Historical Temperaments

Jason Kanter

2/18/2013

Jason has been tuning pianos since 1970. He joined PTG in the mid-90's. Now he doesn't tune much, but has always had a fascination with historic temperaments. Since 2001 he has been tuning a lot of different temperaments. Owen Jorgensen wrote a book entitled Tuning. This book is now a collectors' item, and Jason's copy is all marked up from when he was writing his web site.

The Pathagorian comman is the difference of 12 fifths and the stack of 7 octaves. There is a small difference between these two sequences. In order to make all the fifths equal we do the equal temperament. Pathagoras did not like the fact that the universe was not rational, so he kept this difference secret. He didn't like pi – an irrational number – either.

- If 12 moon months happened to exactly coincide with one solar year, the calendar would be very easy to calculate.
- If twelve stack perfect fifths happened to exactly equal seven stacked octaves, tuning would be simple.
- But 12 lunar months equal 354.37 days. The solar year is (average) 365.25 days. We have to take the additional 10.88 days and distribute them somehow.
- But the 12 stack perfect fifths equal 8413.46 cents. Seven stacke octaves equal 8400cents. We have to take the surplus of 23.46

The Problem of the Comma
Perfect Octave vs. perfect 5th and 4ths: Diatonic Comma
Perfect M3 vs. perfect 5ths/4ths: Syntonic Comma

Major Thirds
Three stack major thirds must total 41 cents sharp
The Pythagorian 3rd has perfect fifths and fourths, but the major third is dissonant with fast beats.
The Paythagorean Third: "Sharp thirds must be as sharp as the ear will permit."
In the earliest mean-tone tunings, two of the thirds would be perfect, and all of the other mean-tone keys would be off, and no one played in those keys.

Tuning Descriptions

- In the 18th century well,. The greatest perfection occurs when CE is the one smallest M3 and C#F is the one largest M#.
- Handel: "In this (CEG) chord tune the fifth pretty flat and the third considerably too sharp/"
- Handel: (for GBD) "Let the fifth be nearer perfect than the lsast tho not quite, tune the third a fifth to E, make it good but just bearing flat."
- "Sharp thirds must be as sharp as the ear will permit, and all fifths as flat as the

Jorgensen's Graphics
Calculations of how far from fifths the circle can go.
Major thirds increase in size in one direction to the largest third, and then decrease in size to the smallest third.
To tune, according to these descriptions, they would listen to the sounds in sequence.

They did use a lot of tuning forks.
In the Pianotech emails, Ed Foote is a university tech in Nashville, TN.

Ed Foote's charts
Meantone
The major thirds in meantone temperament has all the qualities of inequality. Everything else is just.
The **Well temperament**
Equal Temperament

Jason made a chart of the Aaron Meantone.
The five major thirs at the beginning and the four end major thirds are perfect. All the inequality is in the four middle ones. They are perfect because the fifths are all narrowed as we do in equal temperament, but they are narrowed by 5.38 cents (twice as much as we do.
Young temperament (Thomas Youn (Well, 1799)
The fifths are as narrow as the ear can bear. Add a beautiful third and the noise of the fifth disappears. The Pythagorean M3 at 21 cents requires four perfect fifths. The height of the column is cents. The numbers are the beats, forgetting inharmonicity, of the intervals.

All these numbers and charts are posted at http://www.rollingball.com.

Temperaments in Musical History

ET
Everry set of stacked M3s equals 41.06 cents
Renaissance: meantone (1500s-1800s)
Baroque: meantone and well-tempered
Classic: well-tempered, meantone, modified meantone
Romantic: quasi-equal, Victorian well
Modern: equal (1911)

The tendency was to bring down the

The one expanded fifth was called the wolf – a diminished 6^{th}; it was awful to listen to.
Modified meantone put a curve into it and tried to spread it out, but the center of the curve was beyond what the ear could bear.
Well: Werdmeister, Kirnberger, Valotti, Young, (both mathematically clean); Pring
All these thirds go up to the Pythagorean line.
Quasi-Equal: Gaubener Hummel Vienese, Ellis, Pyle: very close to equal
The Victorian Well was trying to achieve equal temperament (which wasn't achieved until 1911) was developed by Broadwood, and Mooore.

Meantone
Modified Meantone
Well – strongest M3 at 21 cents
Victorian Well

Patterns of offsets
Eight temperaments calibrated
Kirnberger across 2 octaves: kind oif a sine curve
Werckmaister, Valotti, Young, Broadwood Usual, Brodadwood Best, Moore
Young compiled the most symmetrical and pure sequence possible

Modern
Jim Coleman: 1994, 2001, 1999, 2001
Tune-off between Coleman and Smith: machine vs. ear
Coleman 4: Raised each C & F and lowered each B and G at the expense of a little extra noise in the other keys.
Coleman 11, using SuperCalc:
Coleman 16: least change in the 4ths and 5ths, and the calmest thirds possible, although he really preferred the 11. The 16 was too stout for him. The sound of the black keys was a little too strident.
Coleman 10-: took the offsets and fi=divided them by 2. Not the size of the third, but the distance from equal temperament is hald, in case someone wants a milder temperament.

Bill Bremmerr's "Equal Beating Victorian Temperament": EBVT III.
Bill used an aural bearing plan to achieve equal beating in as many thirds as he could.
Bradley Lehman's Bach Temperament with the squiggle code. It has 24 parts, each in a different key, 12 in major and 12 in minor keys. He is clinching meantone. Therre have been at least a dozen people who studied this squiggle for code in how he tuned. Bradley turned the squiggle upside down and figured the extra loops meant the fifths were narrow. The squiggles with less turns meant something else, etc. He has gotten a lot of mileage out of this. He can tune a harpsichord to this temperament in twelve minutes.

Robert Wendell's "Natural Synchronous Well" (2002)
The inverted triad plays nicely. The theory is that the strings couple. Robert worked with a meahtematiciain to figure oue how to maximize beat synchronisicity. So the minor major third are 2.5 times. This worked well for Chopin.
Then Wendell made an ET Equivalent in 2002. Everything was pretty close. Some were pure and some expanded, alternating.

Composers chose the key by the quality of the color of the thirds in that temperament.
In the harsher keys the discordants are not as noticeable when playing rapidly or staccato.

Listen to these tunings:
B, F# and C# are the most extreme in Velotti
Broadwood Best: tapered off lower to keep the beats slower
Black keys had pure fifths and white keys pure thirds

Perfect twelfths come close to what inharmonicity comes to.

Dave Carpenter's Verituner listens to 8 partials at once. You can't see what you're doing, but it does nice work.
Tunelab is transparent and you can see what you're actually doing. You can look at the curve and adjust it. Tunelab is listening to just one partial at a time. However, it is tweatable; for example, you can set the C to a 12^{th} about and take actual measurements real-time.
Cyberrtuner
Acutuner

Paul Bailey in California was very much into historical temperaments. Jason and Paul did a test and recorded the pianos with the same piece played by an accomplished pianist, taking selected segments to play. The audience could not choose which tuning was which.

On Jason's personal spreadsheet he has entered in all the data from each style of temperatment. He can push a button and any tuning will immediately be charted. Using this, any tuning or temperament can be analyzed.

In India there are 21 notes in each octave. Chinese music has only five notes in each octave. With Barbershop and string quartets there is no difficulty with intervals.