About Temperaments • Pythagorean • Meantone • Modified Meantone • Well • Victorian Well • Quasi-Equal • Equal • Modern Well • EBVT • Return to rollingball home

About Temperaments

Historical Overview

This section contains a brief graphic overview of types of temperaments in the context of classical composers. The **bottom half of the graphic has live hotspots**, but the upper half (with the names of composers) is sadly lacking in interactivity.

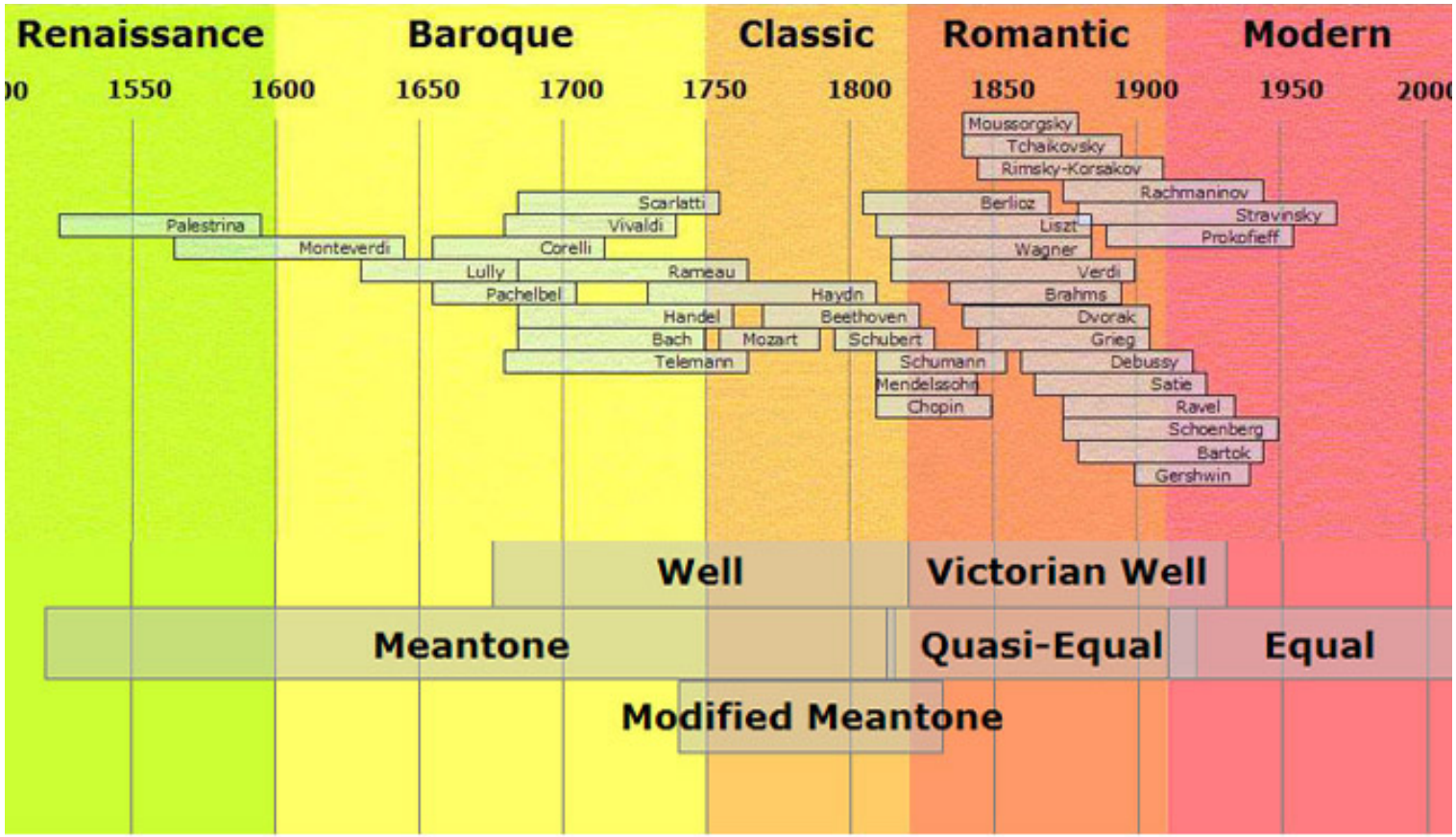
If you click on a miniature and get the full-size chart, you can press **backspace** to return to the current History image.

Homage to Jorgensen

Reading the Charts

About "Key Color"

Temperamental links - other websites sites of interest will appear in the frame to the right, and you can explore while remaining at rollingball.com...



Click on a type of temperament (meantone, modified meantone, well, victorian well, quasi-equal, or equal).

The temperament dates and detailed temperament information are drawn primarily from Jorgensen's tome, Tuning. The composer dates were quickly abstracted from Classical Net's Timeline of Composers.
Consider two aspects of this:
(1) What temperament would the composers have heard when they were children?
(2) What temperament would they have had their keyboards tuned to?

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Pythagorean

Favors pure fifths.

Meantone

Favors pure thirds. The Wolf becomes a factor. Eight keys are playable. [Note, the red and blue "ET horizon" lines are not accurate in the meantone or modified meantone graphs. Yet.]

Modified Meantone

Attempting to mitigate the Wolf and get nine playable keys. This is a transition to Well.

Well

Key Color emerges as all 24 keys can be used.

Victorian Well

While maintaining key color, objectionable thirds are toned down.

Quasi-Equal

Conceptually driving for equal temperament, without the critical understanding of *where to listen* for beat rates.

Equal

The first mathematically sound method of tuning truly equal temperament appeared in 1911.
Equal Temperament

Modern Well

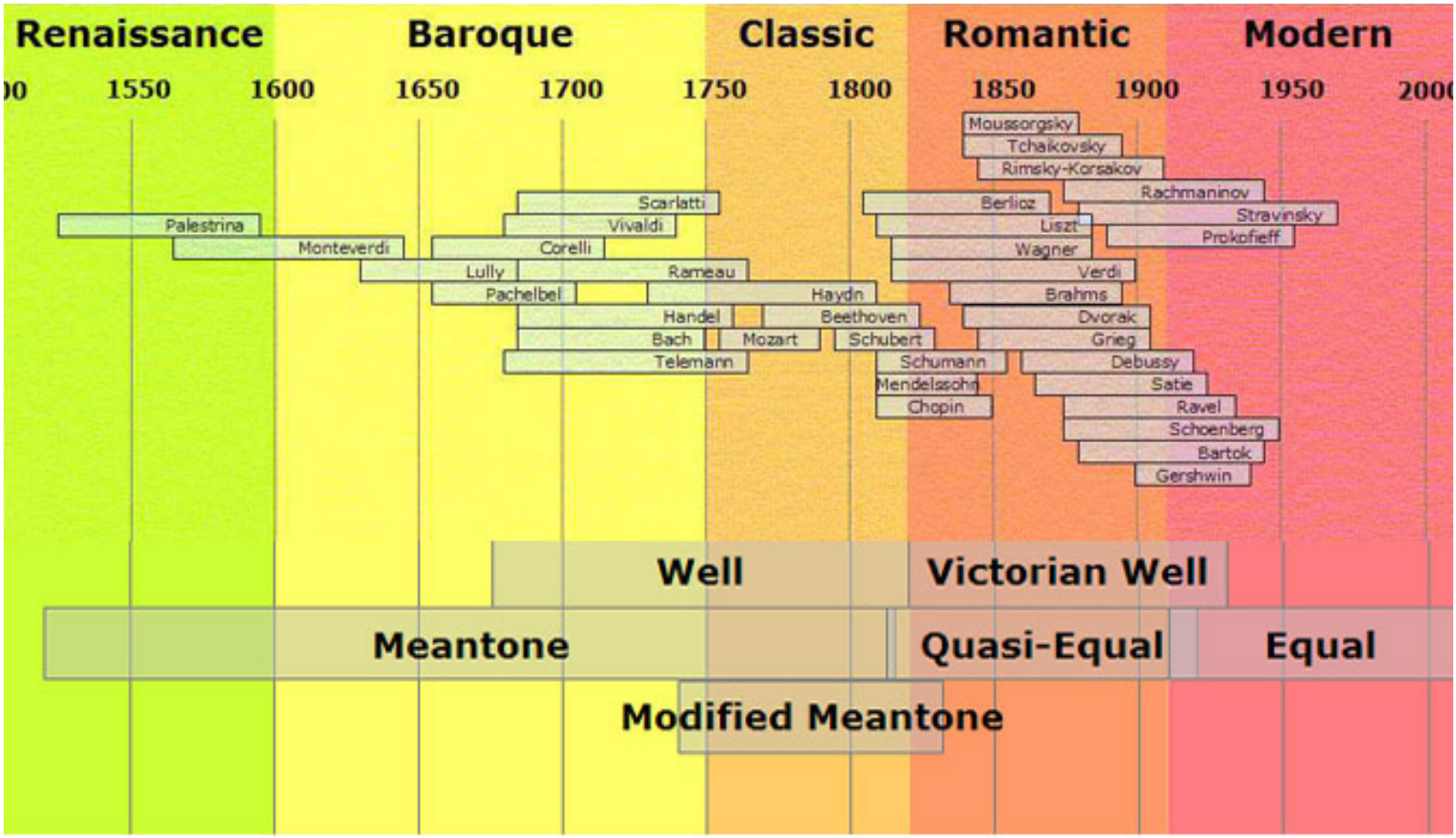
With the advent of electronic tuning devices, there has been a resurgence of key color in a variety of well temperaments.

EBVT

"Equal-Beating Victorian Temperament". Homegrown by Bill Bremmer and eventually refined with Jorgensen's and Swafford's assistance after imbalances were pointed out by Ed Foote, Jason Kanter, Ron Koval, Kent Swafford, and Owen Jorgensen.

A Graphic History of the EBVT

"Do the results create: F3-C4 pure? C4-F4 pure? F3-Bb pure? Bb3-F4 pure? F#3-C#4 pure? G#3-C#4 pure? F3-A3, G3-B3, G3-E4 and C4-E4 all beating exactly the same, 6 beats per second? A3-C#4 and Bb3-D4 beating exactly the same, about 9 beats per second? G3-D4 and A3-D4 tempered exactly the same, about 2 beats per second? Ab3-Eb4 and Bb3-Eb4 tempered exactly the same, very little, less than in ET? These are the features of my EBVT." (8/29/02)



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Consider two aspects of this:
(1) What temperament would the composers have heard when they were children?
(2) What temperament would they have had their keyboards tuned to?

Homage to Jorgensen

Most of the information in this website is cheerfully lifted from Owen Jorgensen's monumental tome, **Tuning: Containing The Perfection of Eighteenth-Century Temperament; The Lost Art of Nineteenth-Century Temperament; and The Science of Equal Temperament.** To save space, I have summarized Jorgensen's wording and decided in many places to eliminate quotation marks and just admit at the outset that it is all taken from his book. Each image contains a citation for the source of the information, generally a page in Jorgensen.

I must say that as a professional organizer of information, I am staggered by the amount of research that Jorgensen managed to capture. It is regrettable that the book has gone out of print. My effort here should be thought of as a supplement to Jorgensen. There may be places where I have misinterpreted the data, and I take full responsibility for that.

There are temperaments here that you will not find in Jorgensen: Coleman, Bailey, Koval, Wendell, Secor, Di Veroli, Bremmer, and Jorgensen's own improvement on Prinz/Kirnberger. In each case I have made comments drawn from personal emails or website postings. Again, if I have misrepresented anything, please let me know and I will promptly fix it.

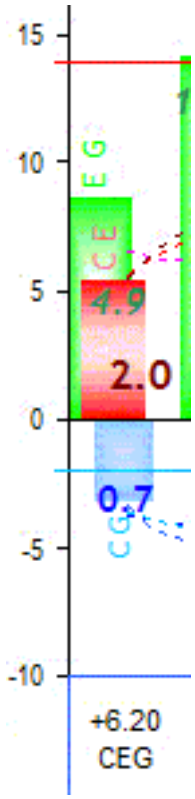
You may download a **somewhat current PDF** file (9/29/06) of these charts here. This is a large file, over 6 MB, so expect it to take a while.

Suggestions to speed things up: if you are using Internet Explorer, once the page has loaded you can "add to Favorites" and on that dialog box you can click **Make available offline**. If you click the **Customize** button, you can save everything within a couple of clicks. This will store all the images on your computer.

On the Mac, you can accomplish the same thus: Go to the menu item **Favorites>Subscribe...** and click the **Customize** button. Then click the Offline tab. Check the box for **Download site for offline browsing** and click the **Options** button. There, click **Download links 3 levels deep** and **Skip links to other sites**. Click **OK** twice to get out of here, and you're done. Later on, when I have updated the site, go to **Favorites** menu and choose **Update Subscriptions**.

Reading the Charts

The charts display **thirteen major triads** in a cycle of fifths, starting with the C3E3G3 triad at the left and proceeding up by fifths and down by fourths until you reach C4E4G4 at the right.



The bars indicate **cents**; the numbers represent **beats**.

Fifths are **blue**; major thirds are **red**; minor thirds are **green**. [Technically, the minor third bars should be shown below zero, since minor thirds are contracted (not expanded like thirds and fourths). But I think they look better behind the major thirds.]

Therefore, in the example C major triad shown at the left, the blue CG fifth is contracted by about 3 cents and beats at 0.7 beats per second (bps). The red CE major third is expanded by a little more than 5 cents, and beats at 2.0 bps. The green EG minor third is contracted by about 8 cents and beats at 4.9 bps.

The fifth CG, minor third of EG, and major third of CE are thus seen together. The "feeling" of C Major is represented in the mingling beat rates of these three intervals. When those beats are synchronous (equal or in whole-number ratios such as 3:2) ... so that they are beating together ... there is something that happens in the soul of the listener.

Immediately below each triad is the **offset** for the fundamental of that triad. (In the example triad shown on this page, C is offset by 6.20 cents sharp.) There is a red "horizon" line (ET reference line) representing 13.7 cents, the amount by which Equally Tempered major thirds are expanded. Likewise there is a blue ET horizon representing equally-tempered fifths, which are all contracted by 1.96 cents. The dotted curves are polynomial trendlines that help to show the degree of balance in the temperament.

The **large red numbers** in the upper right of the chart indicate the minimum and maximum size of the Major Thirds (in cents). This can serve as a quick guide to the degree of key coloring in the temperament.

These are busy charts, and there is some overlapping data. Below the graph is a data table that shows every number in the graph. *Watch this space for an announcement of a printed reference guide containing all these charts (and more) in high-resolution, 11 x 8.5 format.*

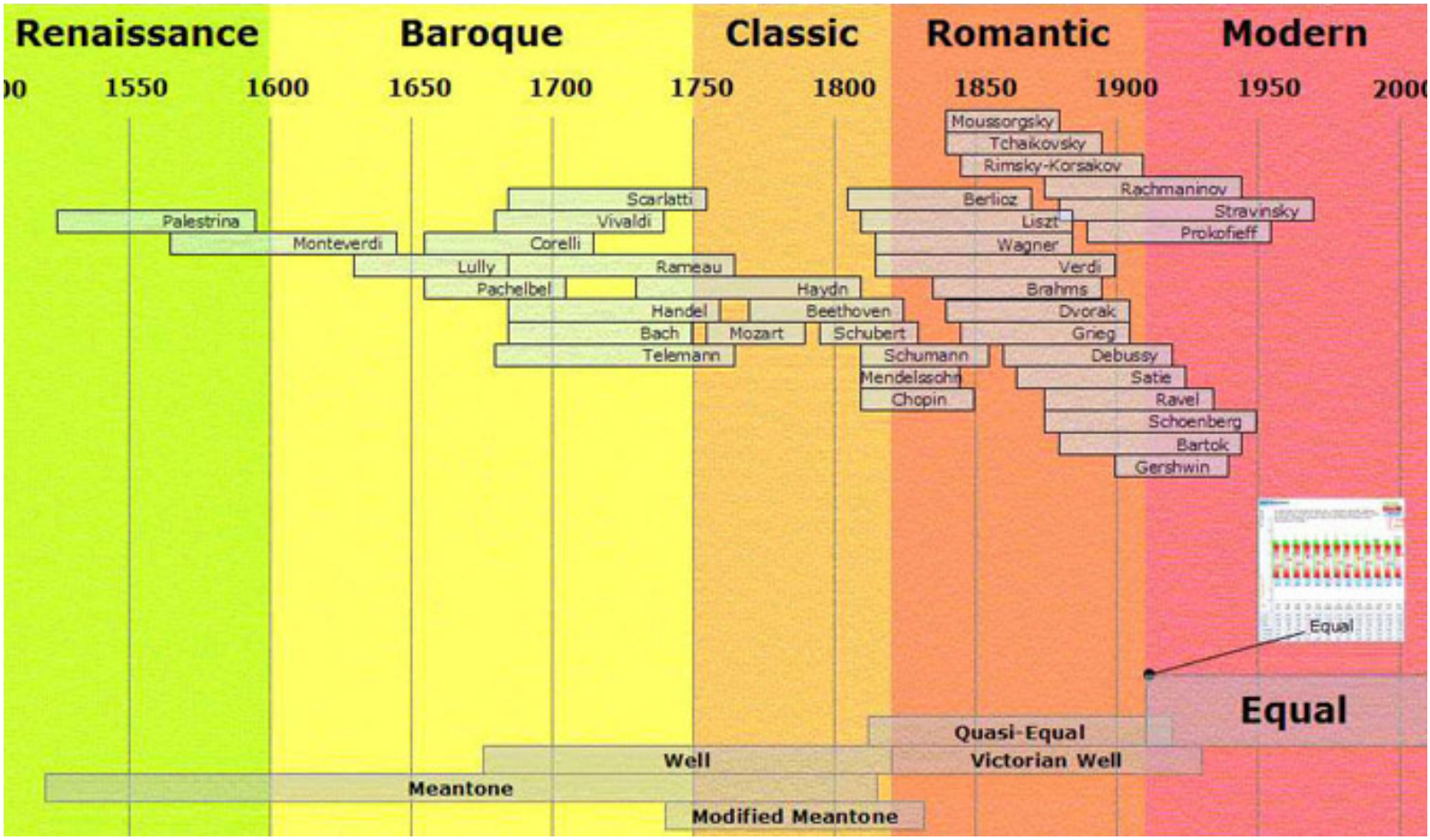
About "Key Color"

Each of the 12 major and 12 minor keys was thought to have its own emotional quality. This is primarily due to the varying sizes of the major thirds in the Well temperaments, which dominated European music during the 17th, 18th and 19th centuries. These descriptions are arranged according to the circle of fifths. You can see that the descriptions change from more peaceful around C major / A minor to more struggling/distressed around F# major / D# minor.

--text drawn from from Christian Schubart's *Ideen zu einer Aesthetik der Tonkunst* (1806).Translated by Rita Steblin in *A History of Key Characteristics in the 18th and Early 19th Centuries*. UMI Research Press (1983)

Major Third	Keys containing the major third	
C-E	**C Major:** Completely pure. Its character is: innocence, simplicity, naivety, children's talk.	**A minor:** Pious womanliness and tenderness of character.
G-B	**G Major:** Everything rustic, idyllic and lyrical, every calm and satisfied passion, every tender gratitude for true friendship and faithful love,--in a word every gentle and peaceful emotion of the heart is correctly expressed by this key.	**E minor:** Naïve, womanly innocent declaration of love, lament without grumbling; sighs accompanied by few tears; this key speaks of the imminent hope of resolving in the pure happiness of C major.
D-F#	**D Major:** The key of triumph, of Hallelujahs, of war-cries, of victory-rejoicing. Thus, the inviting symphonies, the marches, holiday songs and heaven-rejoicing choruses are set in this key.	**B Minor:** This is as it were the key of patience, of calm awaiting one's fate and of submission to divine dispensation.
A-C#	**A Major:** This key includes declarations of innocent love, satisfaction with one's state of affairs; hope of seeing one's beloved again when parting; youthful cheerfulness and trust in God.	**F# Minor:** A gloomy key: it tugs at passion as a dog biting a dress. Resentment and discontent are its language.
E-G#	**E Major:** Noisy shouts of joy, laughing pleasure and not yet complete, full delight lies in E Major.	**C# Minor:** Penitential lamentation, intimate conversation with God, the friend and help-meet of life; sighs of disappointed friendship and love lie in its radius.
B-D#	**B Major:** Strongly colored, announcing wild passions, composed from the most glaring colors. Anger, rage, jealousy, fury, despair and every burden of the heart lies in its sphere.	**Ab Minor:** Grumbling, heart squeezed until it suffocates; wailing lament, difficult struggle; in a word, the color of this key is everything struggling with difficulty.

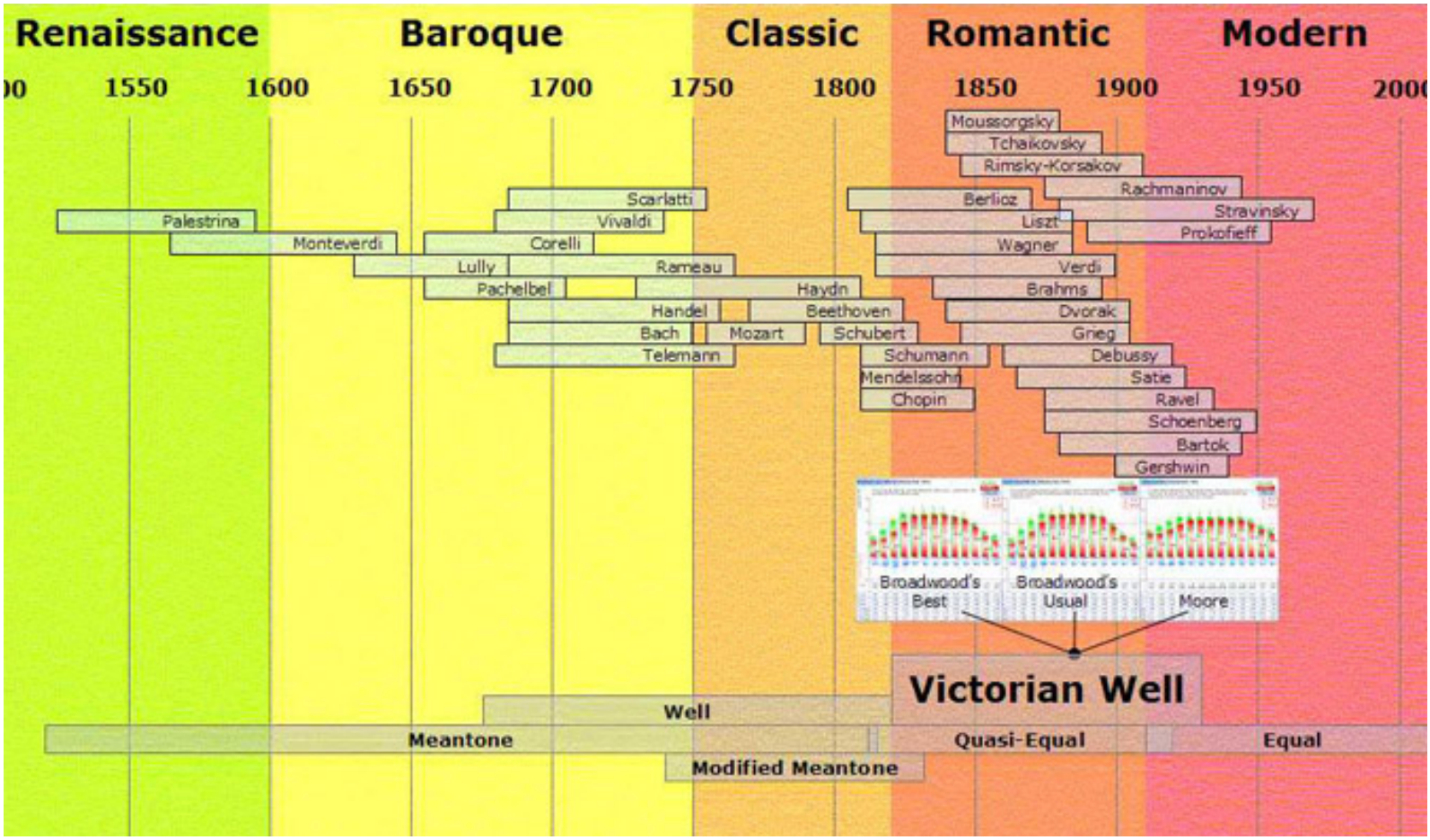
F#-A#	**F# Major:** Triumph over difficulty, free sigh of relief uttered when hurdles are surmounted; echo of a soul which has fiercely struggled and finally conquered lies in all uses of this key.	**D# Minor:** Feelings of the anxiety of the soul's deepest distress, of brooding despair, of blackest depression, of the most gloomy condition of the soul. Every fear, every hesitation of the shuddering heart, breathes out of horrible D# minor. *If ghosts could speak, their speech would approximate this key.*
Db-F	**Db Major:** A leering key, degenerating into grief and rapture. It cannot laugh, but it can smile; it cannot howl, but it can at least grimace its crying. Consequently only unusual characters and feelings can be brought out in this key.	**Bb minor:** A quaint creature, often dressed in the garment of night. It is somewhat surly and very seldom takes on a pleasant countenance. Mocking God and the world; discontented with itself and with everything; preparation for suicide sounds in this key.
Ab-C	**Ab Major:** Key of the grave. Death, grave, putrefaction, judgment, eternity lie in its radius.	**F Minor:** Deep depression, funereal lament, groans of misery and longing for the grave.
Eb-G	**Eb Major:** The key of love, of devotion, of intimate conversation with God.	**C Minor:** Declaration of love and at the same time the lament of unhappy love. All languishing, longing, sighing of the love-sick soul lies in this key.
Bb-D	**Bb Major:** Cheerful love, clear conscience, hope aspiration for a better world.	**G Minor:** Discontent, uneasiness, worry about a failed scheme; bad-tempered gnashing of teeth; in a word: resentment and dislike.
F-A	**F Major:** Complaisance & Calm.	**D Minor:** Melancholy womanliness, the spleen and humours brood.
C-E	**C Major:** Completely pure. Its character is: innocence, simplicity, naivety, children's talk.	**A minor:** Pious womanliness and tenderness of character.



The math for tuning equal temperament (ET) wasn't worked out correctly until 1911.
In a perfect ET, all semitones are exactly the same size. It contains no key-coloring and no tonality.
Equal temperament is:

- Unrestrictive, because modulation through all keys is free from wolf intervals.
- Regular, because all fifths are the same size.
- Circulating, because it obeys the cycle of fifths.

What have we lost?

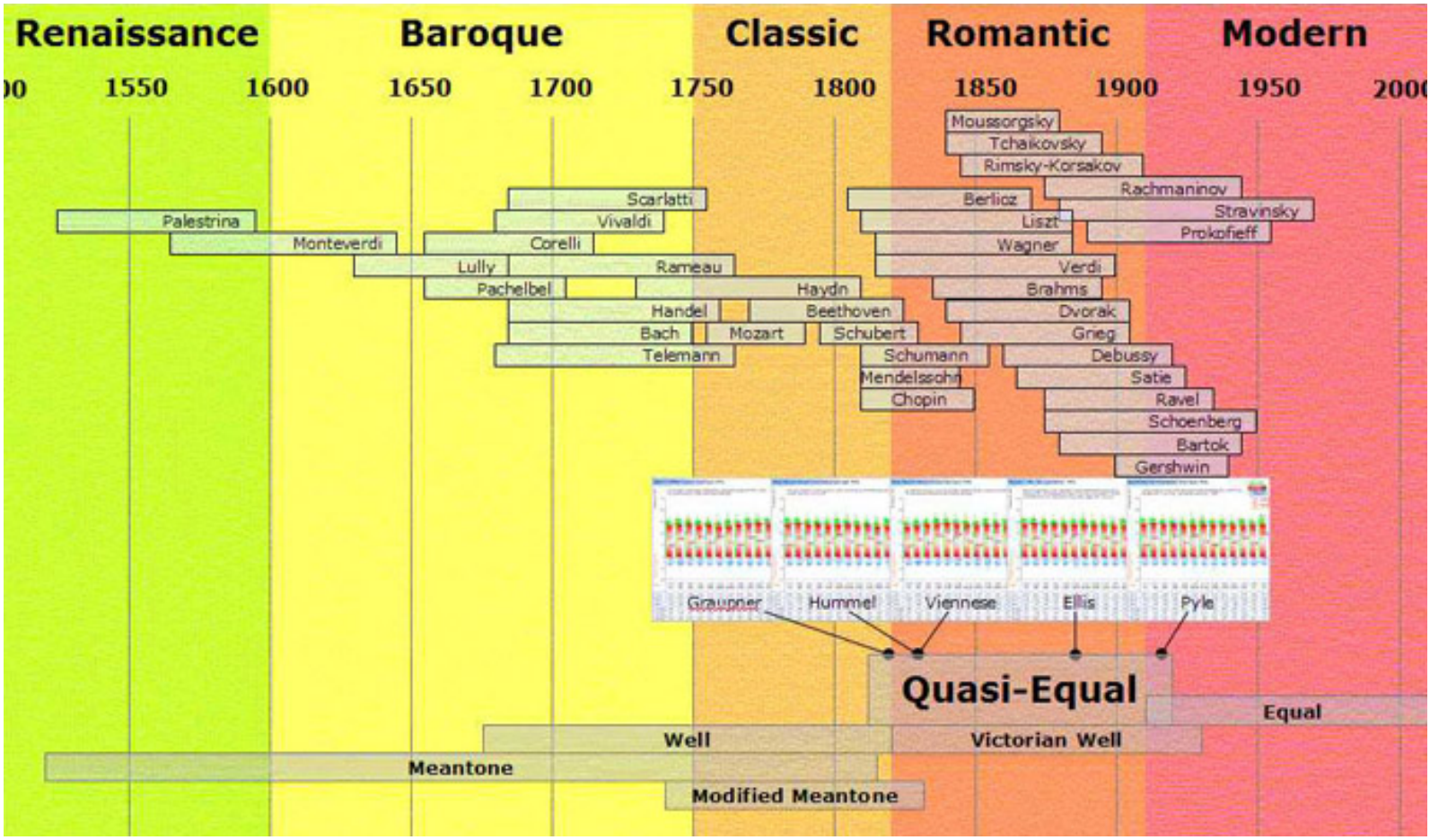


In 1885, the scientist Ellis analyzed the work of seven tuners. These charts represent three of them.
Comparing these Victorian-era tunings to the earlier Well temperaments,
we can see that the differences between the "smoothest" and "harshest" major thirds have been reduced.

