Dulcimer Fast Track Case 2: Having Trouble Tuning?

By Gwen Caeli

"Why does my dulcimer sound out of tune, even though I use my electronic tuner?" asks the bewildered player. Tuning is a part of dulcimer playing and building where both art and science intersect. There can be several causes for sounding out of tune, one of which we will explore here (more to come in ***Dulcimer Fast Track: Case 3***). It is called 'musical temperament', a system of tuning that slightly compromises the pure intervals of 'just intonation' in order to fit the dulcimer's system of fret placement. There are 12 musical tones in a full octave, arranged in 12 *half step intervals* allowing instruments to play in any key (as in the 'chromatic'-scaled piano with black /white keys, guitar, banjo and mandolin). The dulcimer uses 8 of those musical tones, arranged in *whole step intervals*, called 'diatonic' scale, forcing us to play in limited keys. In exploring musical temperament, we learn that it is impossible for dulcimers and other instruments to be mathematically and theoretically absolutely true in a tuning (pure with no disharmony or sourness).

As dulcimer players, we might hear this as being out of tune. Through the centuries as instruments were developed, different temperament remedies were also developed to temper false intervals in the instruments. 'Musical temperament' refers to a number of systems used to subdivide an octave in order to get the correct pitch frequencies (sound vibrations per second) of the needed musical tones for varying instruments. Each system remedy slightly shifts a fraction of a tone onto the next pitch, so that everything will be in sync at the end of the octave. This is all done with mathematical equations multiplying a vibrating string's length ratio by a pre-determined fractional ratio. There are many charts of mathematical calculations that generate ratios for each system. Four main temperament systems were used over the centuries:

- Pythagorean tuning
- Just intonation
- Mean-tone temperament
- Equal temperament

If your ears or tuner indicate a sour note, one a bit sharp or flat on any string at any fret, it could be the temperament and fret placement of your dulcimer is slightly off. If one of the pitches was adjusted slightly incorrectly, even by 0.5 Hz, you will be out of phase by a small margin and the string will vibrate outside of the frequency of the other strings. If you are buying a dulcimer, it is a good idea to check each string at every fret with an electronic tuner.

It all started in the sixth century when the inquisitive Pythagoras walked in front of a blacksmith's shop and heard variations of sound pitches emanating from the different weights of striking hammers on the anvil. Curious as to why different weights caused lower and higher sounds, he soon discovered 'intervals' of sound, known as 'pitches'. The intervals of sound on mountain dulcimer are created when pressing the strings in the interval spaces between the frets. Pythagoras was one of the first mathematical thinkers and his discovery of string lengths divided by simple musical intervals gave him the moniker 'the father of music'.

If you divide a string in half between the bridge and the nut, you have a mathematical ratio of 2:1. Divide that in half and you have 3:2, divide that in half . . ., etc. This is a simplistic view of how we get intervals of frets on the dulcimer. If you have a longer dulcimer where the 'vibrating string

length' from the bridge to the nut (known as VSL) may be 28", 29" or more, the intervals between your frets will each be longer. If you have smaller hands or shorter fingers, it might be difficult to reach into those intervals to form some chords, a shorter instrument might fit you better.

A very knowledgeable dulcimer friend, Howie Mitchell (see previous **Dulcimer Fast Track: Case 1**) introduced me to intervals and musical temperaments. His understanding of the science of music far exceeded mine and he was kind enough to expand my knowledge base. He wrote, "It was just wonderful to see you again . . . it's hard to grab much time for visiting during these dulcimer workshops, but I think we succeeded quite well!" In 2000, Howie sent me his white paper entitled "A Brief and Relatively Simple Discussion of Musical Temperament, as Might Be Applied to Fretted Stringed Instruments, Especially of the Plucked Dulcimer".

Sample string divisions (can be divided many ways)	**2:1** (7^{th} fret dulcimer)	**Perfect octave** (halfway point on your dulcimer's length, where you find the best 'harmonics')
	3:2 (4^{th} fret dulcimer)	**Perfect 5^{th}** (in DAD tuning you are tuned in fifths or 1-5-8, DAA tuning is 1-5-5)

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