implement this proposed enhancement? Tie four additional frets onto the instrument; adjust their spacing by eye using the above figure, or with a multi-temperament tuner; and start by playing scales in the seven keys from four flats to four sharps. Just remember that sharps always use the lower frets of a doubled pair, and flats always use the upper frets. (Recall that "upper" means higher in pitch, or closer to the bridge). In the third fret position, all naturals use the upper fret, whereas in the fourth fret position, all naturals use the lower fret. I have found that playing scales against a drone is a good way to check interval consonance. Using a multi-temperament tuner with an audible tone feature, first I set the drone to the tonic of the scale, *do*. This checks consonance with *mi*, *fa*, *sol*, and *la*. Then, I set the drone to the dominant of the scale, *sol*. This checks consonance with *ti*, *do*, *re*, and *mi*. The most prominent melodic feature

of meantone temperament scales is that the diatonic semitones (minor seconds) from *mi* to *fa*, and from *ti* to *do*, sound noticeably wider.

Here I am interjecting a caveat concerning treble viols and pardesseux. In general, the space between doubled frets gets to be so small that finger placement becomes problematic. Other than the first fret on a treble, I have found this technique impractical. However, it still makes good sense to place the single frets in a meantone pattern for the most frequently encountered tones. This usually means third fret in the minor third placement, and fourth fret in the major third placement. Fortunately, when required, other microtuning techniques, such as longitudinal string pushing/pulling and slightly-over-the-fret finger placement, are more easily applied to shorter, thinner strings. These techniques are also more effective if the milder sixth-comma temperament is used.

Finally, a question that always arises: If I modify my instrument, won't everyone else in my consort have to do the same? Fortunately, the answer is NO. I have been playing in consorts where everyone else is seven-fretted and tuned to equal temperament, and I am tuned to fifth comma with doubled frets. The net result is that when I have the third of a chord (which is hardly ever doubled), it sounds o-o-oh so-o-o nice; and if someone else has it, it sounds no worse than usual. The situation is somewhat improved if you can at least convince the other players to tune their open strings to your meantone pitches, either by ear (preferred), or by using the deviation table above.

The bottom line is the classical cost/benefit tradeoff analysis, as the title of this article implies. The costs are a few dollars of fret material, an hour or so to tie them on (see http://www.vdgsa.org/pgs/frets.html) and adjust them, and the effort to get used to putting your fingers on the right spots. If you are already using a doubled fret in the first fret position, I would guess that a few hours of practice and a few consort sessions would do the trick. If fret doubling is completely new to you, then twice that investment in time should suffice. Now for the benefits: If you get an especial pleasure from hearing very consonantly tuned chords (and it's hard for me to imagine a musician who doesn't), then you will reap a lifetime of keen enjoyment. Sounds (no pun intended) like a pretty good deal to me!

Footnote

DOUBLING VS. SPLITTING

An expedient method of dividing a fret is to split the two strands of a single fret and create a space between them. This technique has several drawbacks.

- If a conventional fret knot is used, the two strands will be connected at that point. This produces a force that will constantly try to pull the strands back together, necessitating continual adjustment to keep them apart.

- Since the fret knot is usually placed on the low-string side of the neck where it is out of the way of the thumb, it will tend to pull the strands together more forcefully on that side than on the high-string side of the neck causing a non-uniform spacing. Optimally, the fret placements should be perfectly parallel.

- A single strand has quite a different feel and action from a double strand, which could require different finger pressure and/or placement.

- A single strand will wear out twice as fast as a double strand, a particularly significant factor if gut is used as the fret material.

Therefore, I highly recommend using conventional two-strand frets for the additional placements to obtain the desired result.