Broadwood's Best: This tuning was done by one of Broadwood's "best tuners".
A shade less color contrast than the Broadwood Usual.

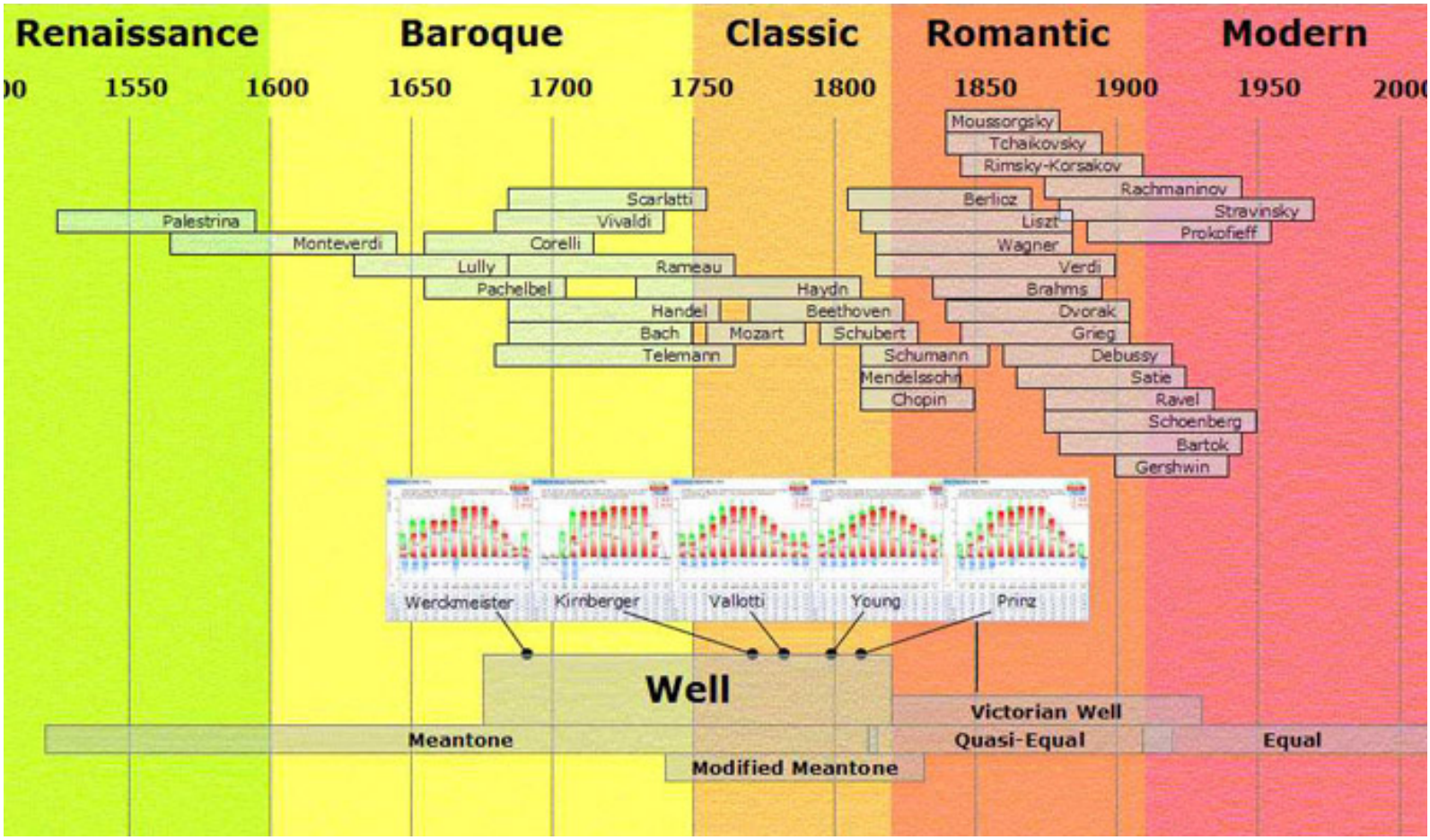
Broadwood's Usual: This was done by Ellis's personal piano tuner, a "usual tuner" from Broadwood.
A shade more color contrast than the Broadwood Best.

Moore (sometimes called "Representative Victorian"): This tuning was done on a harmonium
by a tuner from Moore & Moore. Note that there is some key-coloring but
no M3 is expanded beyond 16 cents.



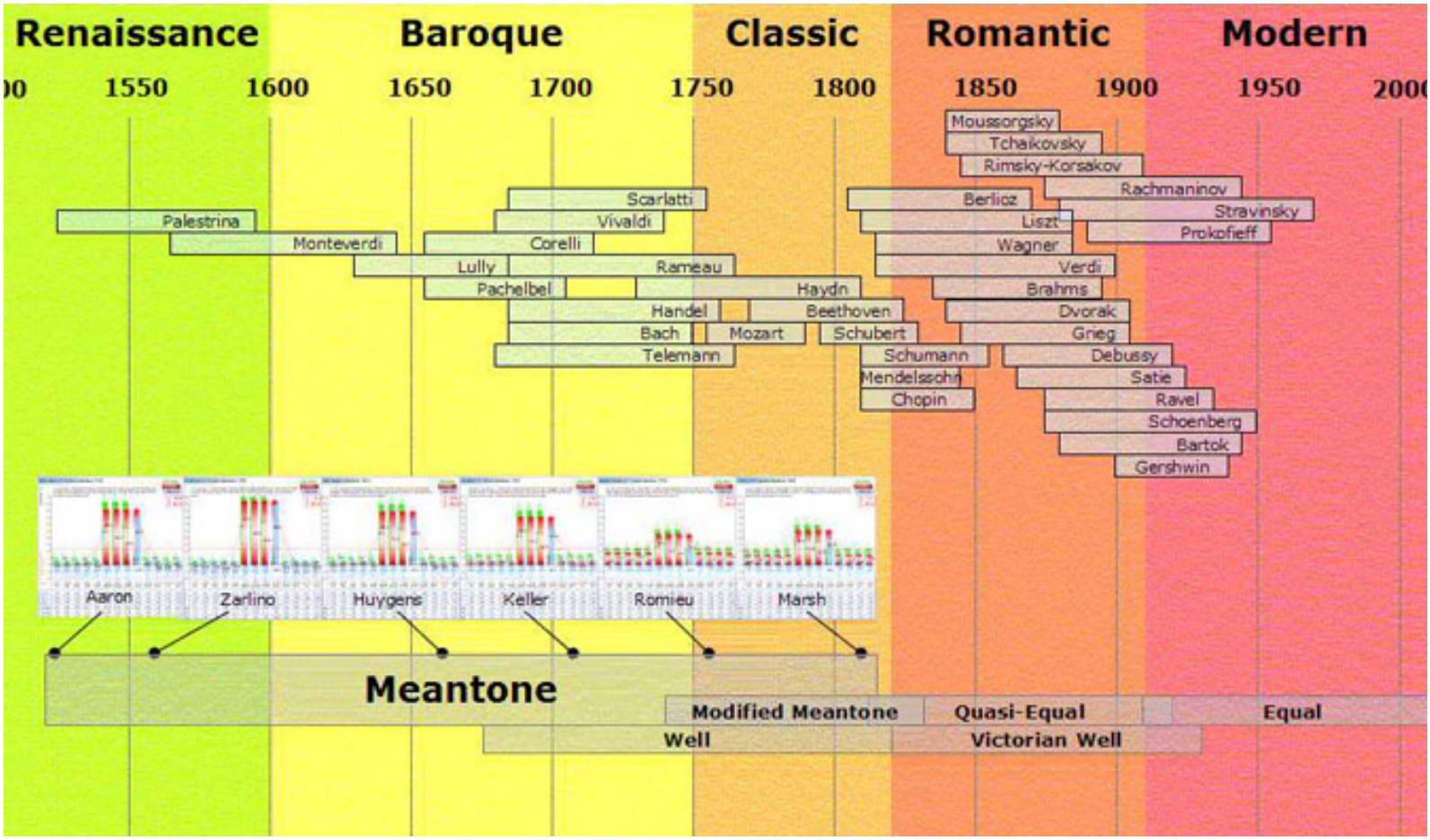
These were tuning methods aiming at equal temperament, without benefit of the correct math for setting the temperament. Most of these tunings have each note within 1 cent of "correct" equal temperament, and hence most of them would pass the strict PTG Tuning Examination. On hearing the piano played, it is unlikely that even a discriminating ear would be able to distinguish any of these tunings from perfect ET.

- Graupner: The founder of the Boston Philharmonic, Graupner wanted the fifths "rather flat" and the thirds "rather sharp than otherwise".
- Hummel: An Austrian musician, known as "Europe's greatest pianist", a student of Mozart. "The only concern for piano tuners in 1829 was that all twelve fifths should be smooth sounding." (Jorgensen, p. 407)
- Viennese: Also by Hummel. This temperament became popularly known as the Viennese.
- Ellis: "New Equal-Beating" (1885). A scientist, Ellis concluded that no one was able to tune mathematically exact equal temperament, and developed this plan to help solve the problem. He had concluded that it was impossible to count beats faster than 5/second.
- Pyle: Pyle and William Braid White both used the same bearing plan, which is the standard still in use today. Pyle started using this variation in 1884. Braid-White's became the standard for Equal Temperament.



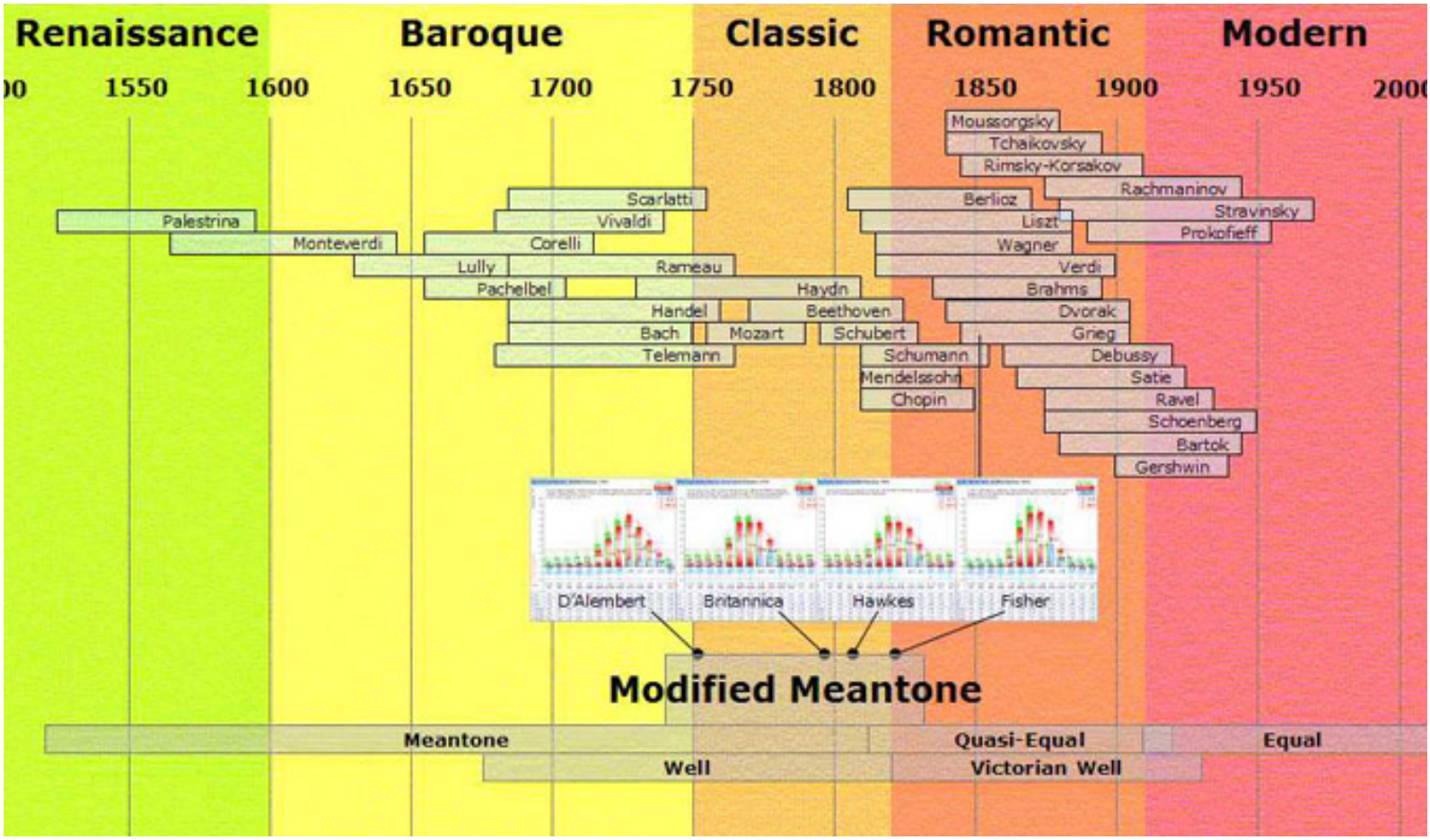
These well temperaments share certain characteristics. They all minimize the size of the major thirds in the vicinity of C on the circle of fifths, and keep the most extreme M3s to exactly or just under the "maximum" of 21.51 cents. These widest thirds are called Pythagorean Thirds because they are formed by the Pythagorean rule of tuning a series of four perfect fifths. (For example, the sequence C-F-Bb-Eb-Ab is tuned with perfect fifths, resulting in a major third Ab-C that measures 21.51 cents wide of just.
This principle can be observed exactly in Werckmeister, Kirnberger, and Prinz, and a fifth lower in Vallotti and Young.)

- Werckmeister showed that excellent well-temperaments were possible with about eight pure fifths. This version is 1/4 ditonic comma well, with tempered fifths on C, G, D and B.
- Kirnberger: German theorist, composer, student of Bach.
  C Major, G Major, E minor and B minor triads were all completely just, achieved by compromising the D and A fifths.
  Contains some of the purest harmony acoustically possible.
- Vallotti: The fifths on the white keys CDEFGA are each one-sixth ditonic comma narrow. The remaining six fifths are pure. A "very conservative" temperament.
- Young: Jorgensen lavishes this praise on the Young temperament: "Notice the complete symmetry... the even changes in the sizes of thirds...the most perfect idealized form of well temperament ever published...a summation of the best ideals of well temperament...the greatest perfection possible."
- Prinz: The major third CE is just. This assured that the Prinz contains as much color-contrast as the original Kirnberger.



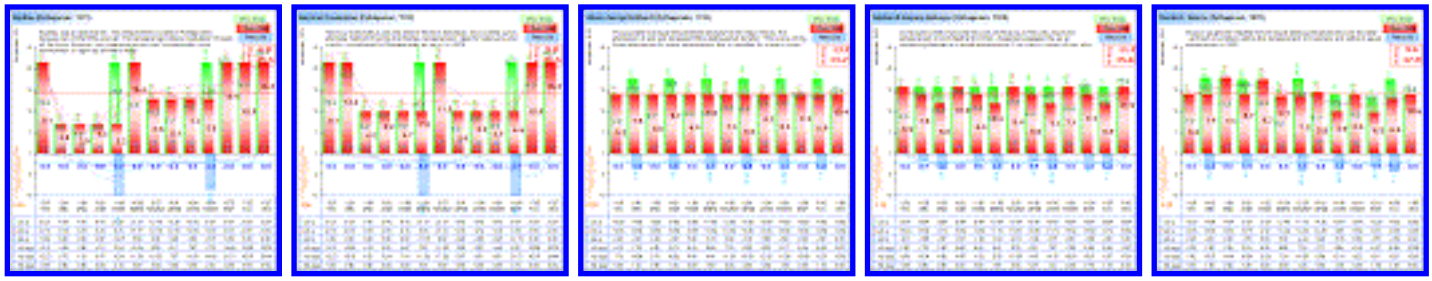
The Meantone family of temperaments strives for extremely clean major thirds in 8 keys, pushing all imperfection into the four remaining major thirds. Theoretically correct meantone temperaments have eleven fifths exactly the same size. Another characteristic is the augmented fifth (actually a diminished sixth) at Ab, the "wolf" fifth. In any meantone temperament, one-third of the potential harmony was intolerable.

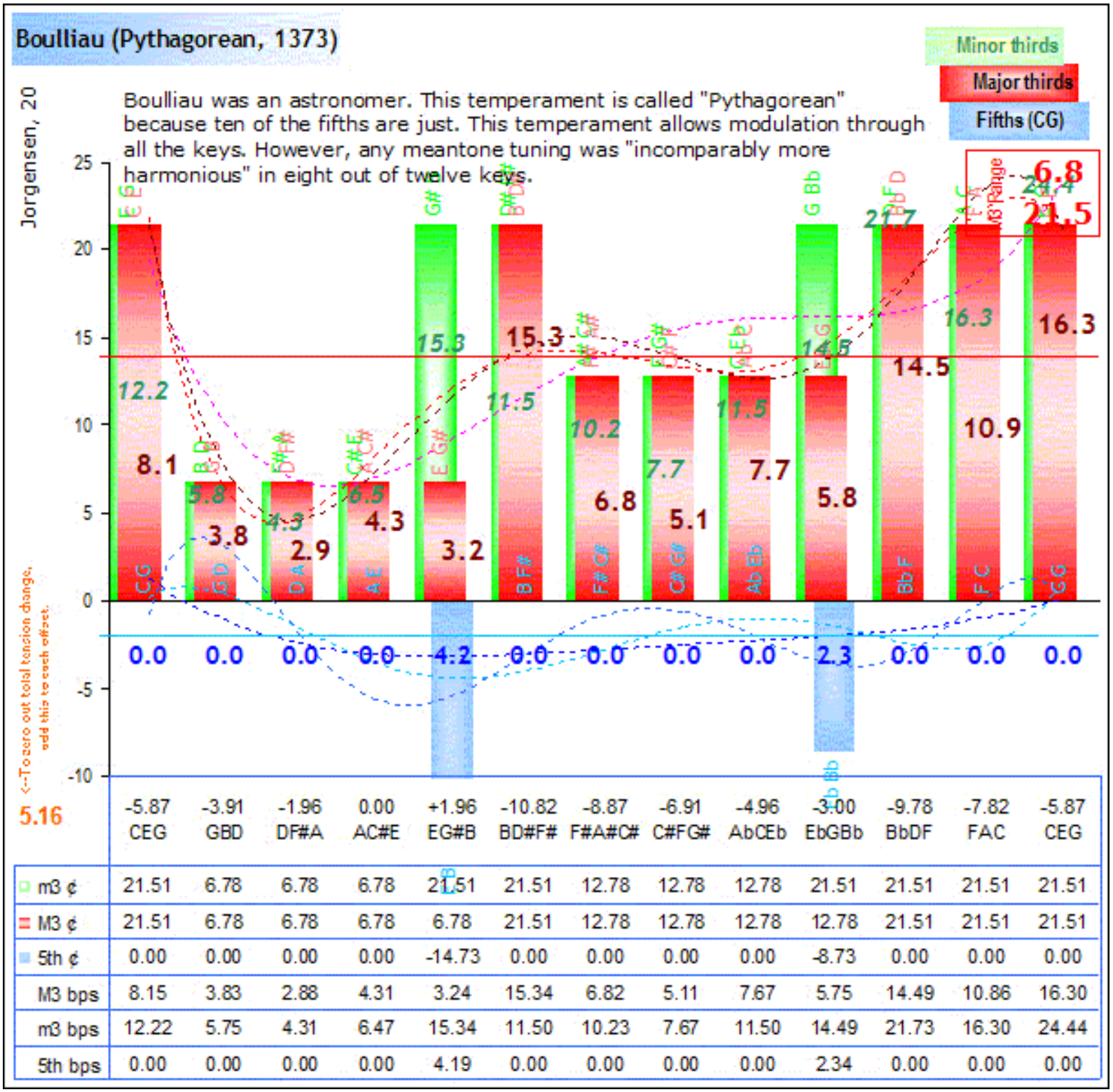
- Aaron: 1/4 syntonic comma.
- Zarlino: 2/7 syntonic comma.
- Huygens: Based on 31 equal divisions of the octave.
- Keller: Almost 1/5 Ditonic. A German harpsichordist who lived in England. He wrote: "Sharp thirds must be as sharp as the ear will permit, and all fifths as flat as the ear will permit." Keller had equal-beating major triads.
- Romieu: 1/7 comma.
- Marsh: 4/25 syntonic. Although Well temperament was quite prominent, Marsh's philosophy was that is better to have only two-thirds of the keyboard harmony tolerably in tune… he disapproved of tempering for the sake of the characters of the keys.



The purpose of modified meantone was to increase the number of good M3s to nine or more.
The price paid for this was harmonic waste in the major triads C#, Eb, Bb, F.

- D'Alembert: French mathematician.
- Britannica: By 1797, tuners had learned to modify the meantone temperament so that nine keys could be used. The Britannica described this temperament as "better adapted than any other to keyed instruments."
- Hawkes: "Improved Modified Meantone" (1807)
- Fisher: A Yale mathematics professor, Fisher studied musical compositions for interval usage, and constructed this temperament so that the C, G, D and A major thirds would be perfect.



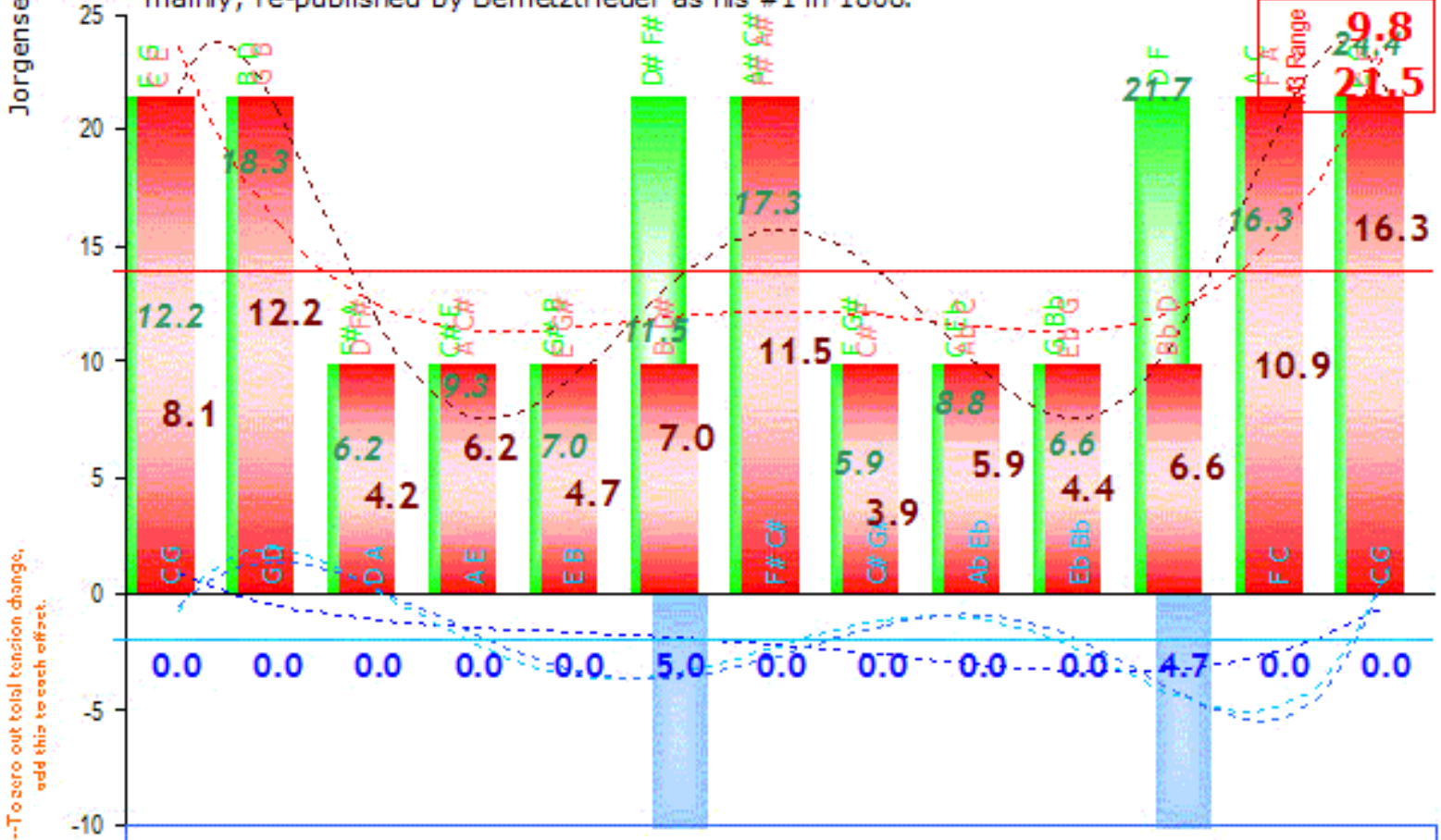

Boulliau (Pythagorean, 1373)
Minor thirds
Major thirds
Fifths (CG)
Boulliau was an astronomer. This temperament is called "Pythagorean" because ten of the fifths are just. This temperament allows modulation through all the keys. However, any meantone tuning was "incomparably more harmonious" in eight out of twelve keys.
Jorgensen, 20
<--To zero out total tension change, add this to each offset.
5.16
-5.87 CEG
-3.91 GBD
-1.96 DF#A
0.00 AC#E
+1.96 EG#B
-10.82 BD#F#
-8.87 F#A#C#
-6.91 C#FG#
-4.96 AbCEb
-3.00 EbGBb
-9.78 BbDF
-7.82 FAC
-5.87 CEG
m3 ¢
M3 ¢
5th ¢
M3 bps
m3 bps
5th bps

Henricus Grammateus (Pythagorean, 1518)

Minor thirds
Major thirds
Fifths (CG)

Jorgensen, 331

Henricus Grammateus was the alias of Heinrich Schreiber, who worked out an alternate method of tuning the Boulliau temperament. Used for lutes and viols mainly; re-published by Bemetztrieder as his #1 in 1808.



	-5.87 CEG	-3.91 GBD	-1.96 DF#A	0.00 AC#E	+1.96 EG#B	+3.91 BD#F#	-5.87 F#A#C#	-3.91 C#FG#	-1.96 AbCEb	0.00 EbGBb	+1.96 BbDF	-7.82 FAC	-5.87 CEG
m3 ¢	21.51	21.51	9.78	9.78	9.78	21.51	21.51	9.78	9.78	9.78	21.51	21.51	21.51
M3 ¢	21.51	21.51	9.78	9.78	9.78	9.78	21.51	9.78	9.78	9.78	9.78	21.51	21.51
5th ¢	0.00	0.00	0.00	0.00	0.00	-11.73	0.00	0.00	0.00	0.00	-11.73	0.00	0.00
M3 bps	8.15	12.22	4.15	6.23	4.67	7.01	11.52	3.92	5.87	4.40	6.61	10.86	16.30
m3 bps	12.22	18.33	6.23	9.34	7.01	11.52	17.28	5.87	8.81	6.61	21.73	16.30	24.44
5th bps	0.00	0.00	0.00	0.00	0.00	5.01	0.00	0.00	0.00	0.00	4.73	0.00	0.00

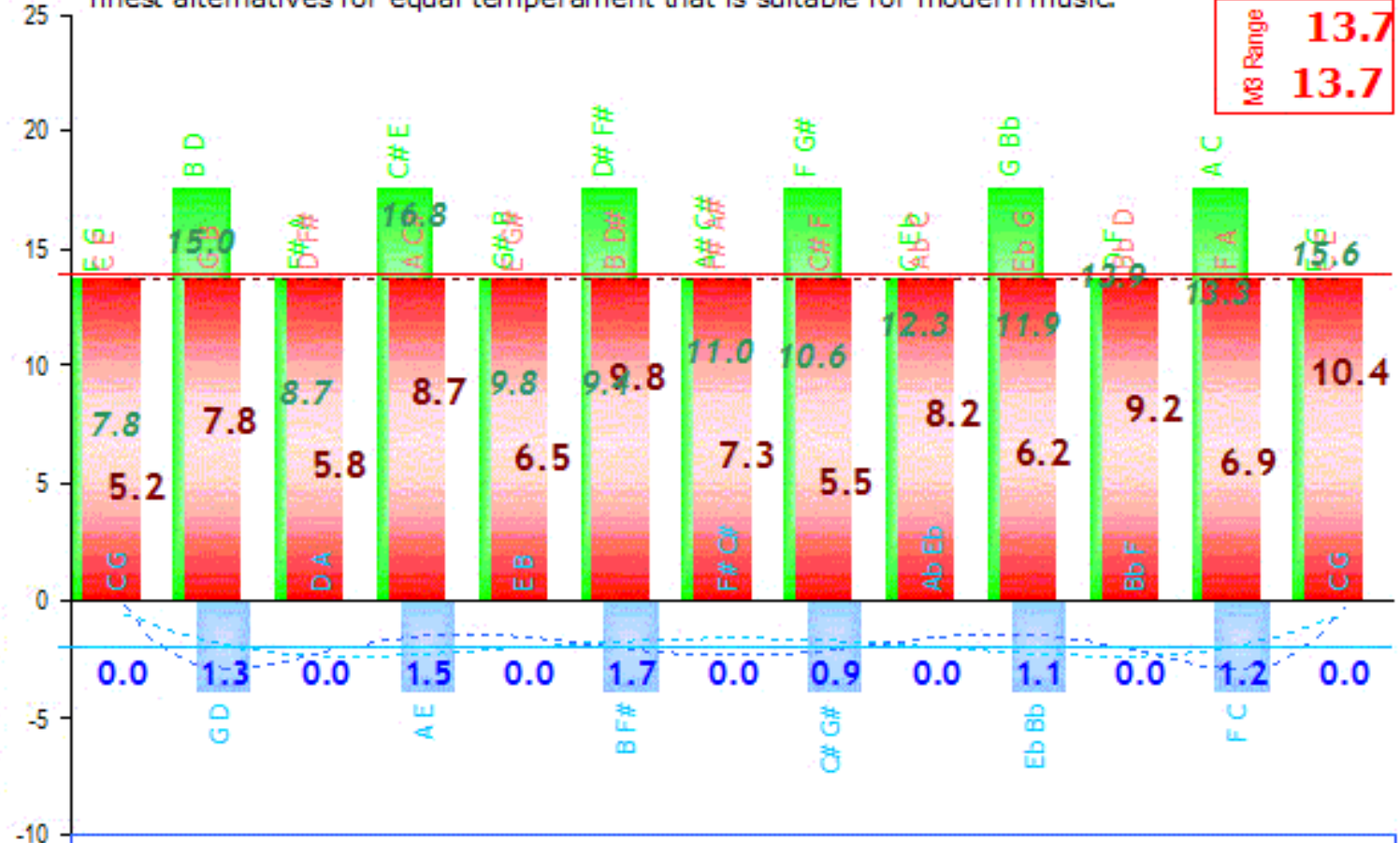
Johann George Neidhardt (Pythagorean, 1732)

Jorgensen, 478

This sounded like equal temperament because of the major thirds. The alternation of just and tempered fifths destroyed all tonality. "This is one of the finest alternatives for equal temperament that is suitable for modern music."

Minor thirds
Major thirds
Fifths (CG)

M3 Range 13.7 13.7



<--To zero out total tension change, add this to each offset.

0.98

	-1.96 CEG	0.00 GBD	-1.96 DF#A	0.00 AC#E	-1.96 EG#B	0.00 BD#F#	-1.96 F#A#C#	0.00 C#FG#	-1.96 AbCEb	0.00 EbGBb	-1.96 BbDF	0.00 FAC	-1.96 CEG
m3 ¢	13.69	17.60	13.69	17.60	13.69	17.60	13.69	17.60	13.69	17.60	13.69	17.60	13.69
M3 ¢	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69
5th ¢	0.00	-3.91	0.00	-3.91	0.00	-3.91	0.00	-3.91	0.00	-3.91	0.00	-3.91	0.00
M3 bps	5.19	7.78	5.82	8.73	6.53	9.80	7.33	5.50	8.23	6.17	9.24	6.93	10.37
m3 bps	7.78	14.98	8.73	16.82	9.80	9.44	11.00	10.59	12.35	11.89	13.86	13.35	15.56
5th bps	0.00	1.33	0.00	1.49	0.00	1.67	0.00	0.94	0.00	1.05	0.00	1.18	0.00

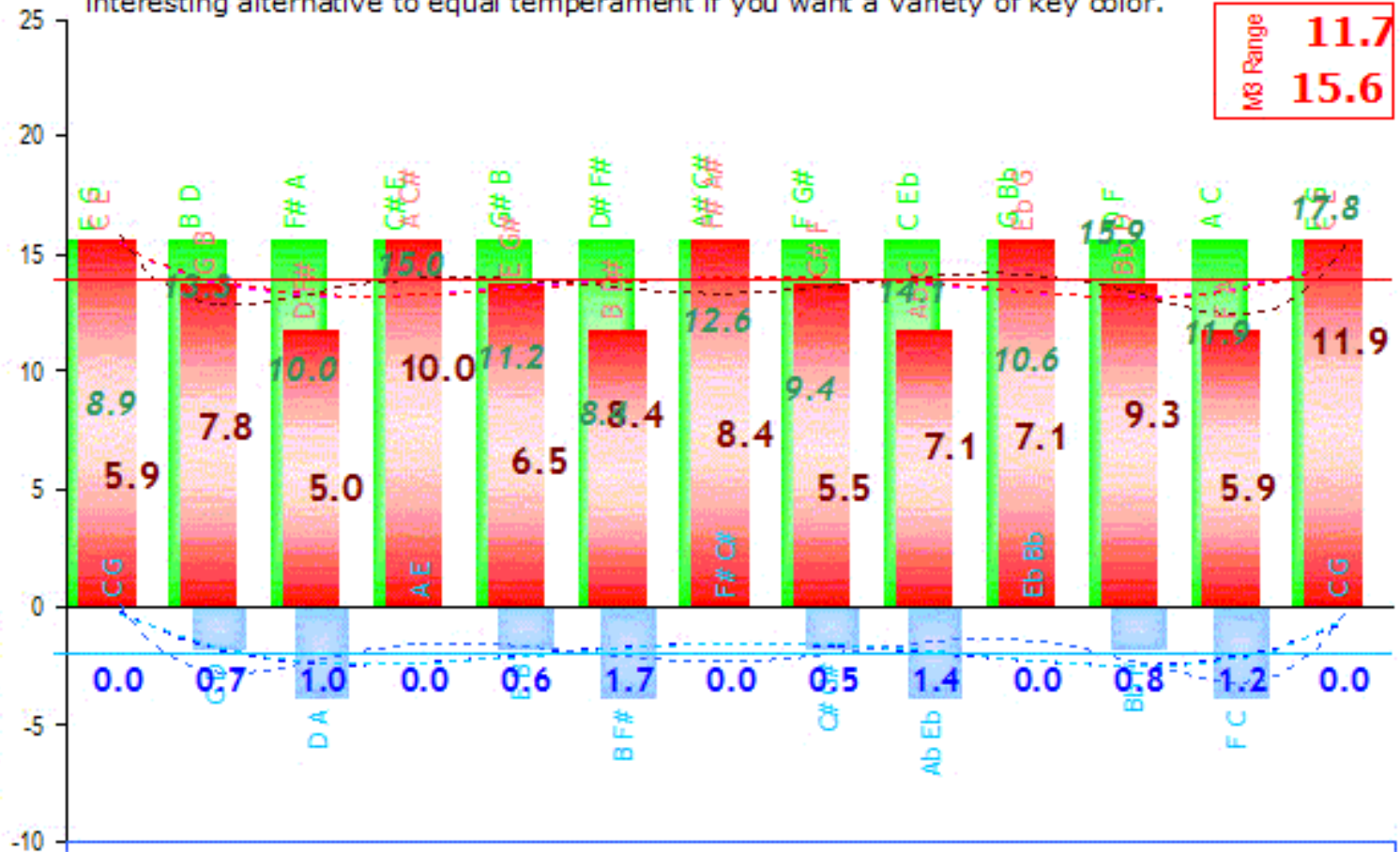
Neidhardt-Marpurg-DeMorgan (Pythagorean, 1858)

Minor thirds
Major thirds
Fifths (CG)

Jorgensen, 483

De Morgan (1858) improved the work of Marpurg (1776) who improved temperament #12 of Neidhardt (1732). Jorgensen suggests this as an interesting alternative to equal temperament if you want a variety of key color.

M3 Range 11.7 15.6



	0.00 CEG	+1.95 GBD	+1.95 DF#A	0.00 AC#E	+1.95 EG#B	+1.95 BD#F#	0.00 F#A#C#	+1.95 C#FG#	+1.95 AbCEb	0.00 EbGBb	+1.95 BbDF	+1.95 FAC	0.00 CEG
m3 ¢	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64
M3 ¢	15.64	13.69	11.74	15.64	13.69	11.74	15.64	13.69	11.74	15.64	13.69	11.74	15.64
5th ¢	-0.01	-1.96	-3.91	-0.01	-1.96	-3.91	-0.01	-1.96	-3.91	-0.01	-1.96	-3.91	-0.01
M3 bps	5.93	7.79	5.00	9.98	6.55	8.41	8.39	5.51	7.07	7.06	9.26	5.95	11.87
m3 bps	8.90	13.34	9.98	14.97	11.22	8.39	12.59	9.43	14.12	10.59	15.87	11.87	17.81
5th bps	0.00	0.66	0.99	0.00	0.56	1.67	0.00	0.47	1.41	0.00	0.79	1.18	0.00

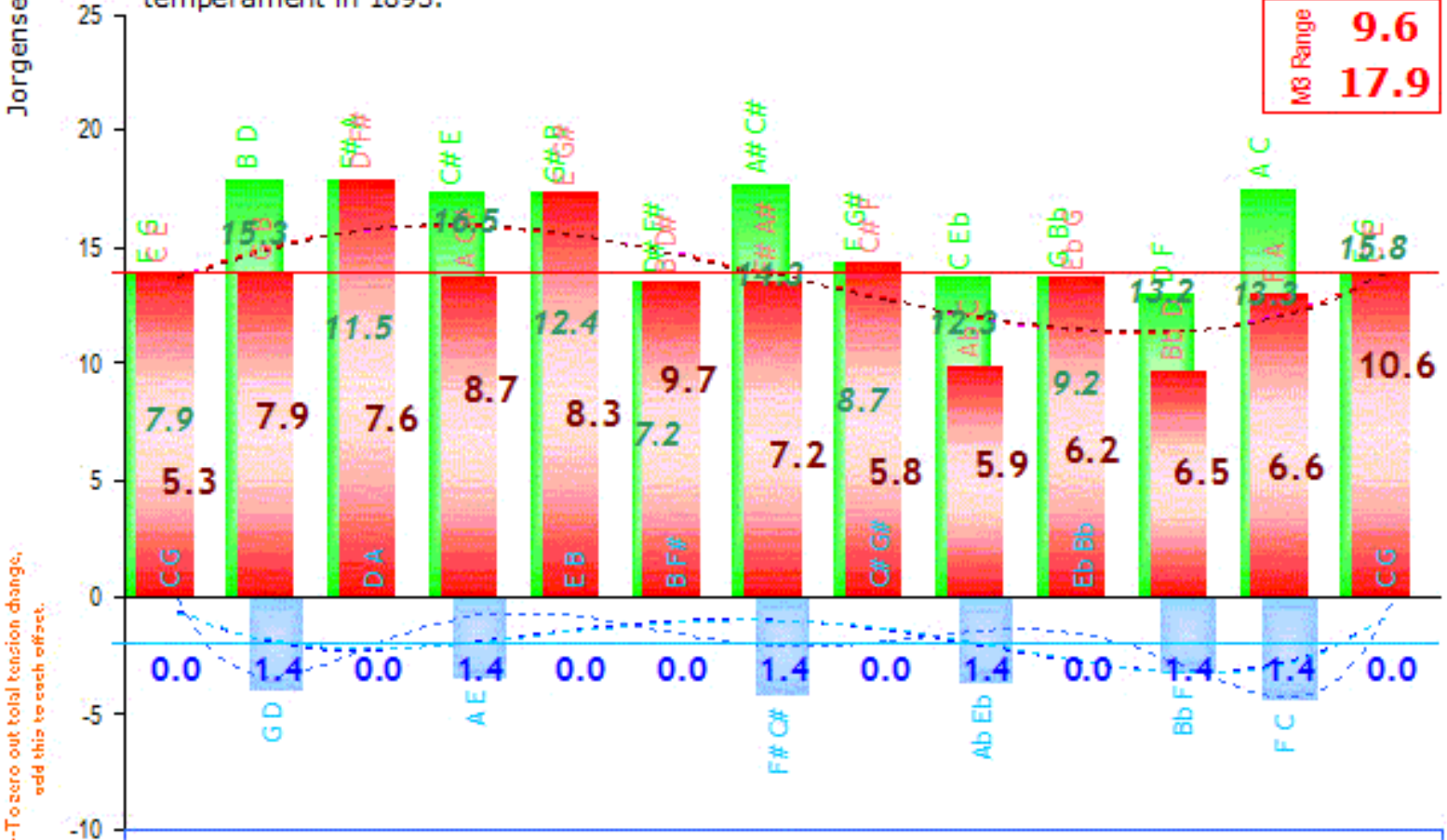
Charles E. Moscow (Pythagorean, 1895)

Jorgensen, 616

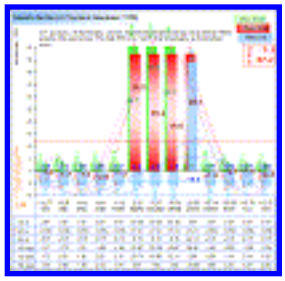
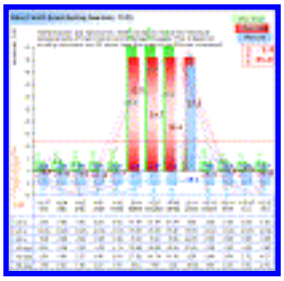
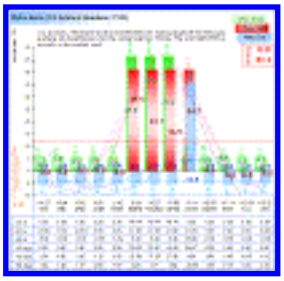
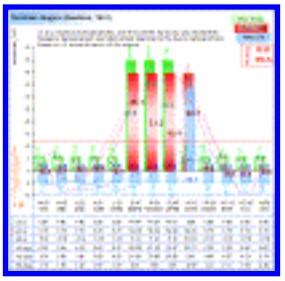
Minor thirds
Major thirds
Fifths (CG)

Moscow sought the "easiest-to-tune equal-beating temperament ever devised" -- and had no problem selling this temperament to musicians and calling it equal temperament in 1895.

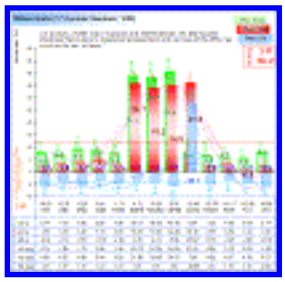
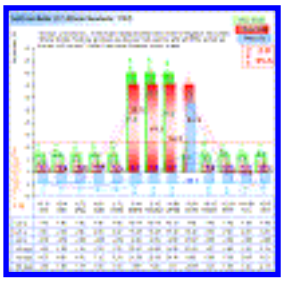
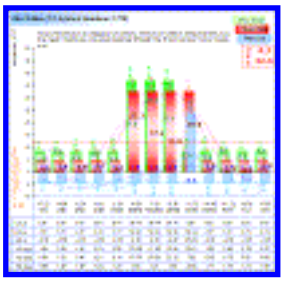
M3 Range 9.6 17.9



	-1.86 CEG	+0.10 GBD	-1.96 DF#A	0.00 AC#E	-1.62 EG#B	+0.34 BD#F#	+2.29 F#A#C#	+0.01 C#FG#	+1.96 AbCEb	+0.14 EbGBb	+2.10 BbDF	+0.69 FAC	-1.86 CEG
m3 ¢	13.93	17.94	17.94	17.27	17.27	13.49	17.73	14.36	13.64	13.64	13.00	17.50	13.93
M3 ¢	13.93	13.93	17.94	13.70	17.27	13.49	13.49	14.36	9.86	13.64	9.64	13.00	13.93
5th ¢	0.00	-4.01	0.00	-3.57	0.00	0.00	-4.24	0.00	-3.78	0.00	-3.37	-4.50	0.00
M3 bps	5.28	7.92	7.64	8.74	8.25	9.66	7.24	5.77	5.94	6.15	6.51	6.58	10.56
m3 bps	7.92	15.27	11.46	16.50	12.38	7.24	14.26	8.66	12.31	9.23	13.17	13.27	15.83
5th bps	0.00	1.36	0.00	1.36	0.00	0.00	1.36	0.00	1.36	0.00	1.36	1.36	0.00

.. Zarlino ... Smith ... Aaron ... Huygens

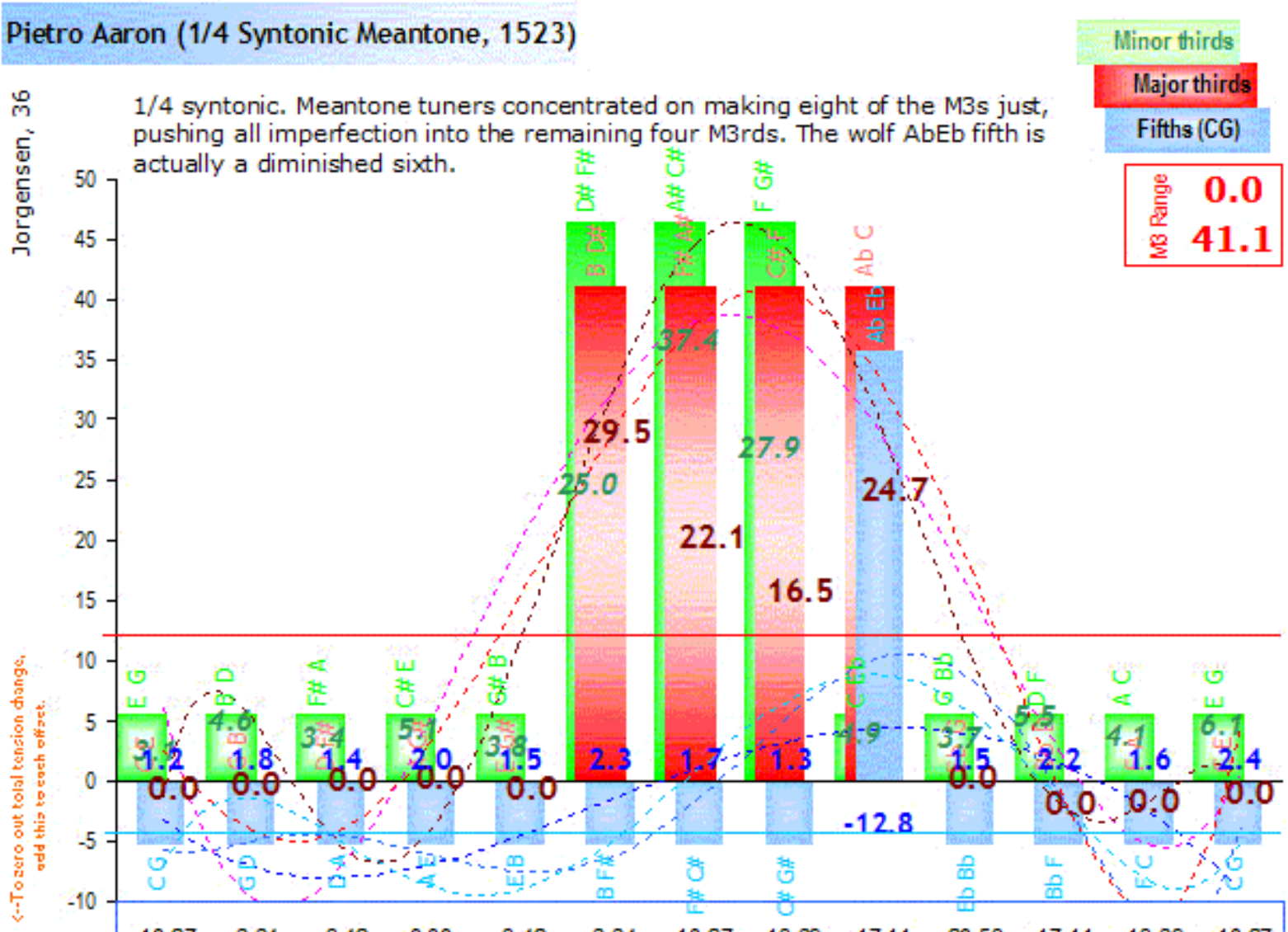

.. Holder ... Keller ... Holden ... Silbermann


.. Marsh ... Romieu

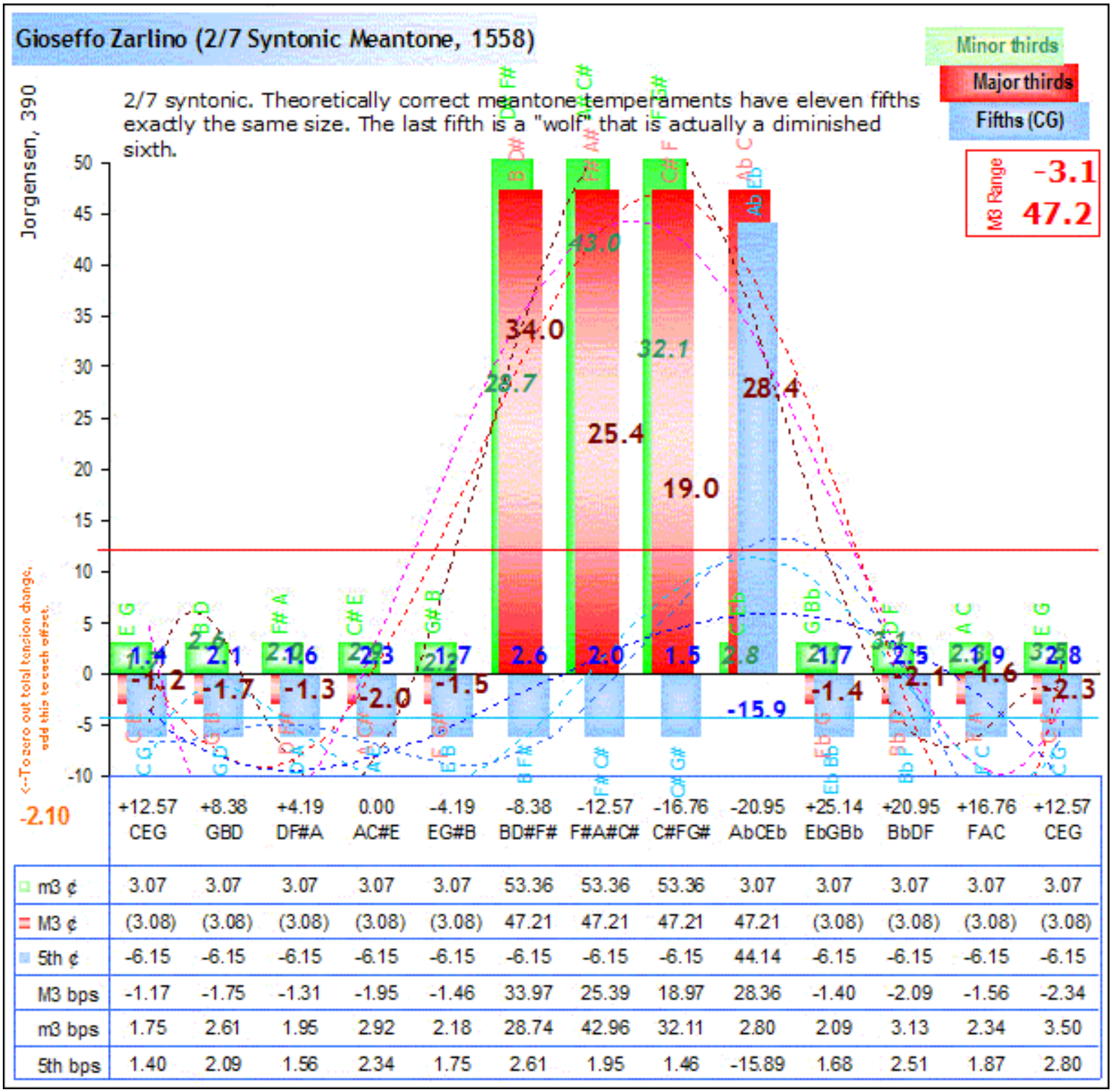
Pietro Aaron (1/4 Syntonic Meantone, 1523)

Jorgensen, 36

1/4 syntonic. Meantone tuners concentrated on making eight of the M3s just, pushing all imperfection into the remaining four M3rds. The wolf AbEb fifth is actually a diminished sixth.



	+10.27 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-6.84 BD#F#	-10.27 F#A#C#	-13.69 C#FG#	-17.11 AbCEb	+20.53 EbGBb	+17.11 BbDF	+13.69 FAC	+10.27 CEG
m3 ¢	5.38	5.38	5.38	5.38	5.38	46.44	46.44	46.44	5.38	5.38	5.38	5.38	5.38
M3 ¢	(0.00)	0.00	(0.00)	0.00	0.00	41.06	41.06	41.06	41.06	0.00	0.00	0.00	(0.00)
5th ¢	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	35.68	-5.38	-5.38	-5.38	-5.38
M3 bps	0.00	0.00	0.00	0.00	0.00	29.52	22.07	16.50	24.67	0.00	0.00	0.00	0.00
m3 bps	3.06	4.58	3.42	5.12	3.83	25.00	37.38	27.95	4.90	3.66	5.48	4.09	6.12
5th bps	1.22	1.83	1.37	2.05	1.53	2.29	1.71	1.28	-12.85	1.46	2.19	1.64	2.45



	+12.57 CEG	+8.38 GBD	+4.19 DF#A	0.00 AC#E	-4.19 EG#B	-8.38 BD#F#	-12.57 F#A#C#	-16.76 C#FG#	-20.95 AbCEb	+25.14 EbGBb	+20.95 BbDF	+16.76 FAC	+12.57 CEG
m3 ¢	3.07	3.07	3.07	3.07	3.07	53.36	53.36	53.36	3.07	3.07	3.07	3.07	3.07
M3 ¢	(3.08)	(3.08)	(3.08)	(3.08)	(3.08)	47.21	47.21	47.21	47.21	(3.08)	(3.08)	(3.08)	(3.08)
5th ¢	-6.15	-6.15	-6.15	-6.15	-6.15	-6.15	-6.15	-6.15	44.14	-6.15	-6.15	-6.15	-6.15
M3 bps	-1.17	-1.75	-1.31	-1.95	-1.46	33.97	25.39	18.97	28.36	-1.40	-2.09	-1.56	-2.34
m3 bps	1.75	2.61	1.95	2.92	2.18	28.74	42.96	32.11	2.80	2.09	3.13	2.34	3.50
5th bps	1.40	2.09	1.56	2.34	1.75	2.61	1.95	1.46	-15.89	1.68	2.51	1.87	2.80

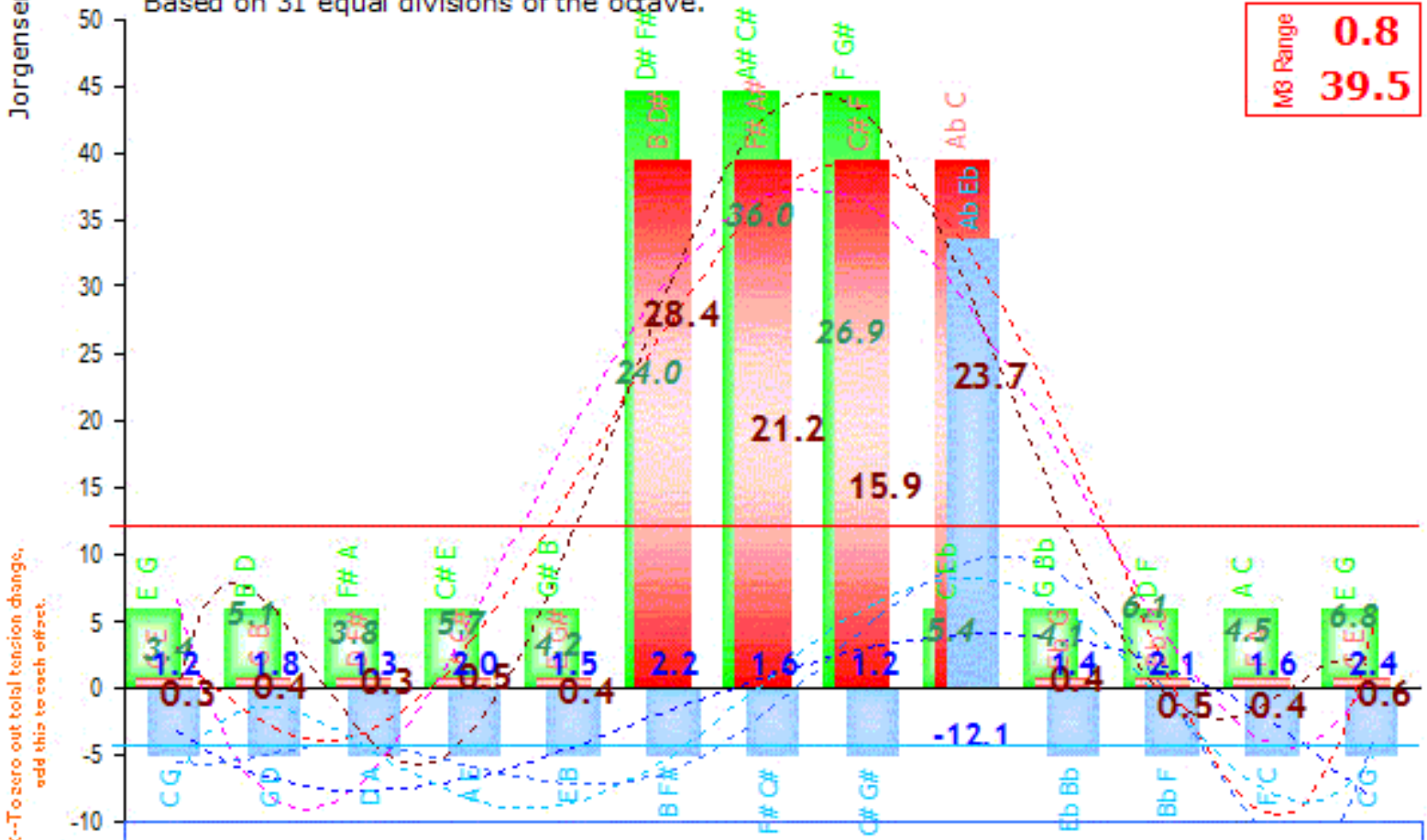
Christiaan Huygens (Meantone, 1661)

Jorgensen, 102

In any meantone temperament, one-third of the harmony was intolerable.
Huygens' temperament sounded almost identical to the Aaron temperament.
Based on 31 equal divisions of the octave.

Minor thirds
Major thirds
Fifths (CG)

M3 Range 0.8 39.5

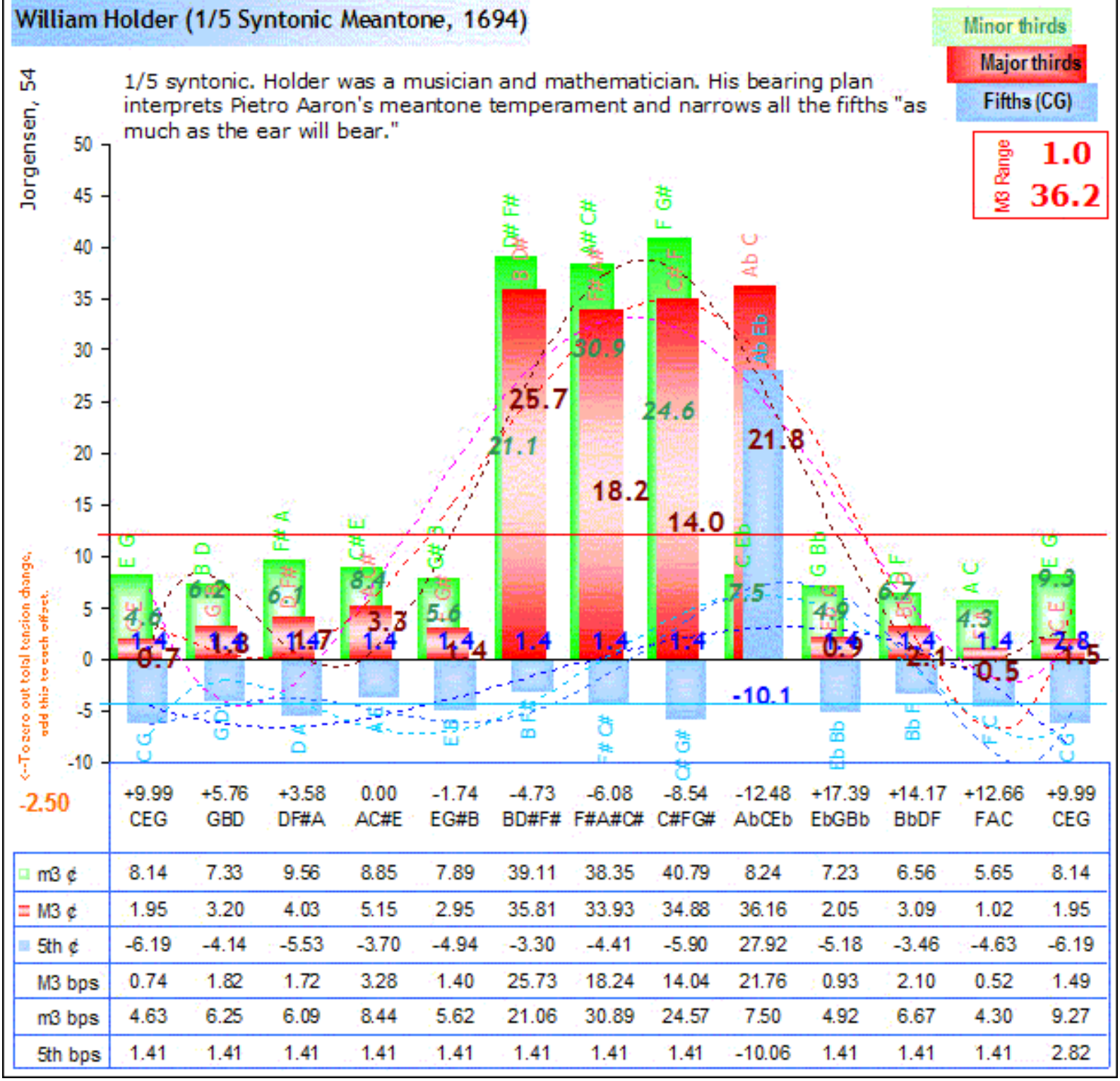


	+9.68 CEG	+6.45 GBD	+3.23 DF#A	0.00 AC#E	-3.23 EG#B	-6.45 BD#F#	-9.68 F#A#C#	-12.90 C#FG#	-16.13 AbCEb	+19.36 EbGBb	+16.13 BbDF	+12.90 FAC	+9.68 CEG
m3 ¢	5.96	5.96	5.96	5.96	5.96	44.67	44.67	44.67	5.96	5.96	5.96	5.96	5.96
M3 ¢	0.78	0.78	0.78	0.78	0.78	39.49	39.49	39.49	39.49	0.78	0.78	0.78	0.78
5th ¢	-5.18	-5.18	-5.18	-5.18	-5.18	-5.18	-5.18	-5.18	33.53	-5.18	-5.18	-5.18	-5.18
M3 bps	0.30	0.44	0.33	0.50	0.37	28.38	21.22	15.87	23.73	0.36	0.53	0.40	0.60
m3 bps	3.39	5.08	3.80	5.68	4.25	24.04	35.96	26.89	5.43	4.06	6.07	4.54	6.79
5th bps	1.18	1.76	1.32	1.97	1.47	2.21	1.65	1.23	-12.07	1.41	2.11	1.58	2.36

William Holder (1/5 Syntonic Meantone, 1694)

Jorgensen, 54

1/5 syntonic. Holder was a musician and mathematician. His bearing plan interprets Pietro Aaron's meantone temperament and narrows all the fifths "as much as the ear will bear."



	+9.99 CEG	+5.76 GBD	+3.58 DF#A	0.00 AC#E	-1.74 EG#B	-4.73 BD#F#	-6.08 F#A#C#	-8.54 C#FG#	-12.48 AbCEb	+17.39 EbGBb	+14.17 BbDF	+12.66 FAC	+9.99 CEG
m3 ¢	8.14	7.33	9.56	8.85	7.89	39.11	38.35	40.79	8.24	7.23	6.56	5.65	8.14
M3 ¢	1.95	3.20	4.03	5.15	2.95	35.81	33.93	34.88	36.16	2.05	3.09	1.02	1.95
5th ¢	-6.19	-4.14	-5.53	-3.70	-4.94	-3.30	-4.41	-5.90	27.92	-5.18	-3.46	-4.63	-6.19
M3 bps	0.74	1.82	1.72	3.28	1.40	25.73	18.24	14.04	21.76	0.93	2.10	0.52	1.49
m3 bps	4.63	6.25	6.09	8.44	5.62	21.06	30.89	24.57	7.50	4.92	6.67	4.30	9.27
5th bps	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	-10.06	1.41	1.41	1.41	2.82

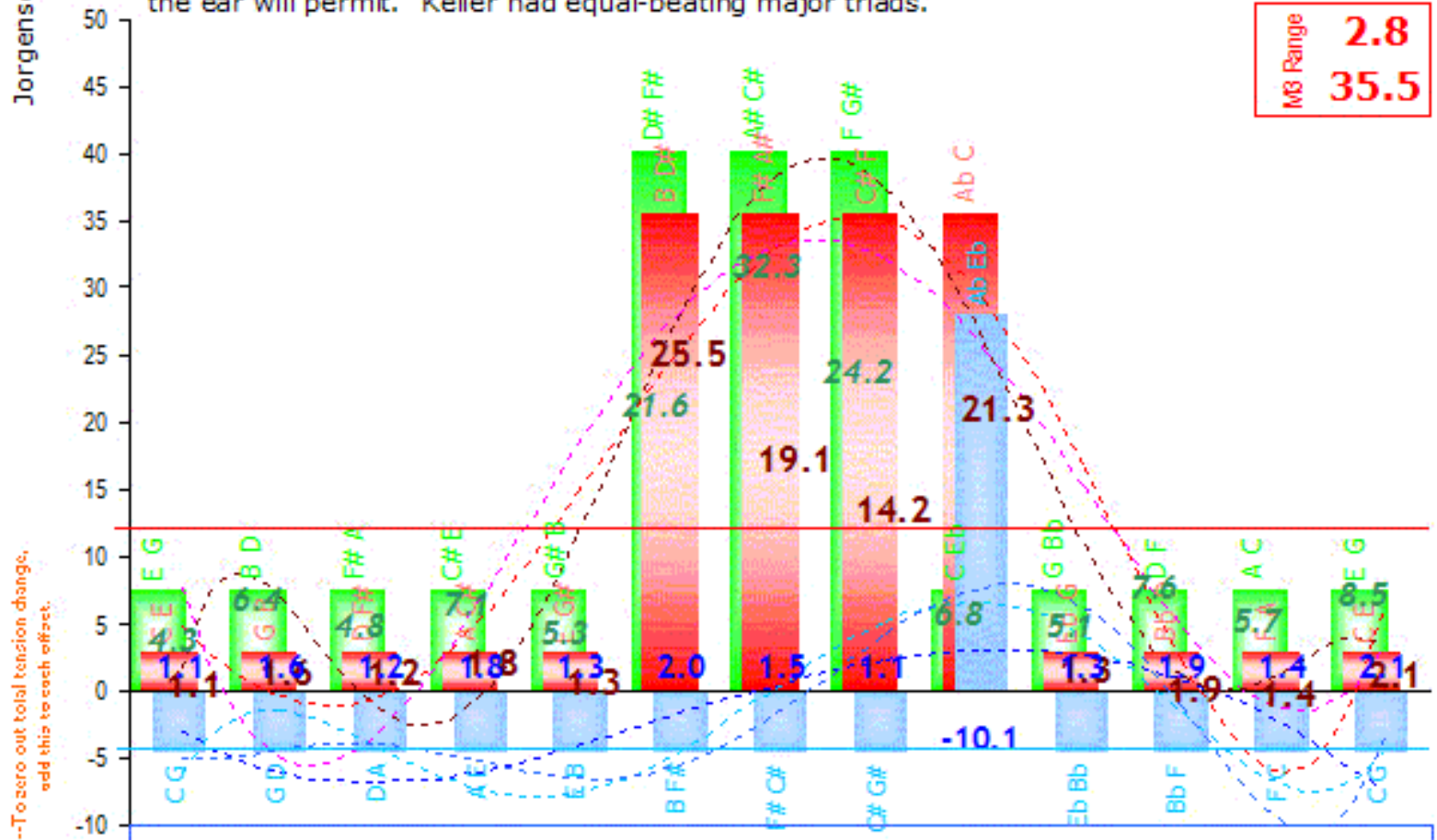
Gottfried Keller (1/5 Ditonic Meantone, 1707)

Jorgensen, 61

"Almost 1/5 Ditonic". A German harpsichordist who lived in England. He wrote: "Sharp thirds must be as sharp as the ear will permit, and all fifths as flat as the ear will permit." Keller had equal-beating major triads.

Minor thirds
Major thirds
Fifths (CG)

M3 Range 2.8 35.5



	+8.16 CEG	+5.44 GBD	+2.72 DF#A	0.00 AC#E	-2.72 EG#B	-5.44 BD#F#	-8.16 F#A#C#	-10.89 C#FG#	-13.61 AbCEb	+16.33 EbGBb	+13.61 BbDF	+10.89 FAC	+8.16 CEG
m3 ¢	7.48	7.48	7.48	7.48	7.48	40.14	40.14	40.14	7.48	7.48	7.48	7.48	7.48
M3 ¢	2.80	2.80	2.80	2.80	2.80	35.46	35.46	35.46	35.46	2.80	2.80	2.80	2.80
5th ¢	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	-4.68	27.98	-4.68	-4.68	-4.68	-4.68
M3 bps	1.06	1.59	1.19	1.78	1.33	25.47	19.05	14.25	21.32	1.27	1.90	1.42	2.13
m3 bps	4.25	6.36	4.76	7.12	5.33	21.59	32.30	24.16	6.80	5.08	7.60	5.69	8.51
5th bps	1.06	1.59	1.19	1.78	1.33	1.99	1.49	1.11	-10.07	1.27	1.90	1.42	2.13

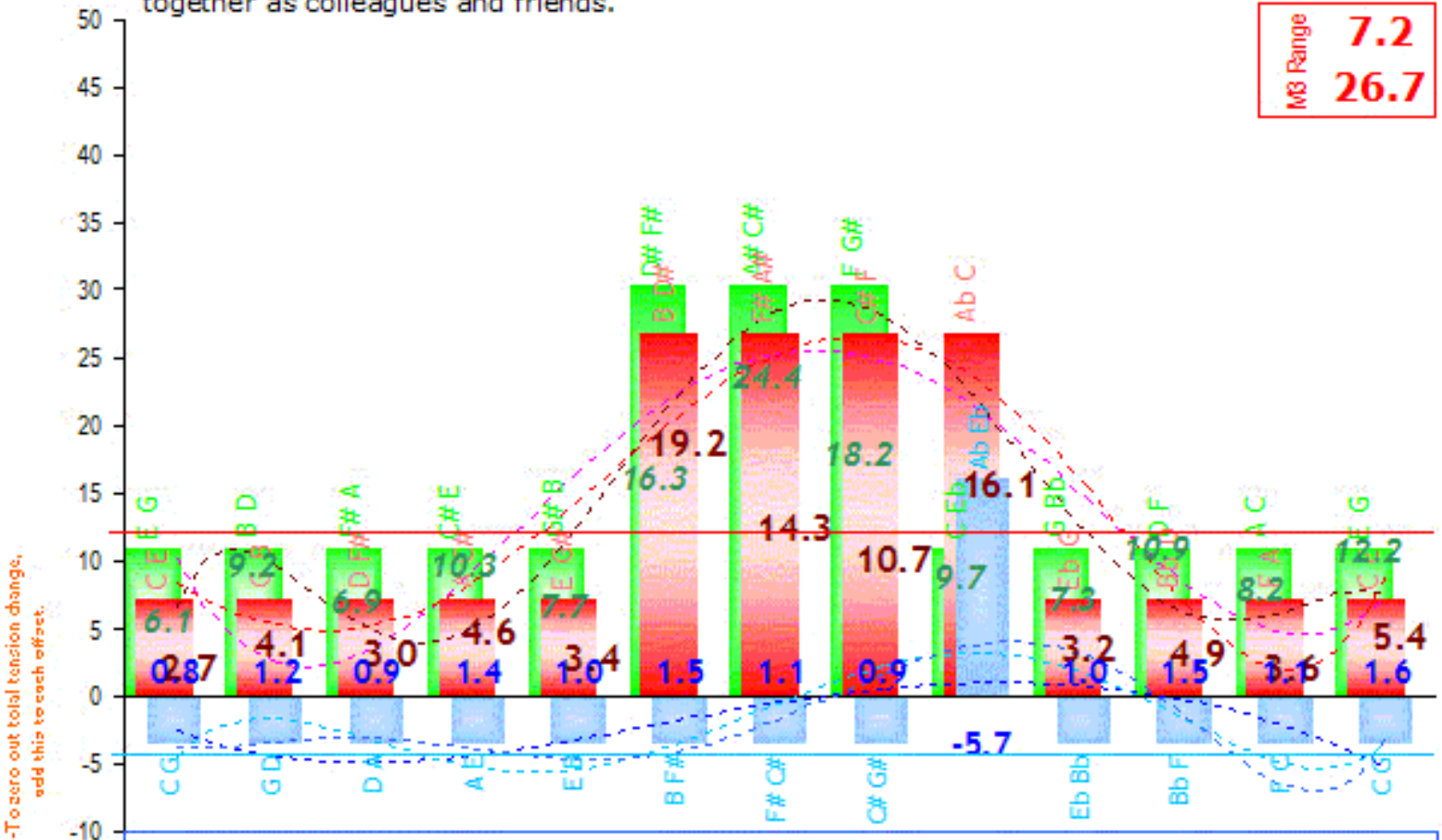
Gottfried Silbermann (1/6 Syntonic Meantone, 1714)

Minor thirds
Major thirds
Fifths (CG)

M3 Range 7.2 26.7

web

Gottfried Silbermann, an organ builder, (1683-1753) and Johann Sebastian Bach (1685-1750) were contemporaries and are known to have worked together as colleagues and friends.

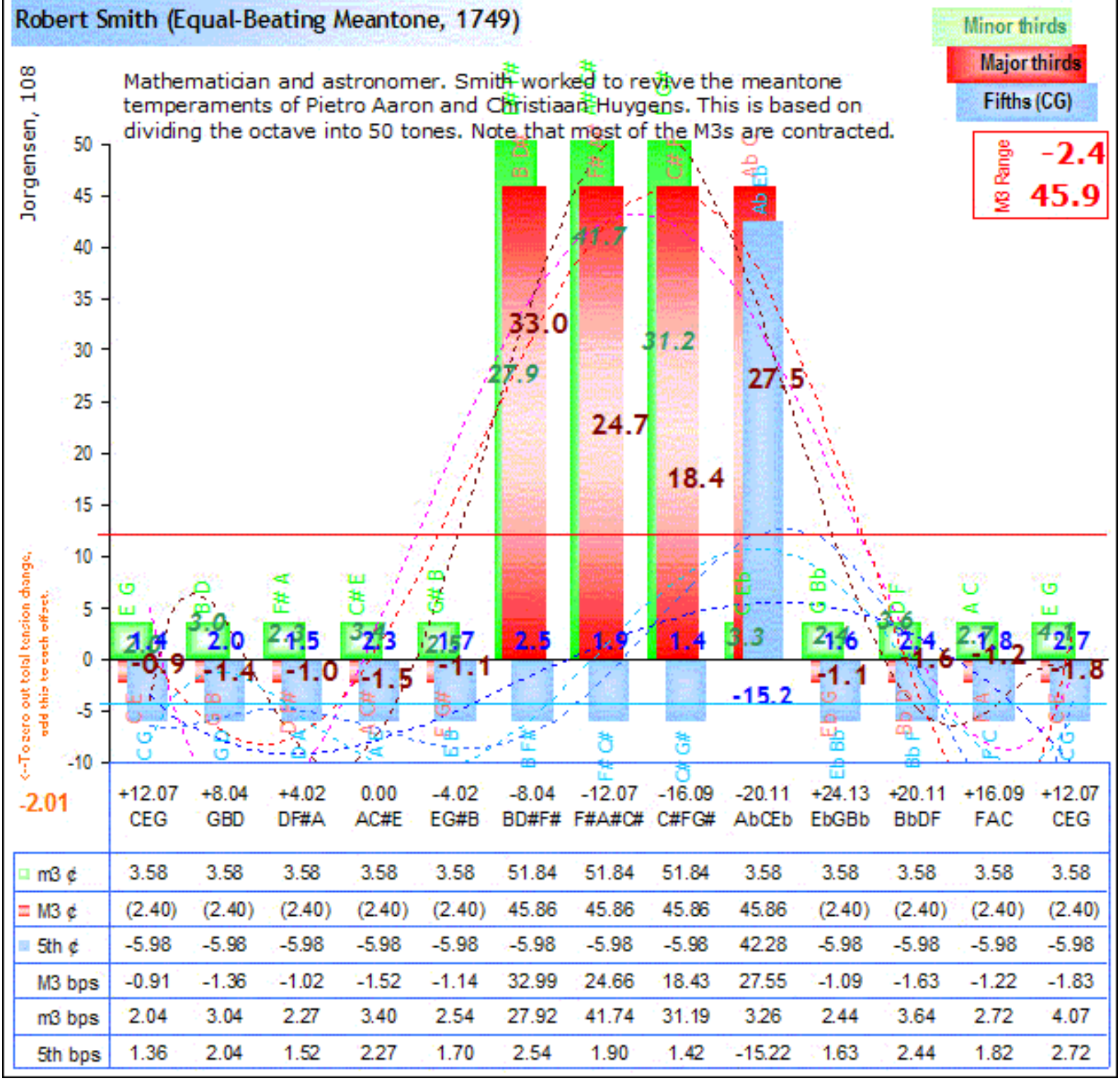


	+4.89 CEG	+3.26 GBD	+1.63 DF#A	0.00 AC#E	-1.63 EG#B	-3.26 BD#F#	-4.89 F#A#C#	-6.52 C#FG#	-8.15 AbCEb	+9.78 EbGBb	+8.15 BbDF	+6.52 FAC	+4.89 CEG
m3 ¢	10.75	10.75	10.75	10.75	10.75	30.31	30.31	30.31	10.75	10.75	10.75	10.75	10.75
M3 ¢	7.17	7.17	7.17	7.17	7.17	26.72	26.72	26.72	26.72	7.17	7.17	7.17	7.17
5th ¢	-3.58	-3.58	-3.58	-3.58	-3.58	-3.58	-3.58	-3.58	15.97	-3.58	-3.58	-3.58	-3.58
M3 bps	2.72	4.07	3.05	4.56	3.42	19.17	14.35	10.74	16.07	3.25	4.86	3.64	5.44
m3 bps	6.12	9.16	6.85	10.26	7.68	16.29	24.38	18.25	9.75	7.30	10.92	8.17	12.23
5th bps	0.81	1.22	0.91	1.37	1.02	1.53	1.14	0.86	-5.75	0.97	1.45	1.09	1.63

Robert Smith (Equal-Beating Meantone, 1749)

Jorgensen, 108

Mathematician and astronomer. Smith worked to revive the meantone temperaments of Pietro Aaron and Christiaan Huygens. This is based on dividing the octave into 50 tones. Note that most of the M3s are contracted.



	+12.07 CEG	+8.04 GBD	+4.02 DF#A	0.00 AC#E	-4.02 EG#B	-8.04 BD#F#	-12.07 F#A#C#	-16.09 C#FG#	-20.11 AbCEb	+24.13 EbGBb	+20.11 BbDF	+16.09 FAC	+12.07 CEG
m3 ¢	3.58	3.58	3.58	3.58	3.58	51.84	51.84	51.84	3.58	3.58	3.58	3.58	3.58
M3 ¢	(2.40)	(2.40)	(2.40)	(2.40)	(2.40)	45.86	45.86	45.86	45.86	(2.40)	(2.40)	(2.40)	(2.40)
5th ¢	-5.98	-5.98	-5.98	-5.98	-5.98	-5.98	-5.98	-5.98	42.28	-5.98	-5.98	-5.98	-5.98
M3 bps	-0.91	-1.36	-1.02	-1.52	-1.14	32.99	24.66	18.43	27.55	-1.09	-1.63	-1.22	-1.83
m3 bps	2.04	3.04	2.27	3.40	2.54	27.92	41.74	31.19	3.26	2.44	3.64	2.72	4.07
5th bps	1.36	2.04	1.52	2.27	1.70	2.54	1.90	1.42	-15.22	1.63	2.44	1.82	2.72

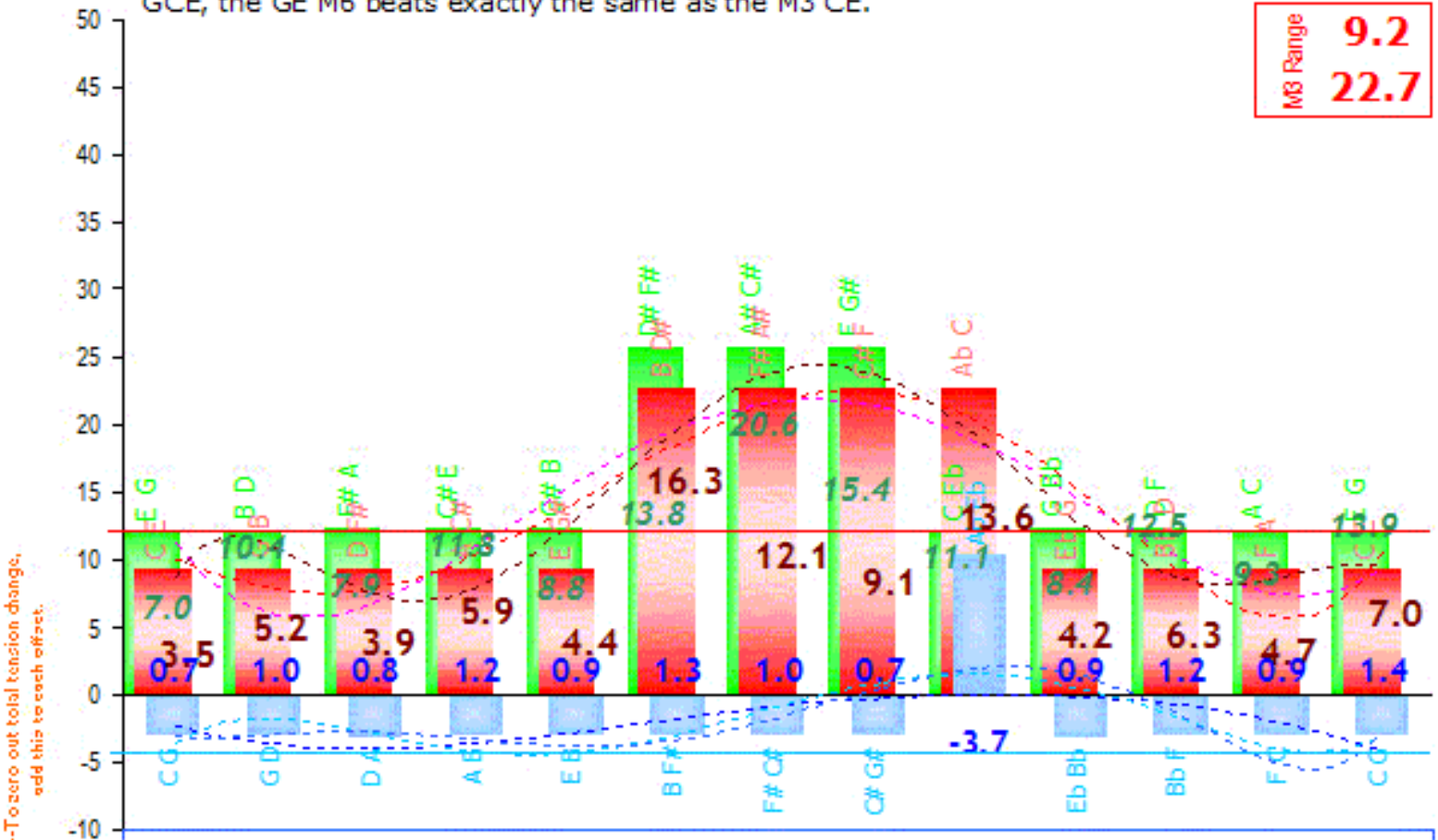
Jean-Baptiste Romieu (1/7 Comma Meantone, 1755)

web

1/7 comma meantone. Note that in most of the playable major triads, the m3 (EG) beats exactly twice the rate of the M3 (CE). Therefore in the inverted triad GCE, the GE M6 beats exactly the same as the M3 CE.

Minor thirds
Major thirds
Fifths (CG)

M3 Range 9.2 22.7

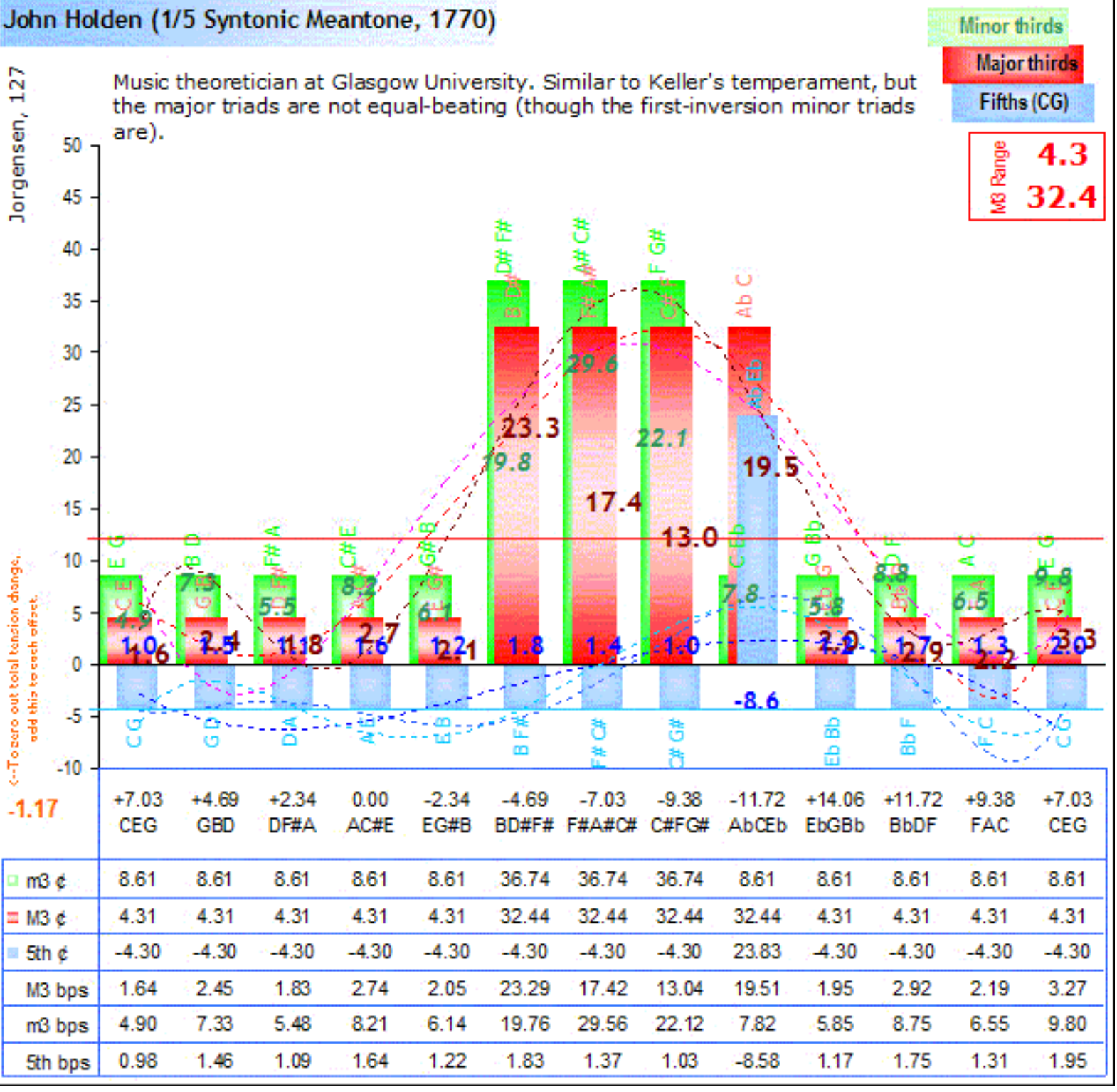


	+3.40 CEG	+2.30 GBD	+1.20 DF#A	0.00 AC#E	-1.10 EG#B	-2.20 BD#F#	-3.30 F#A#C#	-4.40 C#FG#	-5.50 AbCEb	+6.80 EbGBb	+5.60 BbDF	+4.50 FAC	+3.40 CEG
m3 ¢	12.24	12.24	12.34	12.34	12.34	25.74	25.64	25.64	12.24	12.34	12.34	12.24	12.24
M3 ¢	9.19	9.19	9.19	9.29	9.29	22.69	22.59	22.59	22.59	9.19	9.29	9.19	9.19
5th ¢	-3.06	-3.06	-3.16	-3.06	-3.06	-3.06	-3.06	-3.06	10.34	-3.16	-3.06	-3.06	-3.06
M3 bps	3.49	5.22	3.91	5.92	4.43	16.27	12.12	9.08	13.59	4.15	6.29	4.66	6.97
m3 bps	6.96	10.43	7.87	11.78	8.82	13.83	20.63	15.44	11.08	8.36	12.52	9.30	13.93
5th bps	0.69	1.04	0.80	1.16	0.87	1.30	0.98	0.73	-3.72	0.85	1.24	0.93	1.39

John Holden (1/5 Syntonic Meantone, 1770)

Jorgensen, 127

Music theoretician at Glasgow University. Similar to Keller's temperament, but the major triads are not equal-beating (though the first-inversion minor triads are).



	+7.03 CEG	+4.69 GBD	+2.34 DF#A	0.00 AC#E	-2.34 EG#B	-4.69 BD#F#	-7.03 F#A#C#	-9.38 C#FG#	-11.72 AbCEb	+14.06 EbGBb	+11.72 BbDF	+9.38 FAC	+7.03 CEG
m3 ¢	8.61	8.61	8.61	8.61	8.61	36.74	36.74	36.74	8.61	8.61	8.61	8.61	8.61
M3 ¢	4.31	4.31	4.31	4.31	4.31	32.44	32.44	32.44	32.44	4.31	4.31	4.31	4.31
5th ¢	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	23.83	-4.30	-4.30	-4.30	-4.30
M3 bps	1.64	2.45	1.83	2.74	2.05	23.29	17.42	13.04	19.51	1.95	2.92	2.19	3.27
m3 bps	4.90	7.33	5.48	8.21	6.14	19.76	29.56	22.12	7.82	5.85	8.75	6.55	9.80
5th bps	0.98	1.46	1.09	1.64	1.22	1.83	1.37	1.03	-8.58	1.17	1.75	1.31	1.95

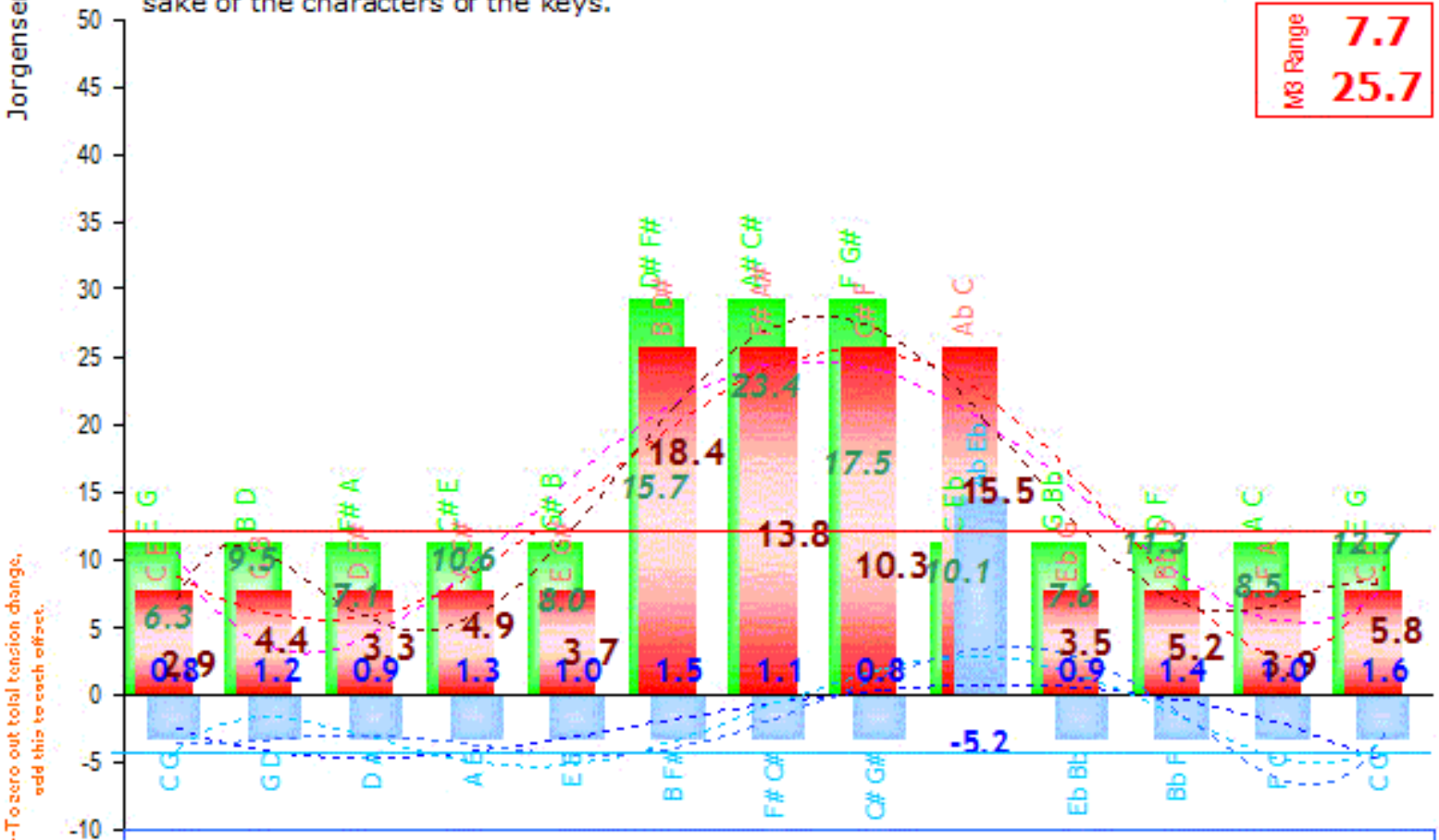
John Marsh (4/25 Syntonic Meantone, 1809)

Jorgensen, 345

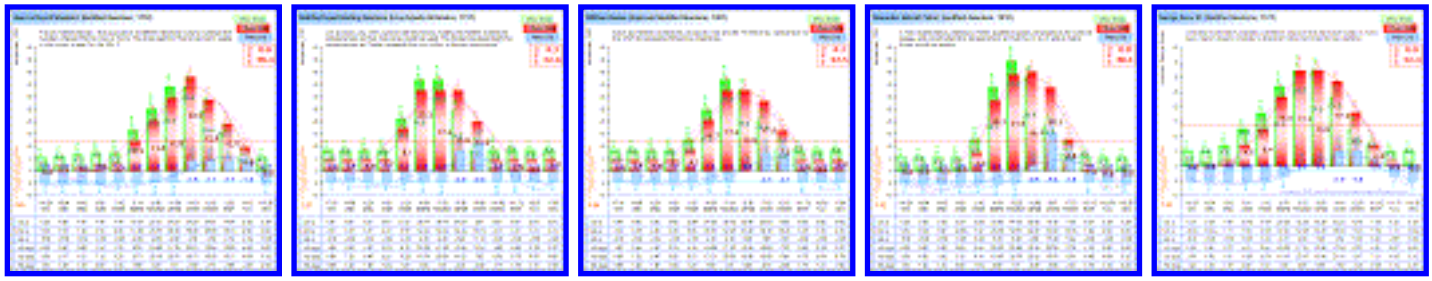
4/25 syntonic. Marsh's philosophy was that is better to have only two-thirds of the keyboard harmony tolerably in tune... he disapproved of tempering for the sake of the characters of the keys.

Minor thirds
Major thirds
Fifths (CG)

M3 Range 7.7 25.7



	+4.50 CEG	+3.00 GBD	+1.50 DF#A	0.00 AC#E	-1.50 EG#B	-3.00 BD#F#	-4.50 F#A#C#	-6.00 C#FG#	-7.50 AbCEb	+9.00 EbGBb	+7.50 BbDF	+6.00 FAC	+4.50 CEG
m3 ¢	11.14	11.14	11.14	11.14	11.14	29.14	29.14	29.14	11.14	11.14	11.14	11.14	11.14
M3 ¢	7.69	7.69	7.69	7.69	7.69	25.69	25.69	25.69	25.69	7.69	7.69	7.69	7.69
5th ¢	-3.46	-3.46	-3.46	-3.46	-3.46	-3.46	-3.46	-3.46	14.54	-3.46	-3.46	-3.46	-3.46
M3 bps	2.92	4.37	3.27	4.89	3.66	18.42	13.79	10.32	15.45	3.48	5.21	3.90	5.84
m3 bps	6.34	9.49	7.10	10.63	7.96	15.66	23.44	17.55	10.10	7.56	11.31	8.47	12.68
5th bps	0.78	1.17	0.88	1.32	0.98	1.47	1.10	0.83	-5.23	0.94	1.40	1.05	1.57

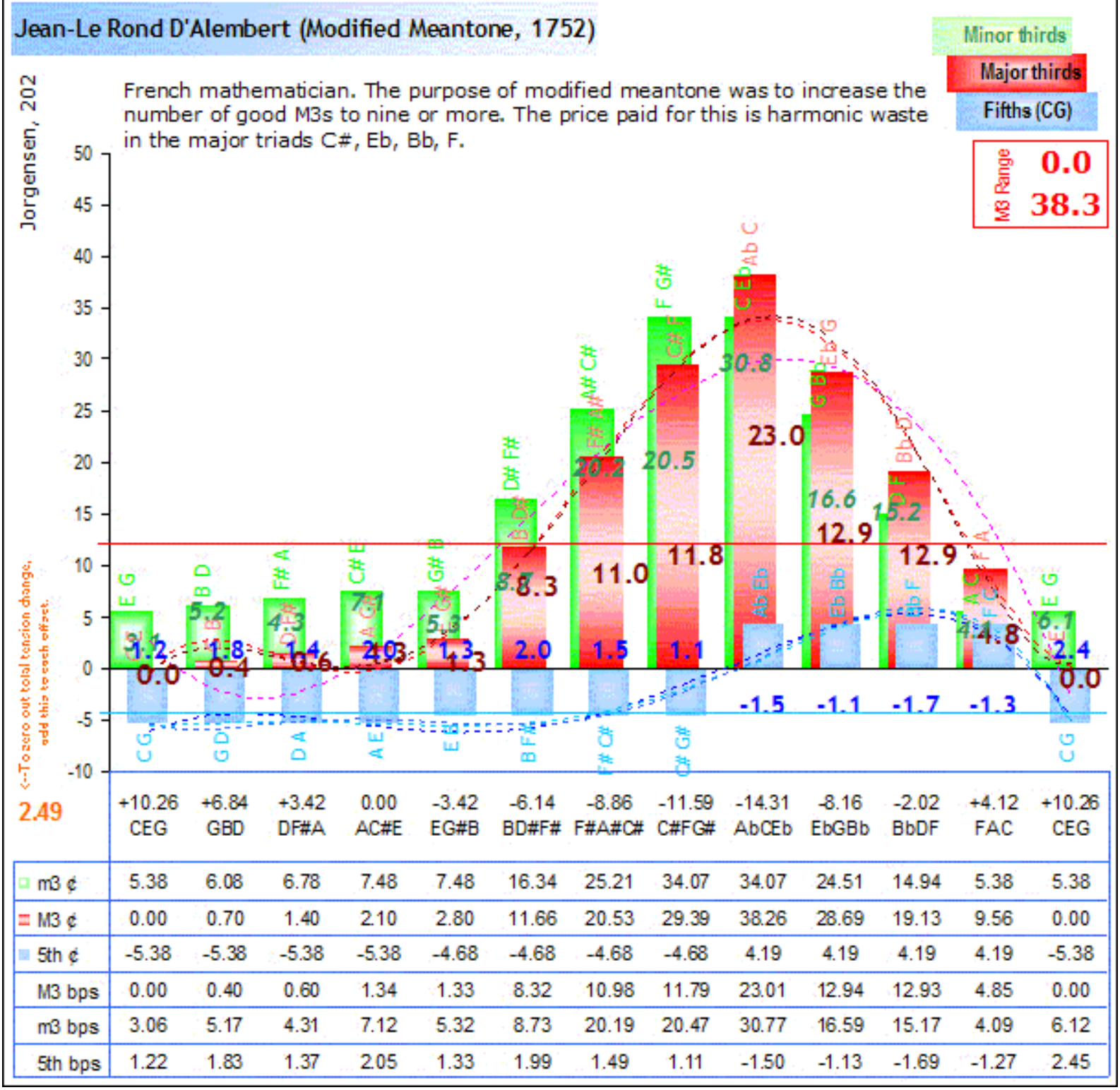


.. d'Alembert ... Britannica ... Hawkes ... Fisher ... Secor

Jean-Le Rond D'Alembert (Modified Meantone, 1752)

Jorgensen, 202

French mathematician. The purpose of modified meantone was to increase the number of good M3s to nine or more. The price paid for this is harmonic waste in the major triads C#, Eb, Bb, F.

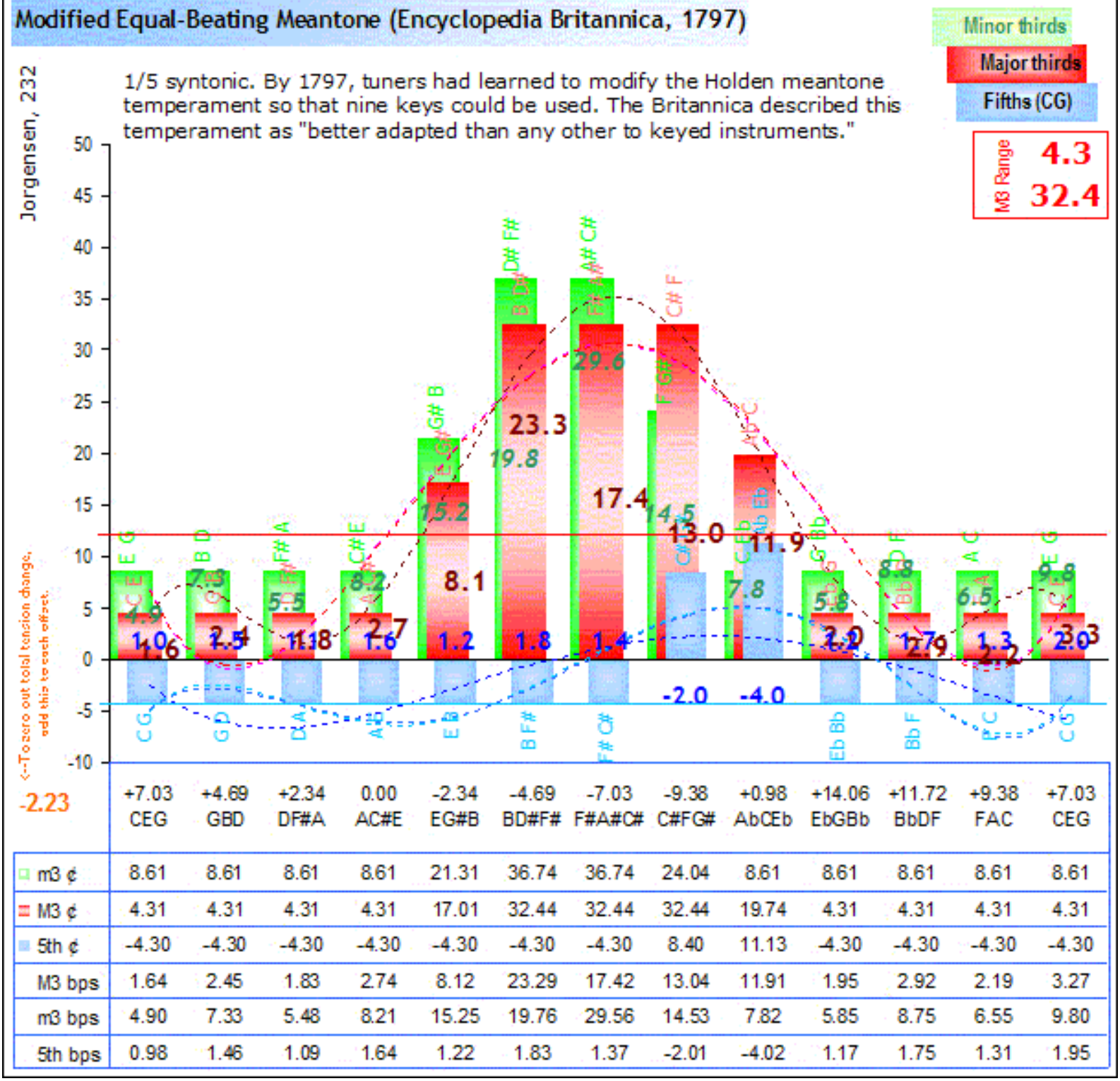


	+10.26 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-6.14 BD#F#	-8.86 F#A#C#	-11.59 C#FG#	-14.31 AbCEb	-8.16 EbGBb	-2.02 BbDF	+4.12 FAC	+10.26 CEG
m3 ¢	5.38	6.08	6.78	7.48	7.48	16.34	25.21	34.07	34.07	24.51	14.94	5.38	5.38
M3 ¢	0.00	0.70	1.40	2.10	2.80	11.66	20.53	29.39	38.26	28.69	19.13	9.56	0.00
5th ¢	-5.38	-5.38	-5.38	-5.38	-4.68	-4.68	-4.68	-4.68	4.19	4.19	4.19	4.19	-5.38
M3 bps	0.00	0.40	0.60	1.34	1.33	8.32	10.98	11.79	23.01	12.94	12.93	4.85	0.00
m3 bps	3.06	5.17	4.31	7.12	5.32	8.73	20.19	20.47	30.77	16.59	15.17	4.09	6.12
5th bps	1.22	1.83	1.37	2.05	1.33	1.99	1.49	1.11	-1.50	-1.13	-1.69	-1.27	2.45

Modified Equal-Beating Meantone (Encyclopedia Britannica, 1797)

Jorgensen, 232

1/5 syntonic. By 1797, tuners had learned to modify the Holden meantone temperament so that nine keys could be used. The Britannica described this temperament as "better adapted than any other to keyed instruments."



	+7.03 CEG	+4.69 GBD	+2.34 DF#A	0.00 AC#E	-2.34 EG#B	-4.69 BD#F#	-7.03 F#A#C#	-9.38 C#FG#	+0.98 AbCEb	+14.06 EbGBb	+11.72 BbDF	+9.38 FAC	+7.03 CEG
m3 ¢	8.61	8.61	8.61	8.61	21.31	36.74	36.74	24.04	8.61	8.61	8.61	8.61	8.61
M3 ¢	4.31	4.31	4.31	4.31	17.01	32.44	32.44	32.44	19.74	4.31	4.31	4.31	4.31
5th ¢	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	8.40	11.13	-4.30	-4.30	-4.30	-4.30
M3 bps	1.64	2.45	1.83	2.74	8.12	23.29	17.42	13.04	11.91	1.95	2.92	2.19	3.27
m3 bps	4.90	7.33	5.48	8.21	15.25	19.76	29.56	14.53	7.82	5.85	8.75	6.55	9.80
5th bps	0.98	1.46	1.09	1.64	1.22	1.83	1.37	-2.01	-4.02	1.17	1.75	1.31	1.95

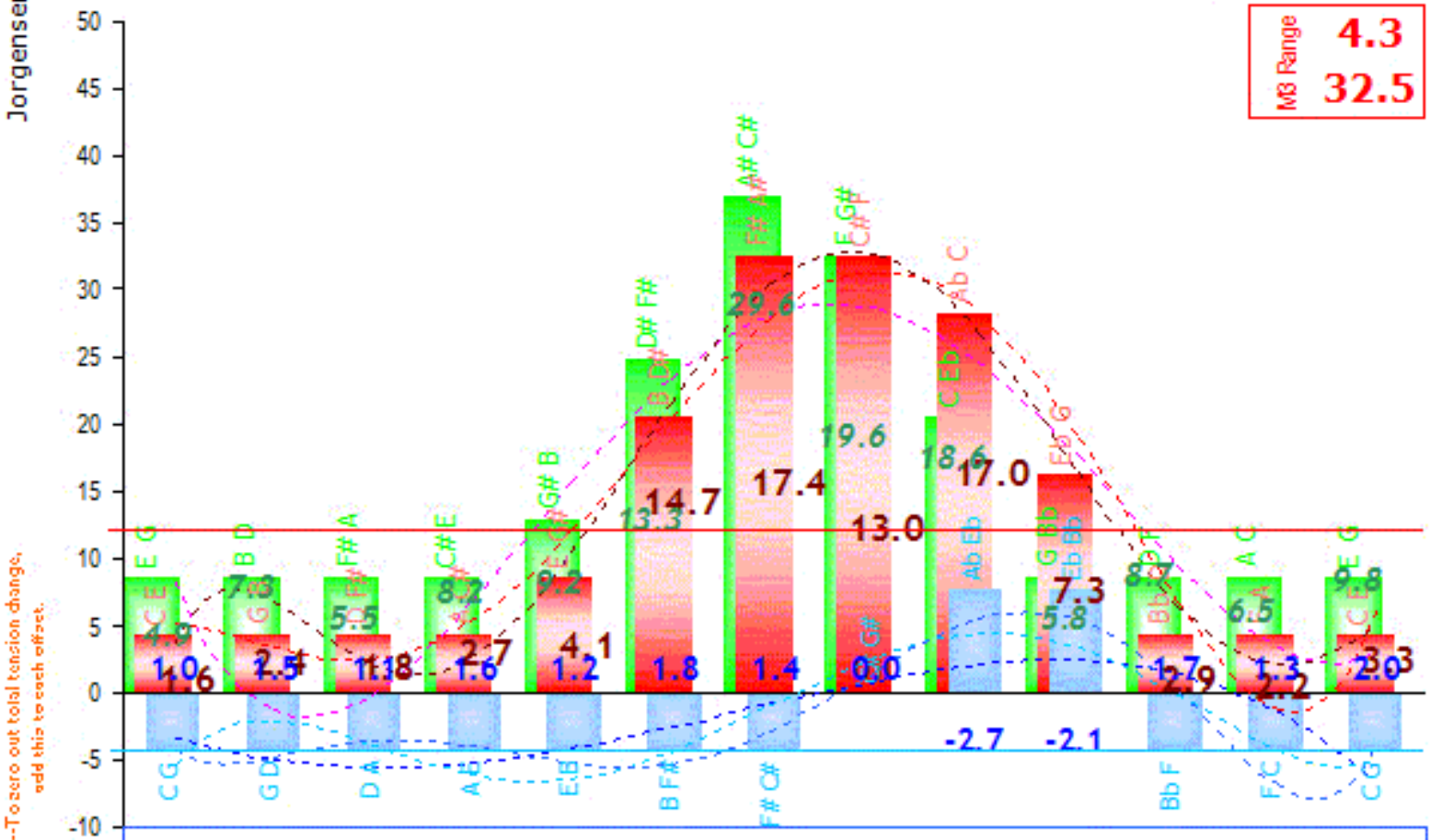
William Hawkes (Improved Modified Meantone, 1807)

Same as Holden's meantone, except for G# and Eb. Primitive by comparison to the 1797 Encyclopedia Britannica meantone.

Jorgensen, 309

Minor thirds
Major thirds
Fifths (CG)

M3 Range 4.3 32.5

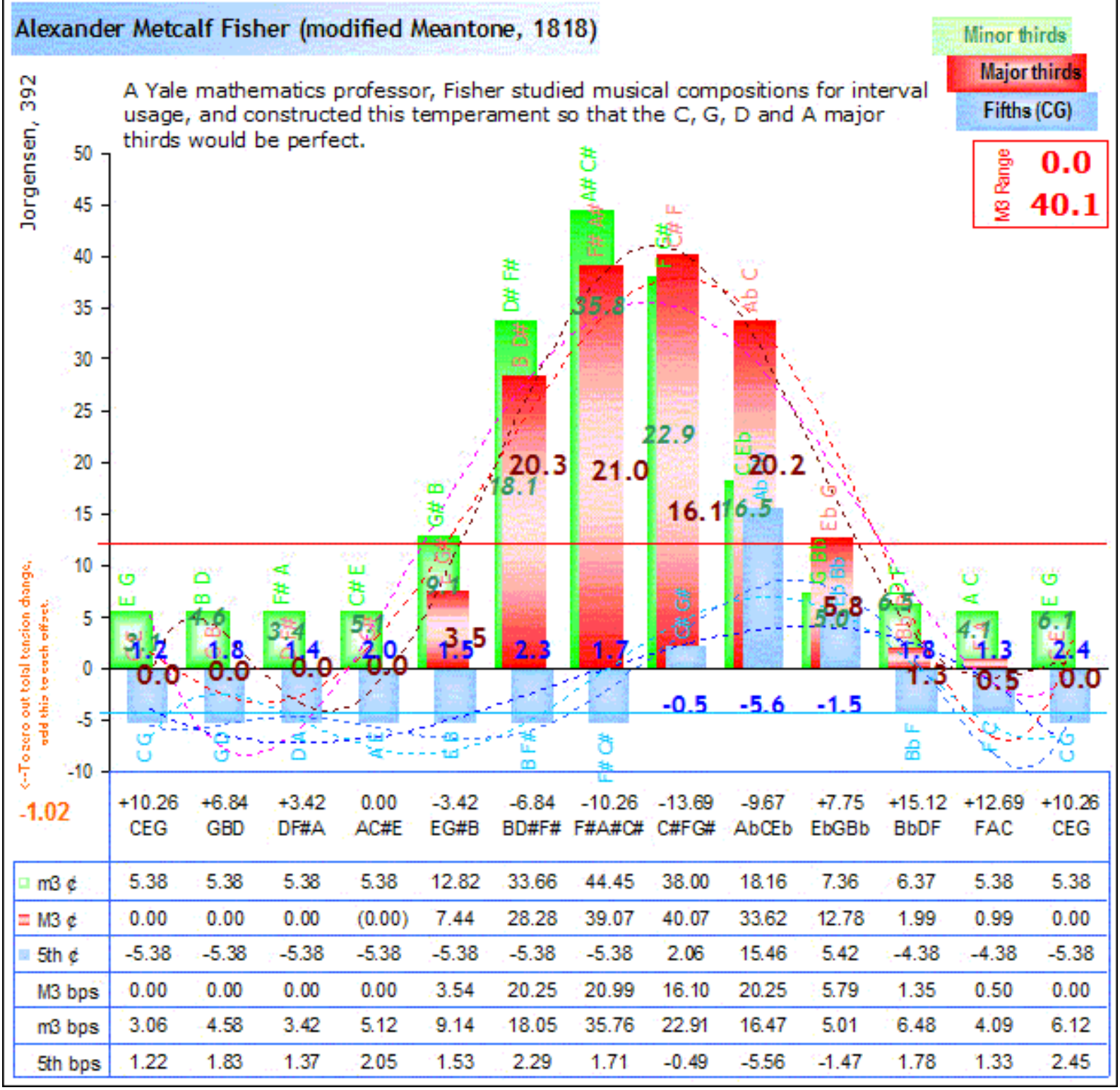


	+7.04 CEG	+4.69 GBD	+2.35 DF#A	0.00 AC#E	-2.35 EG#B	-4.69 BD#F#	-7.04 F#A#C#	-9.39 C#FG#	-7.43 AbCEb	+2.15 EbGBb	+11.73 BbDF	+9.39 FAC	+7.04 CEG
m3 ¢	8.60	8.60	8.60	8.60	12.90	24.83	36.76	32.46	20.53	8.60	8.60	8.60	8.60
M3 ¢	4.30	4.30	4.30	4.30	8.60	20.53	32.46	32.46	28.16	16.23	4.30	4.30	4.30
5th ¢	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	-4.30	0.00	7.63	7.63	-4.30	-4.30	-4.30
M3 bps	1.63	2.44	1.83	2.74	4.10	14.69	17.43	13.04	16.95	7.33	2.92	2.18	3.27
m3 bps	4.89	7.32	5.48	8.20	9.21	13.31	29.58	19.56	18.58	5.84	8.75	6.54	9.79
5th bps	0.98	1.46	1.09	1.64	1.23	1.83	1.37	0.00	-2.74	-2.06	1.75	1.31	1.96

Alexander Metcalf Fisher (modified Meantone, 1818)

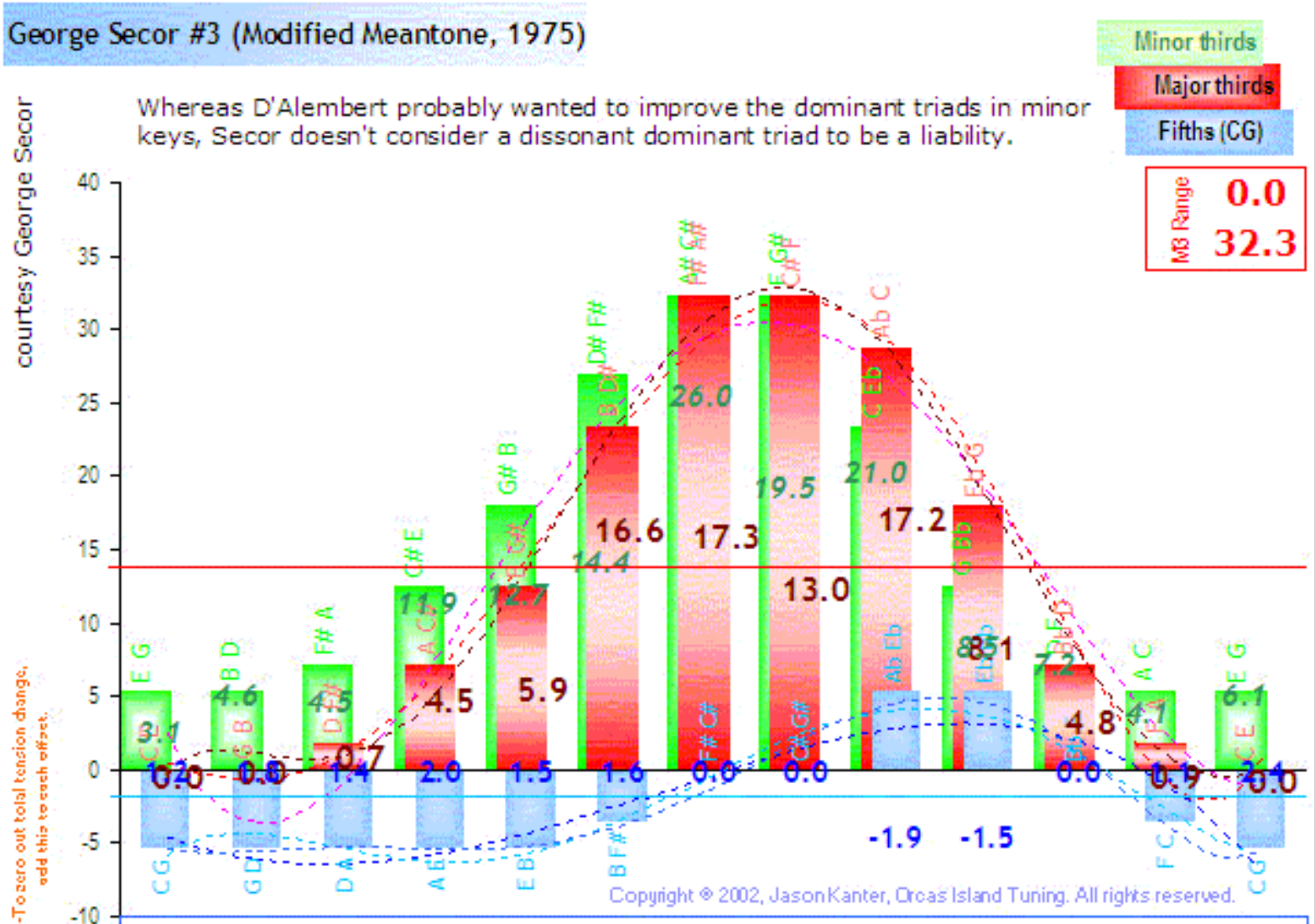
Jorgensen, 392

A Yale mathematics professor, Fisher studied musical compositions for interval usage, and constructed this temperament so that the C, G, D and A major thirds would be perfect.



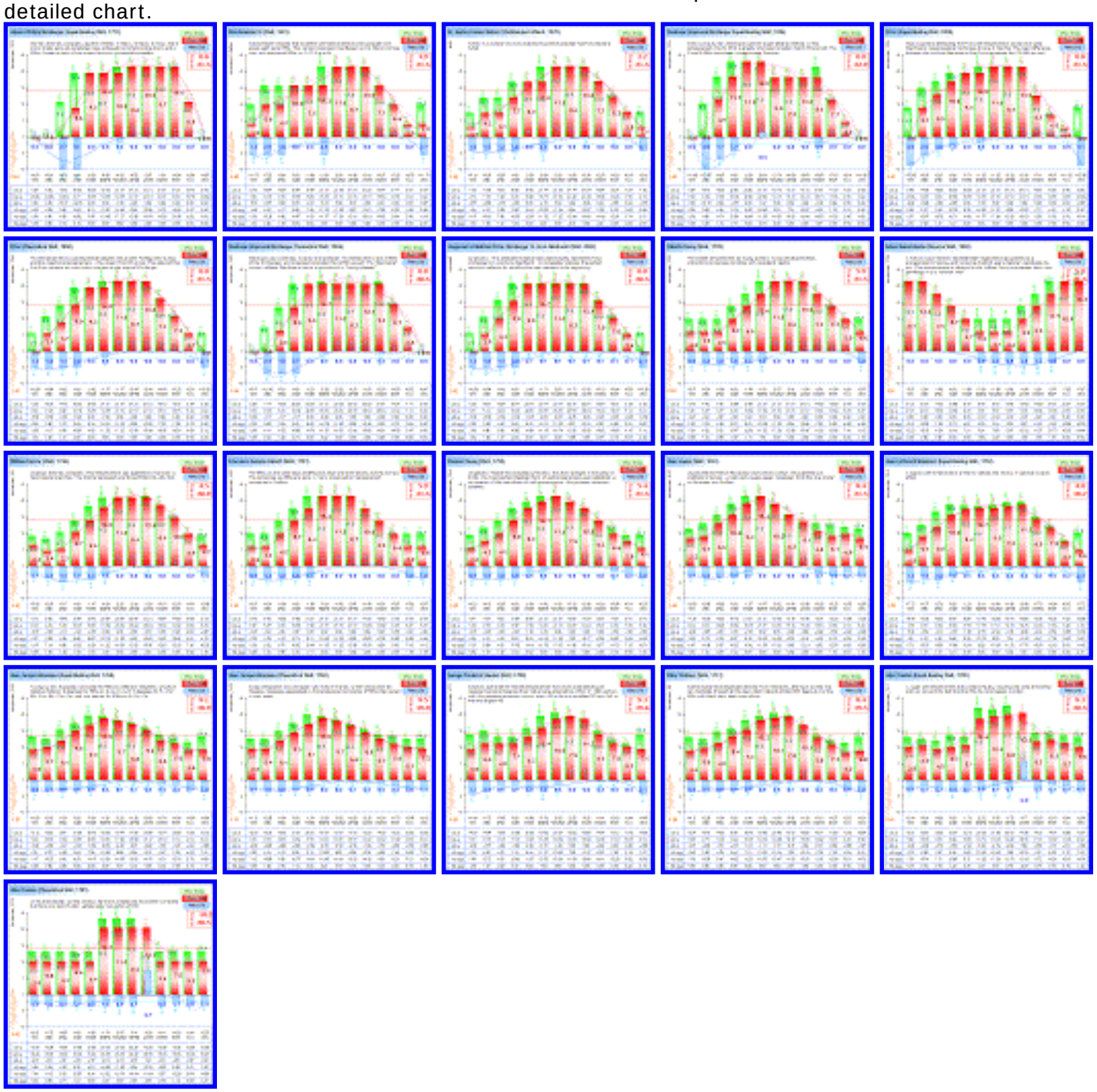
	+10.26 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-6.84 BD#F#	-10.26 F#A#C#	-13.69 C#FG#	-9.67 AbCEb	+7.75 EbGBb	+15.12 BbDF	+12.69 FAC	+10.26 CEG
m3 ¢	5.38	5.38	5.38	5.38	12.82	33.66	44.45	38.00	18.16	7.36	6.37	5.38	5.38
M3 ¢	0.00	0.00	0.00	(0.00)	7.44	28.28	39.07	40.07	33.62	12.78	1.99	0.99	0.00
5th ¢	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	2.06	15.46	5.42	-4.38	-4.38	-5.38
M3 bps	0.00	0.00	0.00	0.00	3.54	20.25	20.99	16.10	20.25	5.79	1.35	0.50	0.00
m3 bps	3.06	4.58	3.42	5.12	9.14	18.05	35.76	22.91	16.47	5.01	6.48	4.09	6.12
5th bps	1.22	1.83	1.37	2.05	1.53	2.29	1.71	-0.49	-5.56	-1.47	1.78	1.33	2.45

George Secor #3 (Modified Meantone, 1975)



	+10.26 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-6.84 BD#F#	-8.55 F#A#C#	-6.60 C#FG#	-4.64 AbCEb	+2.69 EbGBb	+10.02 BbDF	+11.97 FAC	+10.26 CEG
m3 ¢	5.38	5.38	7.09	12.46	17.84	26.88	32.26	32.26	23.22	12.46	7.09	5.38	5.38
M3 ¢	(0.00)	(0.00)	1.71	7.09	12.46	23.22	32.26	32.26	28.59	17.84	7.09	1.71	(0.00)
5th ¢	-5.38	-5.38	-5.38	-5.38	-5.38	-3.67	0.00	0.00	5.38	5.38	0.00	-3.67	-5.38
M3 bps	0.00	0.00	0.73	4.51	5.94	16.60	17.31	12.98	17.24	8.07	4.81	0.87	0.00
m3 bps	3.06	4.58	4.51	11.89	12.74	14.40	25.97	19.48	21.04	8.47	7.21	4.09	6.12
5th bps	1.22	1.83	1.37	2.05	1.53	1.56	0.00	0.00	-1.93	-1.45	0.00	1.12	2.45

Hover over the thumbnail for a second to see the name of the temperament. Click on the thumbnail to see the detailed chart.



The last two (Preston) are actually modified meantones, not Well temperaments, as you can see from the characteristic rectangular profile and the augmented fifth.

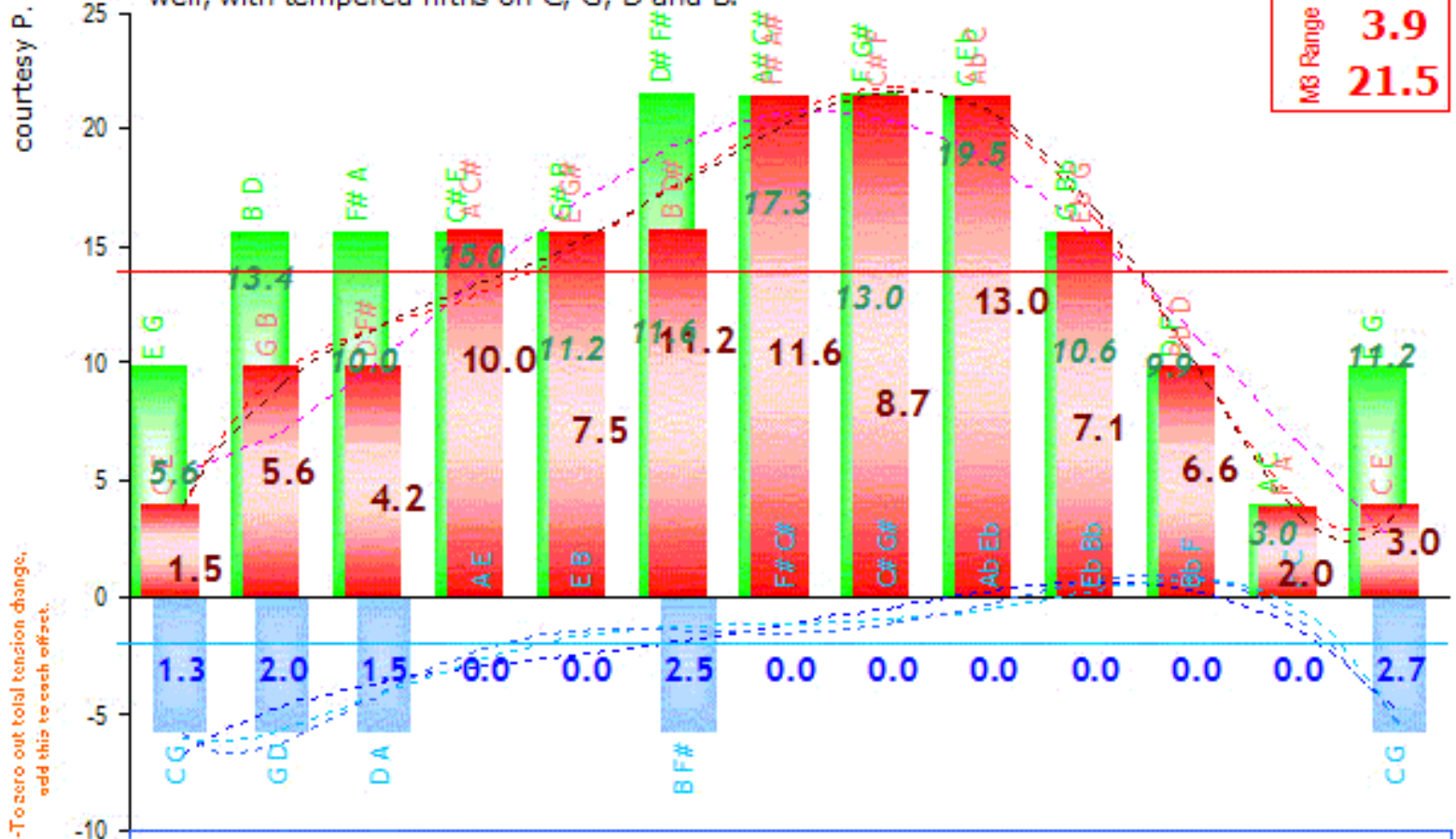
Werckmeister III (Well, 1691)

Minor thirds
Major thirds
Fifths (CG)

courtesy P. Bailey

Werckmeister showed that excellent well-temperaments were possible with about eight pure fifths. This version (courtesy Paul Bailey) is 1/4 ditonic comma well, with tempered fifths on C, G, D and B.

M3 Range 3.9 21.5



<--To zero out total tension change, add this to each effect.

-4.89

	+11.73 CEG	+7.82 GBD	+3.91 DF#A	0.00 AC#E	+1.96 EG#B	+3.91 BD#F#	0.00 F#A#C#	+1.96 C#FG#	+3.91 AbCEb	+5.87 EbGBb	+7.82 BbDF	+9.78 FAC	+11.73 CEG
m3 ¢	9.78	15.64	15.64	15.64	15.64	21.51	21.50	21.51	21.50	15.64	9.77	3.91	9.78
M3 ¢	3.92	9.78	9.78	15.65	15.64	15.65	21.51	21.51	21.51	15.64	9.78	3.91	3.92
5th ¢	-5.87	-5.87	-5.87	0.00	-0.01	-5.87	0.00	-0.01	0.00	-0.01	0.00	-0.01	-5.87
M3 bps	1.49	5.57	4.17	9.99	7.49	11.23	11.56	8.67	13.01	7.08	6.63	1.98	2.98
m3 bps	5.58	13.36	9.98	14.97	11.23	11.57	17.34	13.01	19.51	10.62	9.94	2.98	11.16
5th bps	1.34	2.00	1.49	0.00	0.00	2.51	0.00	0.00	0.00	0.00	0.00	0.00	2.67

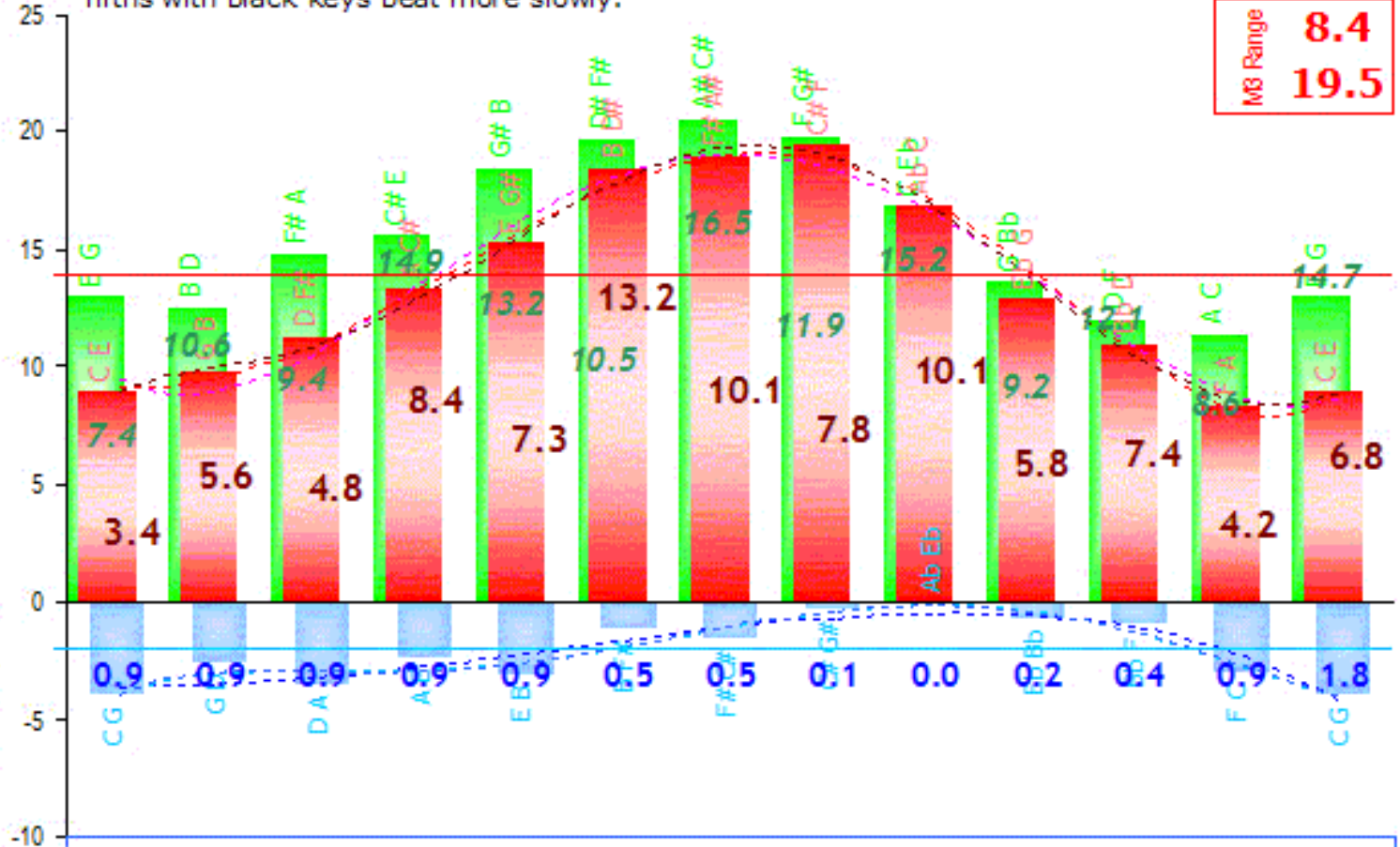
Peter Prelleur (Well, 1731)

Jorgensen, 81

Well temperament descended directly from meantone, altering it so that one can modulate through all the keys. Each natural (white) fifth beats at 0.9; the fifths with black keys beat more slowly.

Minor thirds
Major thirds
Fifths (CG)

M3 Range 8.4 19.5



<--To zero out total tension change, add this to each offset.

-1.58

	+4.31 CEG	+2.29 GBD	+1.59 DF#A	0.00 AC#E	-0.41 EG#B	-1.62 BD#F#	-0.84 F#A#C#	-0.45 C#FG#	+1.20 AbCEb	+3.15 EbGBb	+4.37 BbDF	+5.33 FAC	+4.31 CEG
m3 ¢	12.94	12.43	14.80	15.61	18.46	19.63	20.46	19.77	16.80	13.57	11.90	11.33	12.94
M3 ¢	8.96	9.77	11.26	13.24	15.30	18.46	18.89	19.47	16.80	12.82	10.91	8.35	8.96
5th ¢	-3.97	-2.66	-3.55	-2.37	-3.16	-1.17	-1.57	-0.31	0.00	-0.74	-0.99	-2.98	-3.97
M3 bps	3.40	5.56	4.79	8.44	7.31	13.23	10.14	7.83	10.13	5.79	7.39	4.24	6.81
m3 bps	7.36	10.59	9.45	14.92	13.23	10.55	16.47	11.93	15.20	9.19	12.08	8.61	14.72
5th bps	0.90	0.90	0.90	0.90	0.90	0.50	0.50	0.07	0.00	0.20	0.40	0.90	1.80

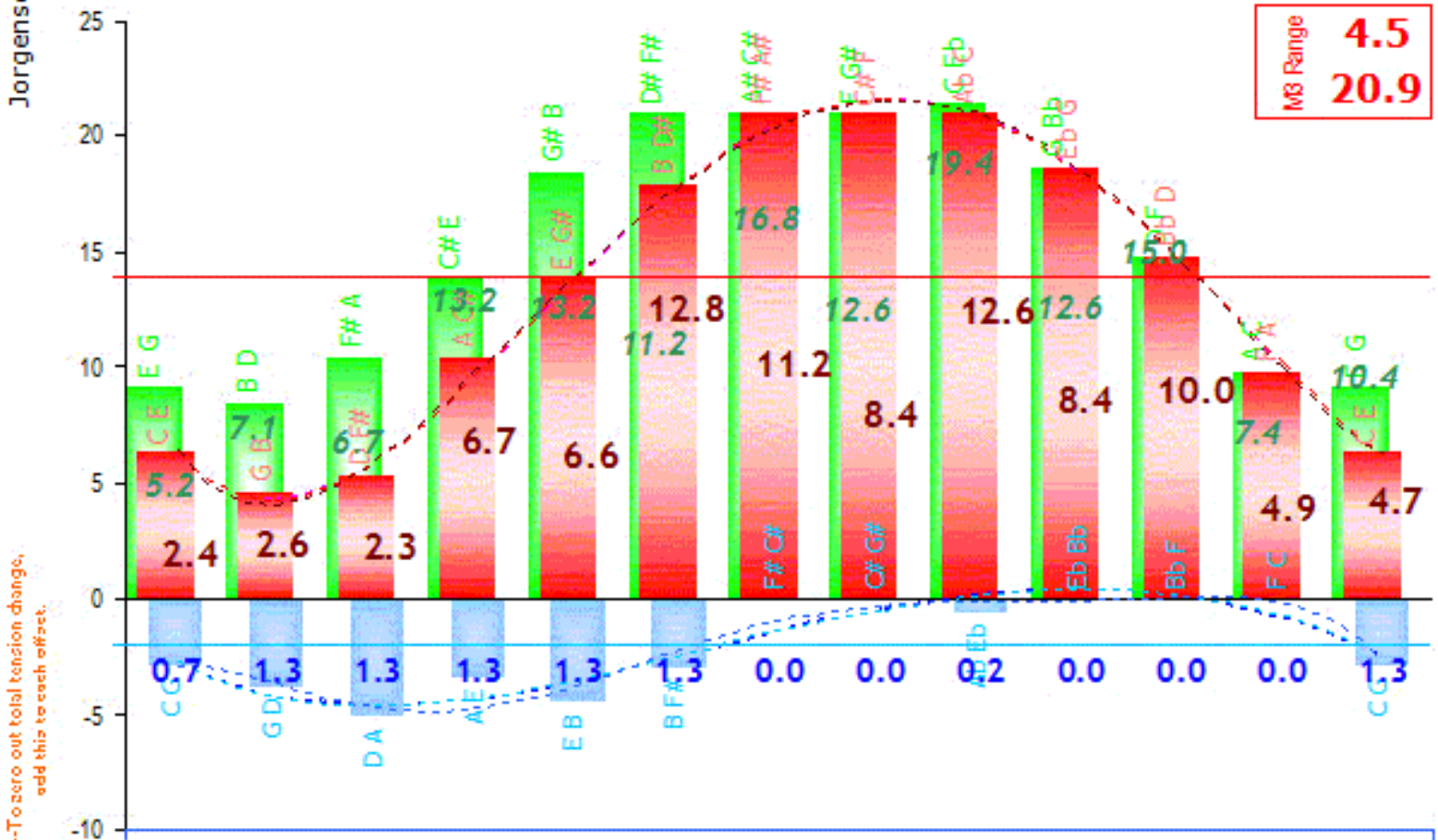
William Tans'ur (Well, 1746)

Minor thirds
Major thirds
Fifths (CG)

Jorgensen, 89

Organist, theorist, composer. This temperament was published in his book "A New Musical Grammar." He directly tempered only three fifths (CG, GD, DA).

M3 Range 4.5 20.9

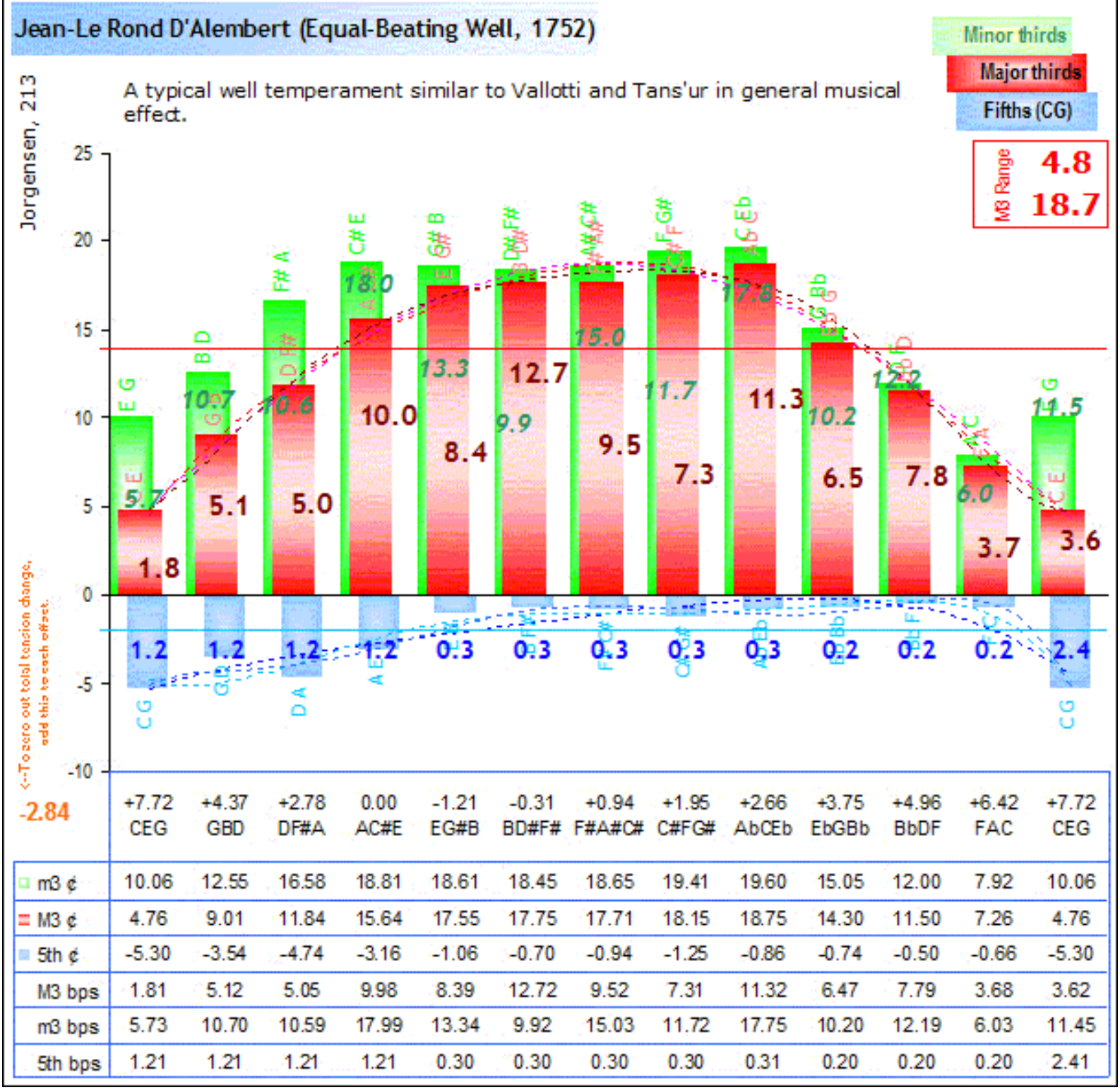


	+5.96 CEG	+5.05 GBD	+3.17 DF#A	0.00 AC#E	-1.47 EG#B	-4.09 BD#F#	-5.20 F#A#C#	-3.24 C#FG#	-1.29 AbCEb	+0.10 EbGBb	+2.05 BbDF	+4.01 FAC	+5.96 CEG
m3 ¢	9.12	8.38	10.45	13.87	18.45	20.94	20.94	20.94	21.51	18.64	14.80	9.68	9.12
M3 ¢	6.25	4.54	5.32	10.45	13.87	17.88	20.94	20.94	20.94	18.64	14.80	9.68	6.25
5th ¢	-2.87	-3.83	-5.13	-3.43	-4.58	-3.06	0.00	0.00	-0.57	0.00	0.00	0.00	-2.87
M3 bps	2.37	2.58	2.26	6.66	6.62	12.79	11.22	8.42	12.62	8.42	10.02	4.91	4.75
m3 bps	5.19	7.14	6.66	13.25	13.20	11.22	16.83	12.62	19.45	12.63	15.03	7.36	10.38
5th bps	0.65	1.30	1.30	1.30	1.30	1.30	0.00	0.00	0.21	0.00	0.00	0.00	1.30

Jean-Le Rond D'Alembert (Equal-Beating Well, 1752)

Jorgensen, 213

A typical well temperament similar to Vallotti and Tans'ur in general musical effect.

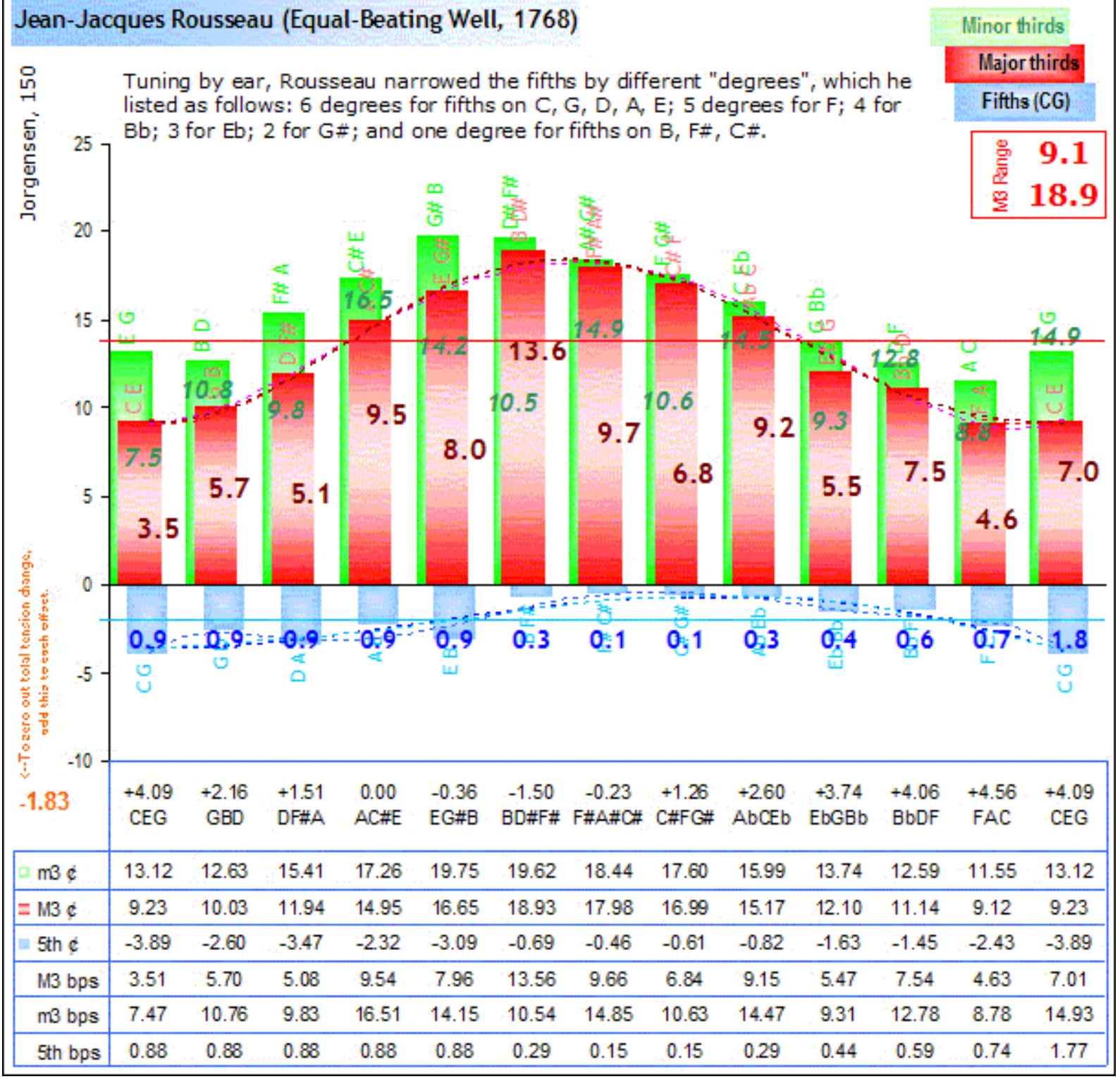


	+7.72 CEG	+4.37 GBD	+2.78 DF#A	0.00 AC#E	-1.21 EG#B	-0.31 BD#F#	+0.94 F#A#C#	+1.95 C#FG#	+2.66 AbCEb	+3.75 EbGBb	+4.96 BbDF	+6.42 FAC	+7.72 CEG
m3 ¢	10.06	12.55	16.58	18.81	18.61	18.45	18.65	19.41	19.60	15.05	12.00	7.92	10.06
M3 ¢	4.76	9.01	11.84	15.64	17.55	17.75	17.71	18.15	18.75	14.30	11.50	7.26	4.76
5th ¢	-5.30	-3.54	-4.74	-3.16	-1.06	-0.70	-0.94	-1.25	-0.86	-0.74	-0.50	-0.66	-5.30
M3 bps	1.81	5.12	5.05	9.98	8.39	12.72	9.52	7.31	11.32	6.47	7.79	3.68	3.62
m3 bps	5.73	10.70	10.59	17.99	13.34	9.92	15.03	11.72	17.75	10.20	12.19	6.03	11.45
5th bps	1.21	1.21	1.21	1.21	0.30	0.30	0.30	0.30	0.31	0.20	0.20	0.20	2.41

Jean-Jacques Rousseau (Equal-Beating Well, 1768)

Jorgensen, 150

Tuning by ear, Rousseau narrowed the fifths by different "degrees", which he listed as follows: 6 degrees for fifths on C, G, D, A, E; 5 degrees for F; 4 for Bb; 3 for Eb; 2 for G#; and one degree for fifths on B, F#, C#.

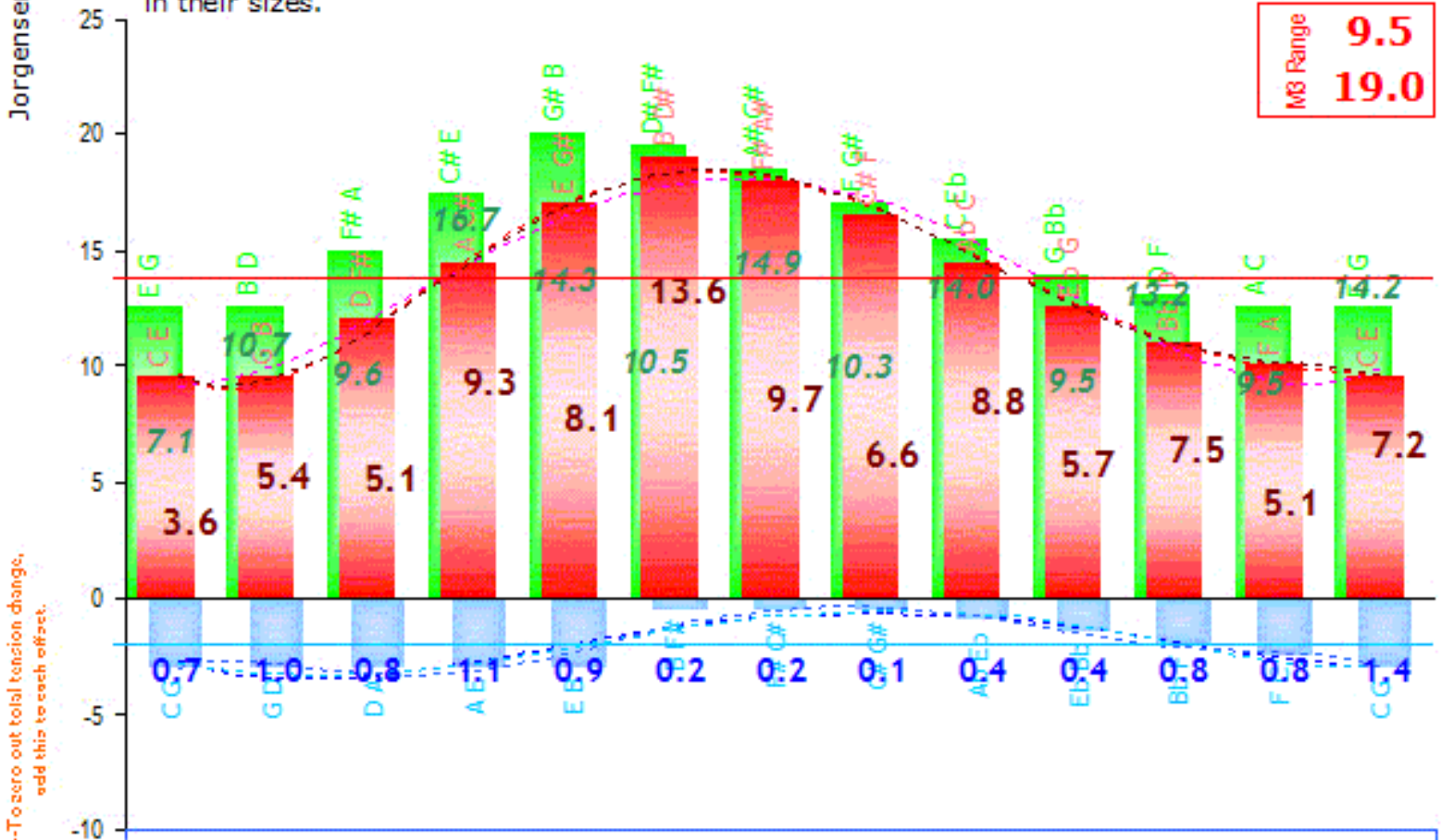


	+4.09 CEG	+2.16 GBD	+1.51 DF#A	0.00 AC#E	-0.36 EG#B	-1.50 BD#F#	-0.23 F#A#C#	+1.26 C#FG#	+2.60 AbCEb	+3.74 EbGBb	+4.06 BbDF	+4.56 FAC	+4.09 CEG
m3 ¢	13.12	12.63	15.41	17.26	19.75	19.62	18.44	17.60	15.99	13.74	12.59	11.55	13.12
M3 ¢	9.23	10.03	11.94	14.95	16.65	18.93	17.98	16.99	15.17	12.10	11.14	9.12	9.23
5th ¢	-3.89	-2.60	-3.47	-2.32	-3.09	-0.69	-0.46	-0.61	-0.82	-1.63	-1.45	-2.43	-3.89
M3 bps	3.51	5.70	5.08	9.54	7.96	13.56	9.66	6.84	9.15	5.47	7.54	4.63	7.01
m3 bps	7.47	10.76	9.83	16.51	14.15	10.54	14.85	10.63	14.47	9.31	12.78	8.78	14.93
5th bps	0.88	0.88	0.88	0.88	0.88	0.29	0.15	0.15	0.29	0.44	0.59	0.74	1.77

Jean-Jacques Rousseau (Theoretical Well, 1768)

Swiss philosopher and composer who lived in France; wrote Dictionnaire de Musique. Rousseau specialized in the tempering (narrowing) of fifths that varied in their sizes.

Jorgensen, 143

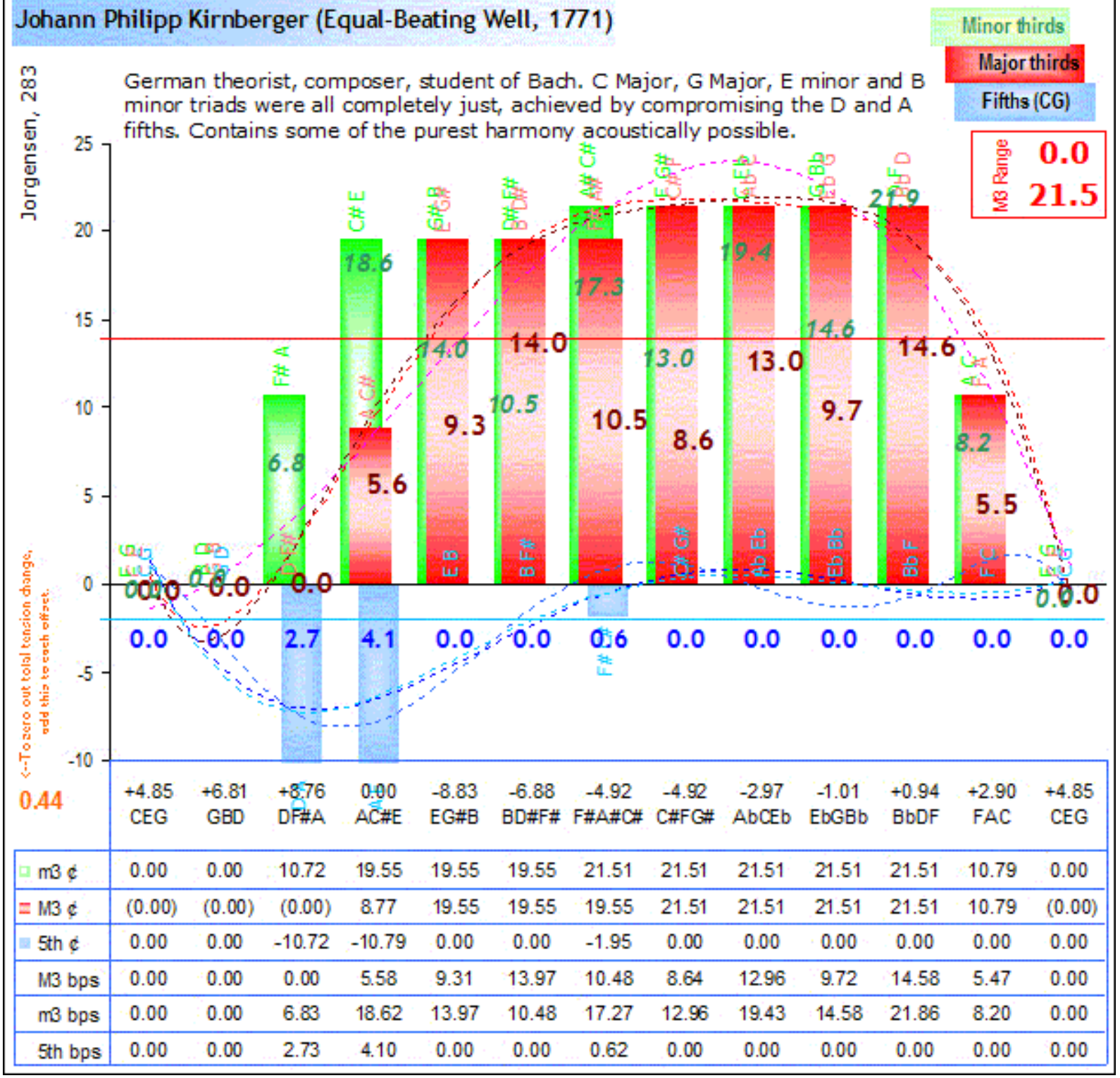


	+3.12 CEG	+2.08 GBD	+1.04 DF#A	0.00 AC#E	-1.04 EG#B	-2.08 BD#F#	-0.62 F#A#C#	+0.83 C#FG#	+2.29 AbCEb	+3.24 EbGBb	+3.70 BbDF	+3.66 FAC	+3.12 CEG
m3 ¢	12.52	12.52	15.02	17.51	20.01	19.51	18.51	17.01	15.52	14.02	13.02	12.52	12.52
M3 ¢	9.53	9.53	12.02	14.52	17.01	19.01	18.01	16.51	14.52	12.52	11.02	10.03	9.53
5th ¢	-2.99	-2.99	-2.99	-2.99	-2.99	-0.50	-0.50	-0.50	-1.00	-1.50	-2.00	-2.50	-2.99
M3 bps	3.62	5.41	5.12	9.26	8.13	13.62	9.67	6.65	8.76	5.66	7.46	5.08	7.23
m3 bps	7.12	10.66	9.58	16.75	14.34	10.48	14.91	10.27	14.03	9.50	13.21	9.51	14.24
5th bps	0.68	1.02	0.76	1.14	0.85	0.21	0.16	0.12	0.36	0.40	0.81	0.76	1.36

Johann Philipp Kirnberger (Equal-Beating Well, 1771)

Jorgensen, 283

German theorist, composer, student of Bach. C Major, G Major, E minor and B minor triads were all completely just, achieved by compromising the D and A fifths. Contains some of the purest harmony acoustically possible.



	+4.85 CEG	+6.81 GBD	+8.76 DF#A	0.00 AC#E	-8.83 EG#B	-6.88 BD#F#	-4.92 F#A#C#	-4.92 C#FG#	-2.97 AbCEb	-1.01 EbGBb	+0.94 BbDF	+2.90 FAC	+4.85 CEG
m3 ¢	0.00	0.00	10.72	19.55	19.55	19.55	21.51	21.51	21.51	21.51	21.51	10.79	0.00
M3 ¢	(0.00)	(0.00)	(0.00)	8.77	19.55	19.55	19.55	21.51	21.51	21.51	21.51	10.79	(0.00)
5th ¢	0.00	0.00	-10.72	-10.79	0.00	0.00	-1.95	0.00	0.00	0.00	0.00	0.00	0.00
M3 bps	0.00	0.00	0.00	5.58	9.31	13.97	10.48	8.64	12.96	9.72	14.58	5.47	0.00
m3 bps	0.00	0.00	6.83	18.62	13.97	10.48	17.27	12.96	19.43	14.58	21.86	8.20	0.00
5th bps	0.00	0.00	2.73	4.10	0.00	0.00	0.62	0.00	0.00	0.00	0.00	0.00	0.00

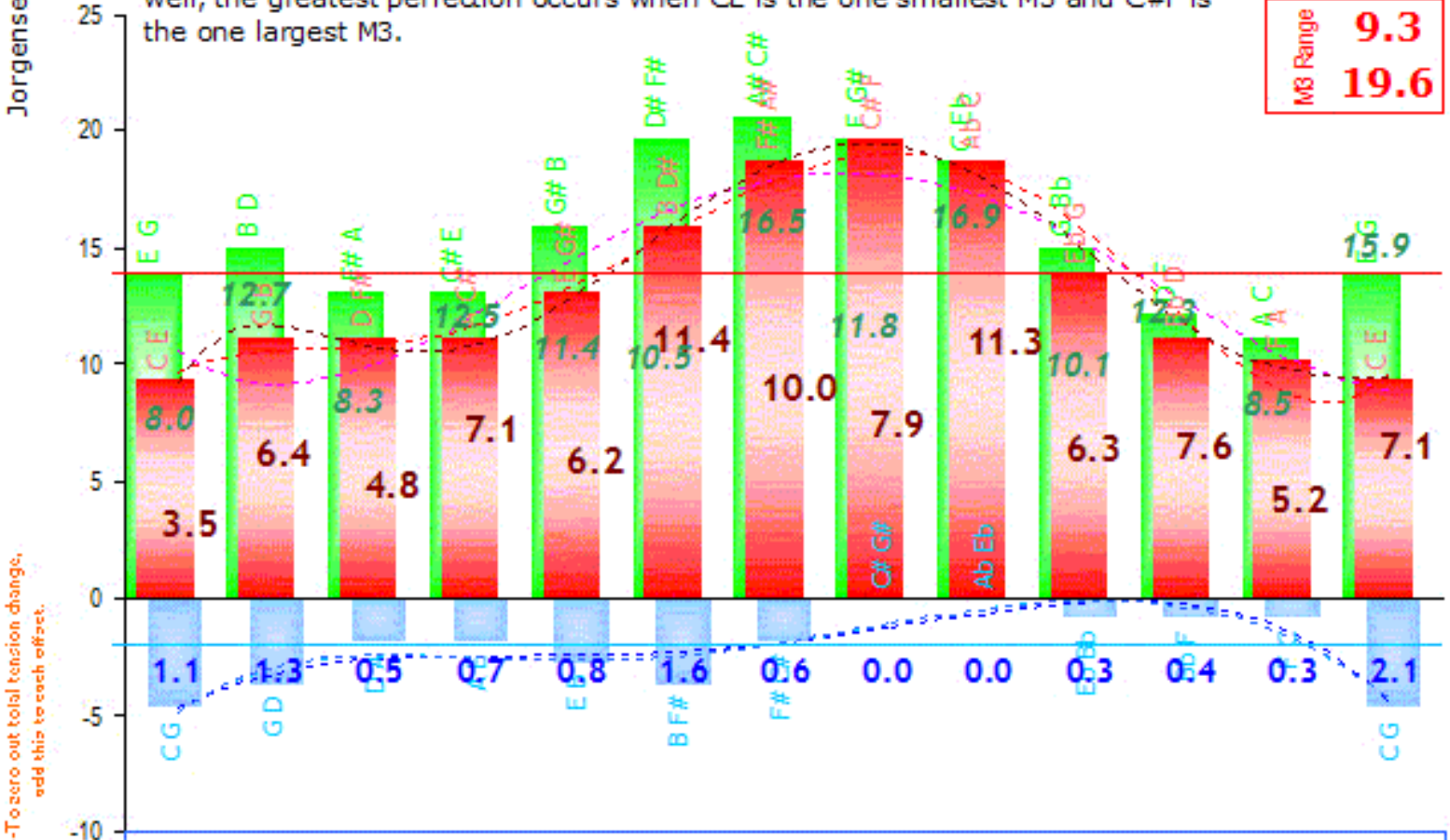
George Frederick Handel (Well, 1780)

Minor thirds
Major thirds
Fifths (CG)

Jorgensen, 172

Whoever authored the Handel temperament had more understanding of classical harmonic balance than had anyone else before 1780. In 18th century well, the greatest perfection occurs when CE is the one smallest M3 and C#F is the one largest M3.

M3 Range 9.3 19.6



<--To zero out total tension change, add this to each effect.

-0.59

	+4.46 CEG	+1.72 GBD	-0.08 DF#A	0.00 AC#E	+0.08 EG#B	-0.78 BD#F#	-2.58 F#A#C#	-2.50 C#FG#	-0.55 AbCEb	+1.41 EbGBb	+2.42 BbDF	+3.44 FAC	+4.46 CEG
m3 ¢	14.00	14.94	13.06	13.06	15.88	19.63	20.57	19.63	18.69	14.94	12.12	11.18	14.00
M3 ¢	9.31	11.18	11.18	11.18	13.06	15.88	18.69	19.63	18.69	14.00	11.18	10.25	9.31
5th ¢	-4.69	-3.75	-1.88	-1.88	-2.82	-3.75	-1.88	0.00	0.00	-0.94	-0.94	-0.94	-4.69
M3 bps	3.53	6.36	4.76	7.13	6.24	11.37	10.03	7.89	11.27	6.32	7.56	5.19	7.07
m3 bps	7.96	12.72	8.33	12.48	11.37	10.53	16.54	11.84	16.90	10.11	12.29	8.50	15.93
5th bps	1.06	1.27	0.48	0.72	0.80	1.60	0.60	0.00	0.00	0.25	0.38	0.28	2.13

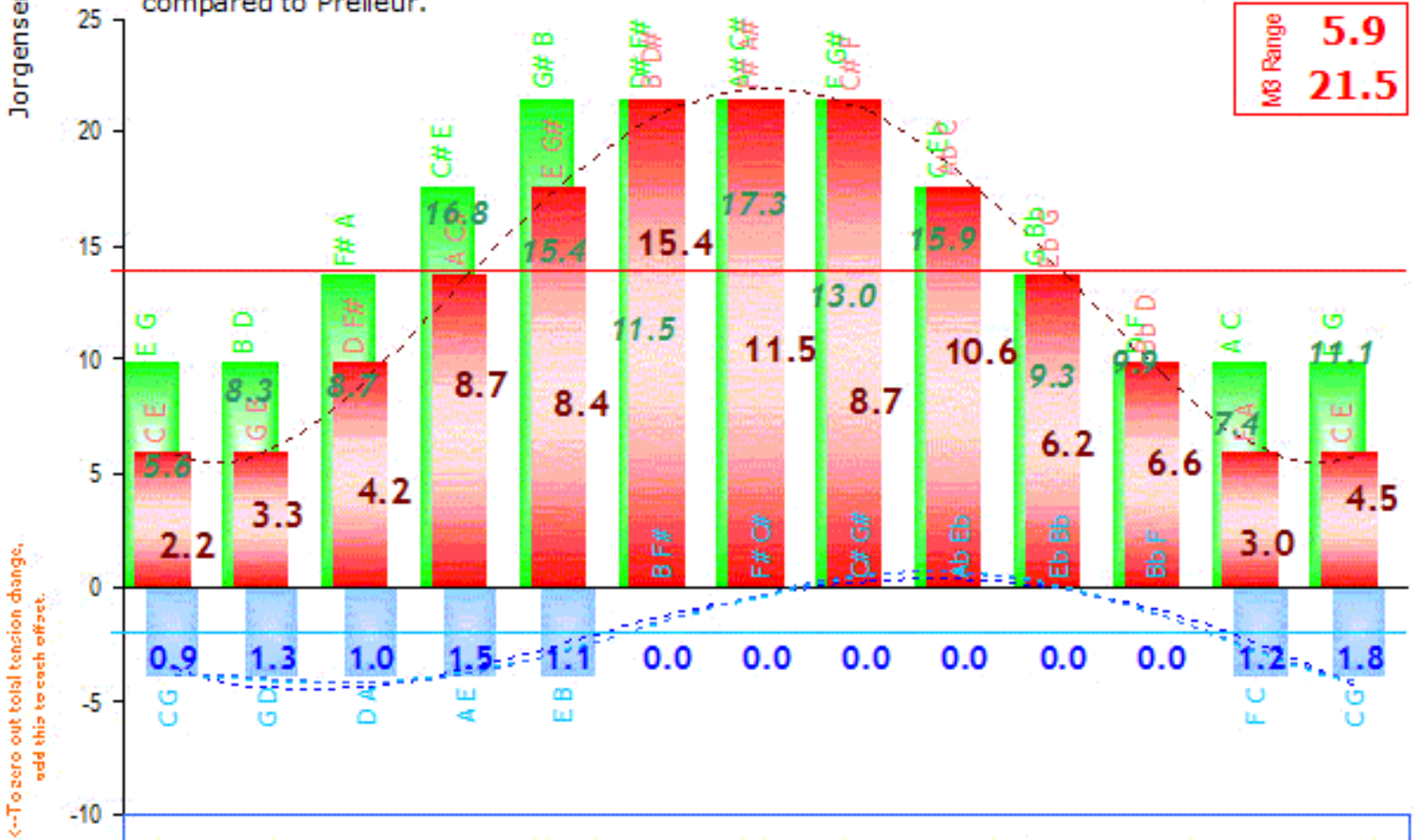
Francesco Antonio Vallotti (Well, 1781)

Minor thirds
Major thirds
Fifths (CG)

The fifths on the white keys CDEFGA are each one-sixth ditonic comma narrow. The remaining six fifths are pure. A "very conservative" temperament compared to Prelleur.

Jorgensen, 185

M3 Range 5.9 21.5



<--To zero out total tension change, add this to each effect.

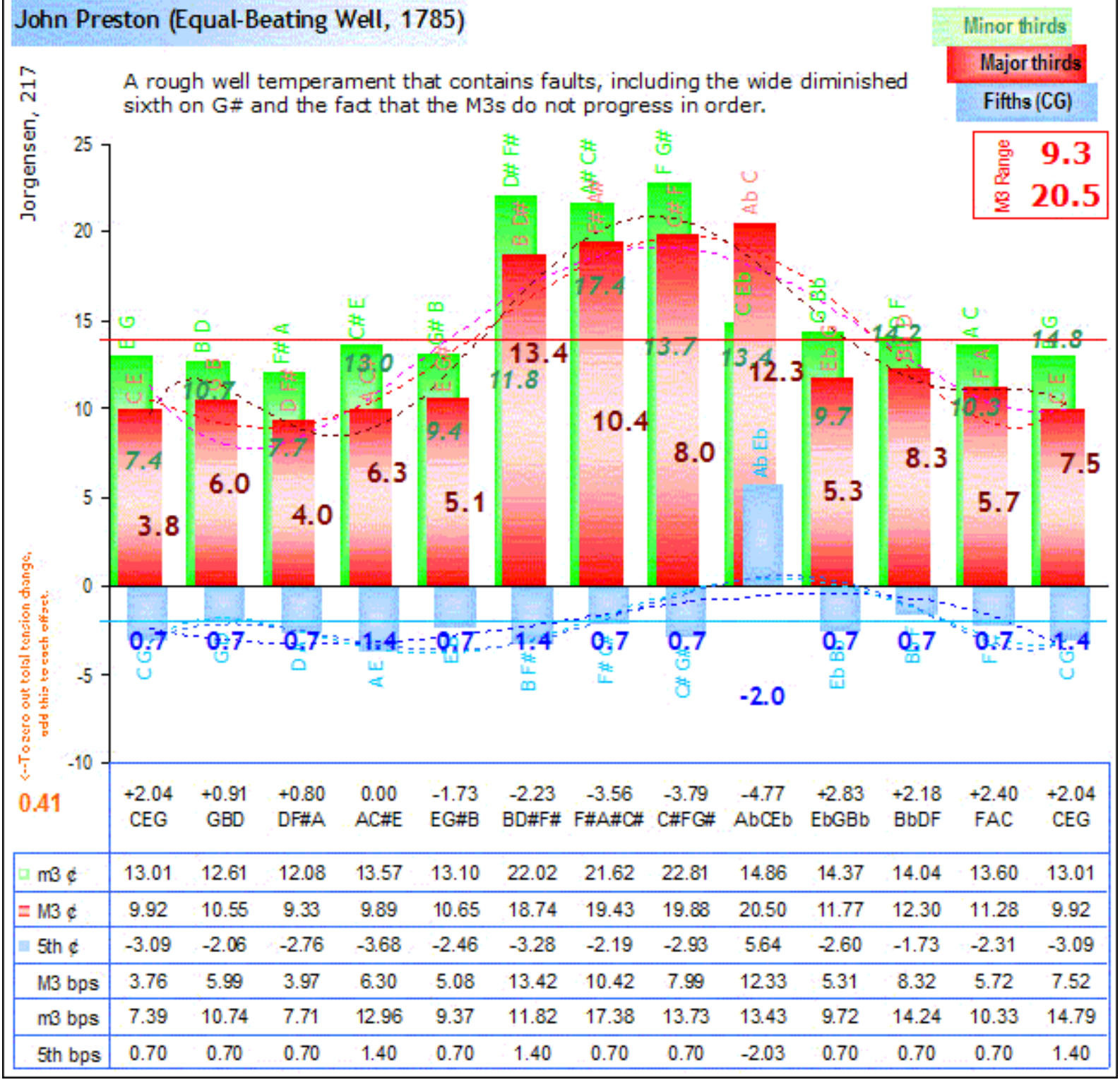
-1.96

	+5.87 CEG	+3.91 GBD	+1.96 DF#A	0.00 AC#E	-1.96 EG#B	-3.91 BD#F#	-1.96 F#A#C#	0.00 C#FG#	+1.96 AbCEb	+3.91 EbGBb	+5.87 BbDF	+7.82 FAC	+5.87 CEG
m3 ¢	9.78	9.78	13.69	17.60	21.51	21.51	21.51	21.51	17.60	13.69	9.78	9.78	9.78
M3 ¢	5.87	5.87	9.78	13.69	17.60	21.51	21.51	21.51	17.60	13.69	9.78	5.87	5.87
5th ¢	-3.91	-3.91	-3.91	-3.91	-3.91	0.00	0.00	0.00	0.00	0.00	0.00	-3.91	-3.91
M3 bps	2.23	3.33	4.16	8.73	8.41	15.40	11.55	8.66	10.62	6.19	6.62	2.98	4.46
m3 bps	5.56	8.32	8.73	16.82	15.40	11.55	17.32	12.99	15.93	9.28	9.93	7.43	11.12
5th bps	0.89	1.33	0.99	1.49	1.11	0.00	0.00	0.00	0.00	0.00	0.00	1.19	1.78

John Preston (Equal-Beating Well, 1785)

Jorgensen, 217

A rough well temperament that contains faults, including the wide diminished sixth on G# and the fact that the M3s do not progress in order.

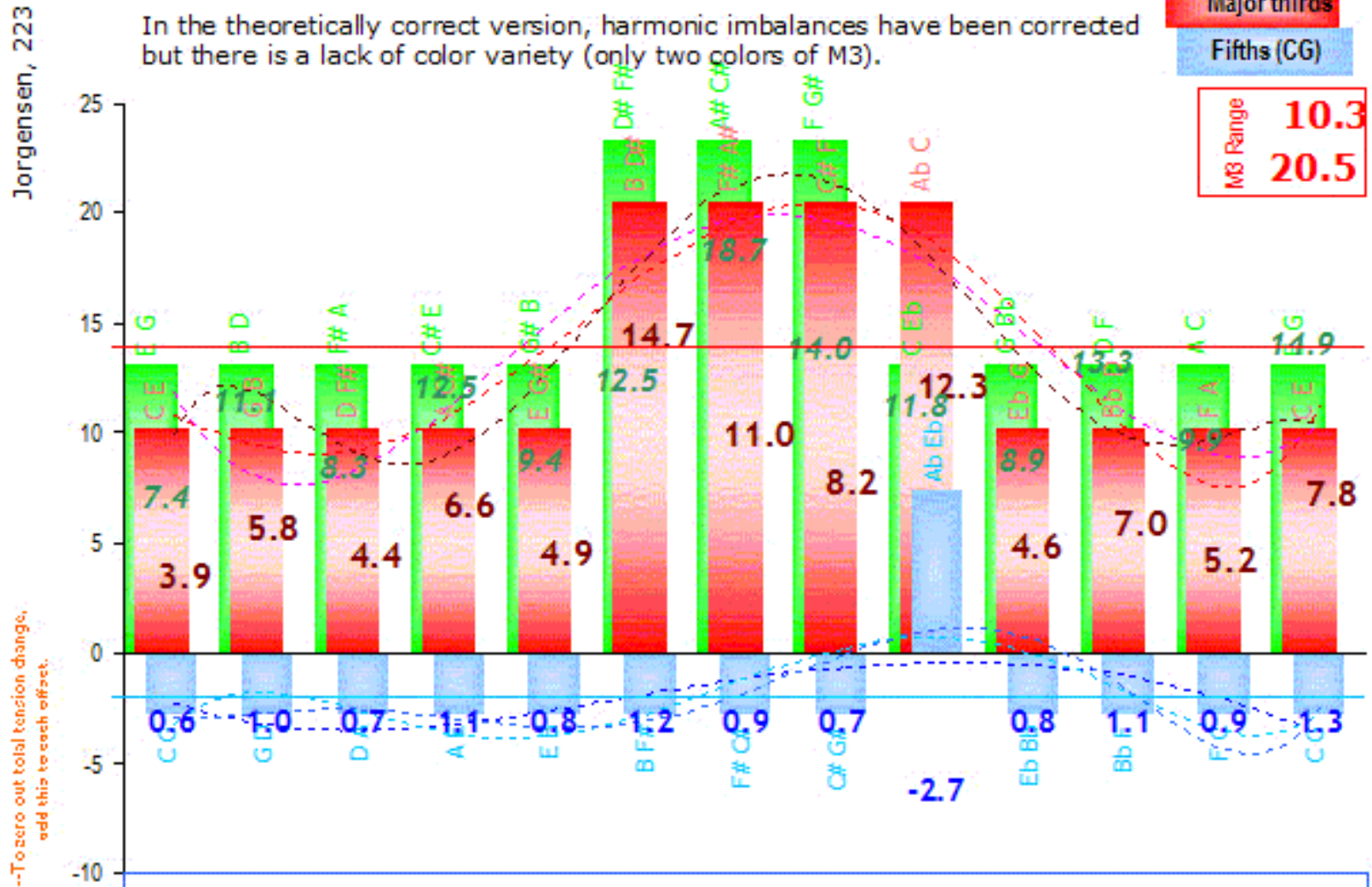


	+2.04 CEG	+0.91 GBD	+0.80 DF#A	0.00 AC#E	-1.73 EG#B	-2.23 BD#F#	-3.56 F#A#C#	-3.79 C#FG#	-4.77 AbCEb	+2.83 EbGBb	+2.18 BbDF	+2.40 FAC	+2.04 CEG
m3 ¢	13.01	12.61	12.08	13.57	13.10	22.02	21.62	22.81	14.86	14.37	14.04	13.60	13.01
M3 ¢	9.92	10.55	9.33	9.89	10.65	18.74	19.43	19.88	20.50	11.77	12.30	11.28	9.92
5th ¢	-3.09	-2.06	-2.76	-3.68	-2.46	-3.28	-2.19	-2.93	5.64	-2.60	-1.73	-2.31	-3.09
M3 bps	3.76	5.99	3.97	6.30	5.08	13.42	10.42	7.99	12.33	5.31	8.32	5.72	7.52
m3 bps	7.39	10.74	7.71	12.96	9.37	11.82	17.38	13.73	13.43	9.72	14.24	10.33	14.79
5th bps	0.70	0.70	0.70	1.40	0.70	1.40	0.70	0.70	-2.03	0.70	0.70	0.70	1.40

John Preston (Theoretical Well, 1785)

Jorgensen, 223

In the theoretically correct version, harmonic imbalances have been corrected but there is a lack of color variety (only two colors of M3).



	+2.55 CEG	+1.70 GBD	+0.85 DF#A	0.00 AC#E	-0.85 EG#B	-1.70 BD#F#	-2.55 F#A#C#	-3.41 C#FG#	-4.26 AbCEb	+5.11 EbGBb	+4.26 BbDF	+3.41 FAC	+2.55 CEG
m3 ¢	13.09	13.09	13.09	13.09	13.09	23.30	23.30	23.30	13.09	13.09	13.09	13.09	13.09
M3 ¢	10.28	10.28	10.28	10.28	10.28	20.50	20.50	20.50	20.50	10.28	10.28	10.28	10.28
5th ¢	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	-2.81	7.41	-2.81	-2.81	-2.81	-2.81
M3 bps	3.90	5.84	4.38	6.55	4.91	14.69	11.00	8.24	12.33	4.65	6.96	5.21	7.80
m3 bps	7.44	11.15	8.35	12.50	9.36	12.52	18.74	14.04	11.84	8.87	13.28	9.94	14.89
5th bps	0.64	0.95	0.71	1.07	0.80	1.20	0.90	0.67	-2.67	0.76	1.14	0.85	1.27

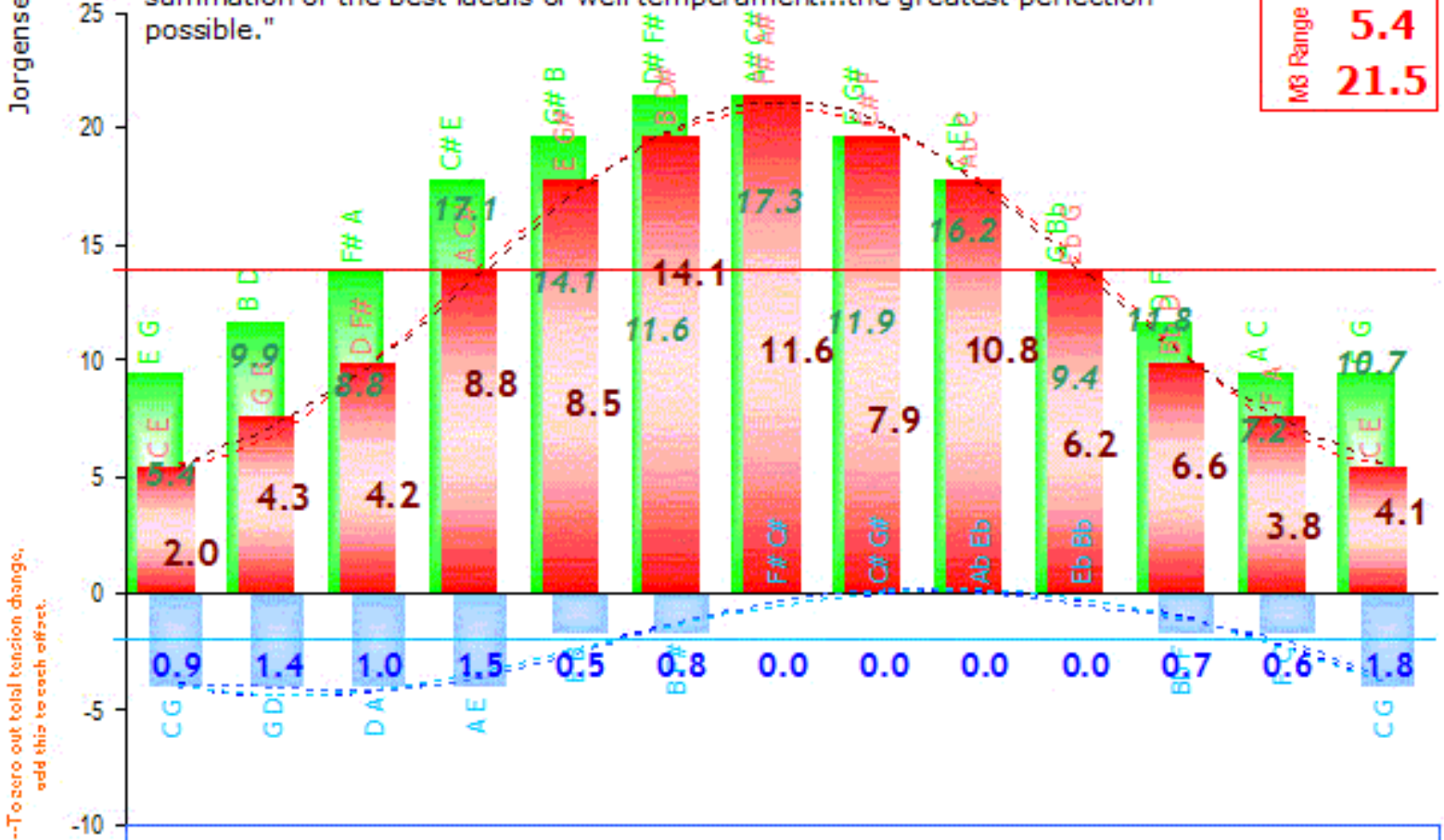
Thomas Young (Well, 1799)

Jorgensen, 264

Jorgensen: "Notice the complete symmetry...the even changes in the sizes of thirds...the most perfect idealized form of well temperament ever published...a summation of the best ideals of well temperament...the greatest perfection possible."

Minor thirds
Major thirds
Fifths (CG)

M3 Range 5.4 21.5

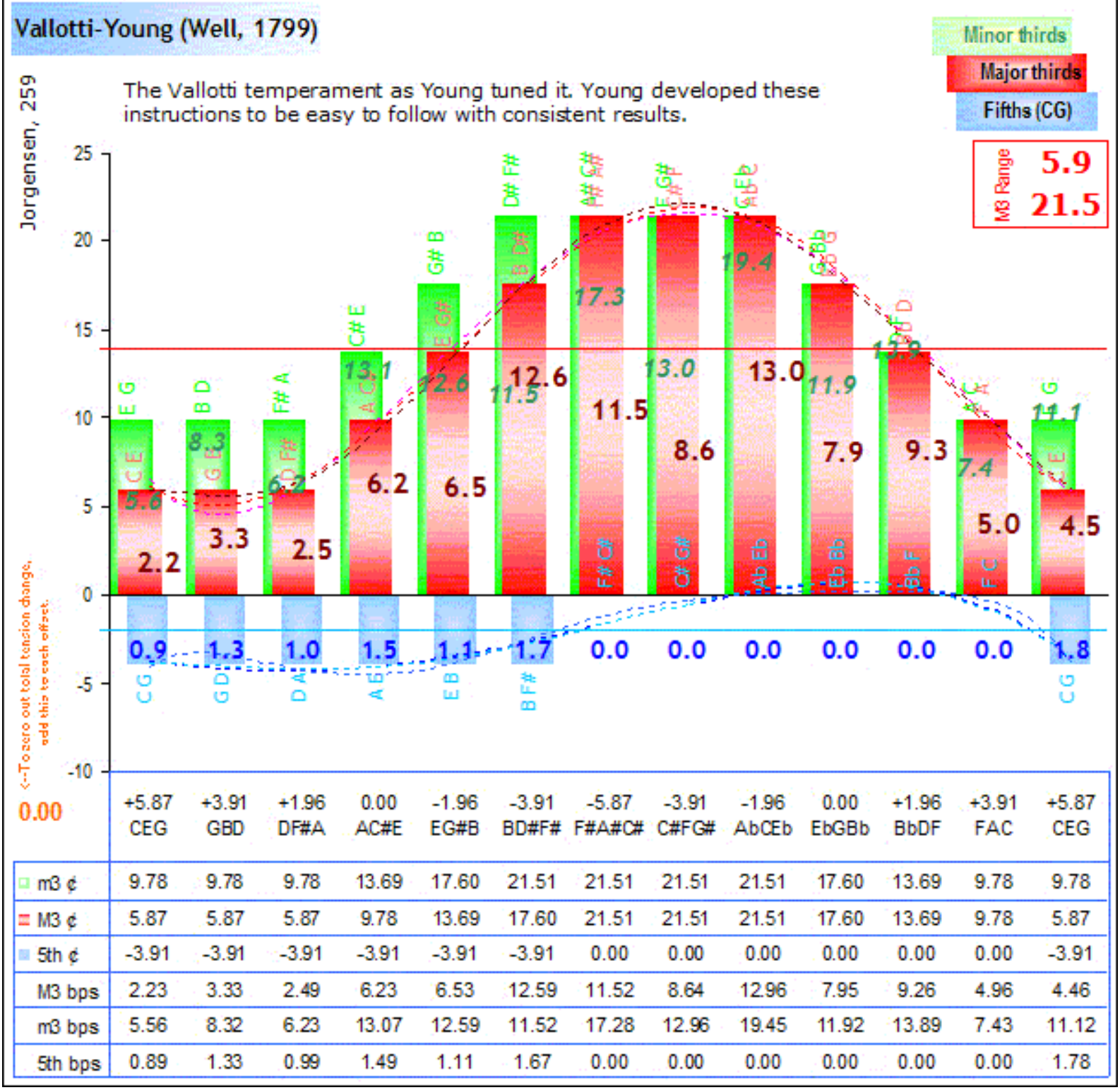


	+6.23 CEG	+4.15 GBD	+2.08 DF#A	0.00 AC#E	-2.08 EG#B	-1.96 BD#F#	-1.83 F#A#C#	+0.12 C#FG#	+2.08 AbCEb	+4.03 EbGBb	+5.99 BbDF	+6.11 FAC	+6.23 CEG
m3 ¢	9.41	11.61	13.81	17.84	19.67	21.51	21.51	19.67	17.84	13.81	11.61	9.41	9.41
M3 ¢	5.38	7.58	9.78	13.81	17.84	19.67	21.51	19.67	17.84	13.81	9.78	7.58	5.38
5th ¢	-4.03	-4.03	-4.03	-4.03	-1.83	-1.83	0.00	0.00	0.00	0.00	-1.83	-1.83	-4.03
M3 bps	2.04	4.31	4.16	8.81	8.53	14.10	11.55	7.92	10.77	6.24	6.62	3.84	4.08
m3 bps	5.35	9.89	8.81	17.05	14.10	11.55	17.33	11.88	16.15	9.37	11.79	7.15	10.71
5th bps	0.92	1.37	1.03	1.54	0.52	0.78	0.00	0.00	0.00	0.00	0.74	0.56	1.83

Vallotti-Young (Well, 1799)

Jorgensen, 259

The Vallotti temperament as Young tuned it. Young developed these instructions to be easy to follow with consistent results.

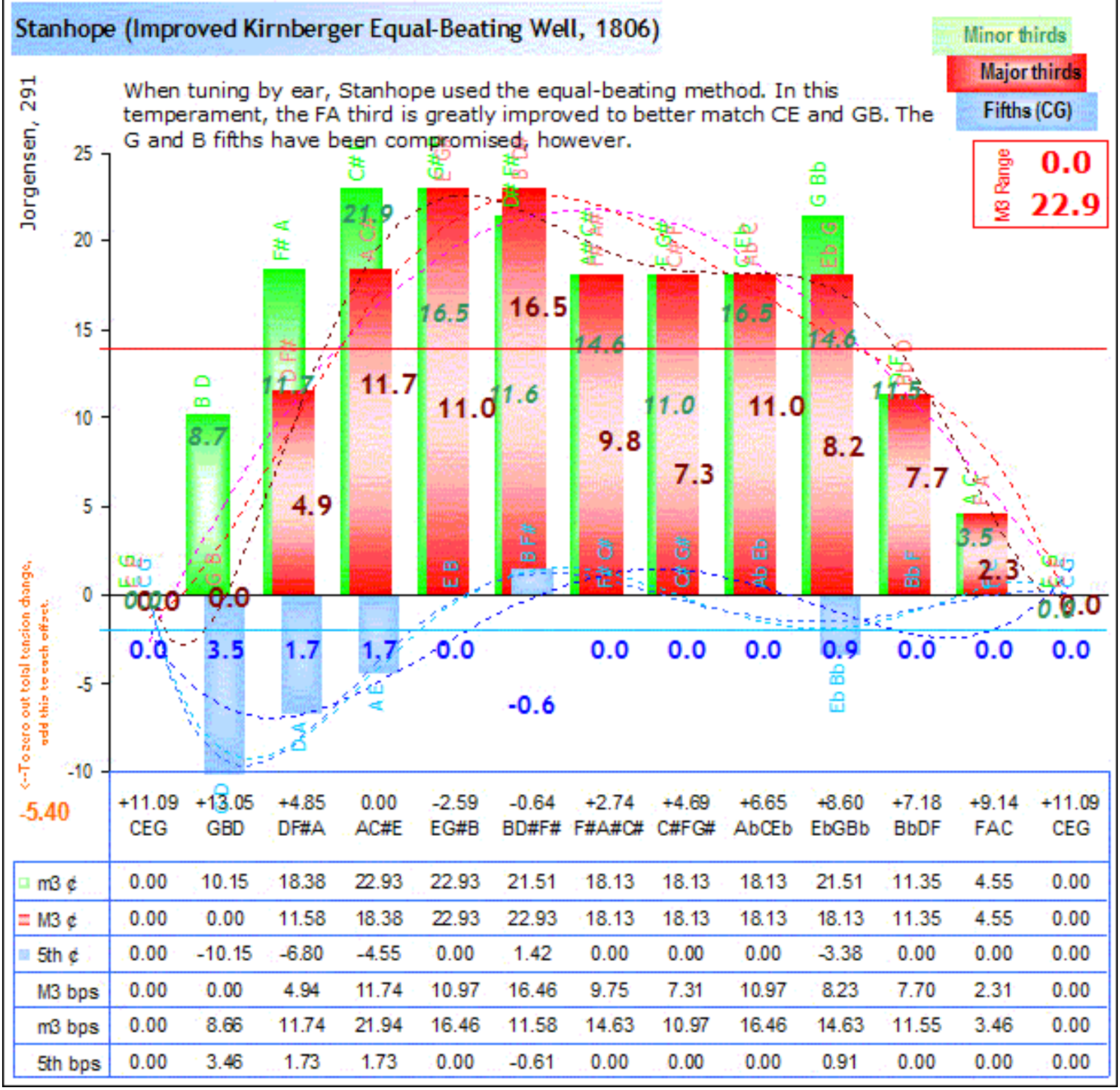


	+5.87 CEG	+3.91 GBD	+1.96 DF#A	0.00 AC#E	-1.96 EG#B	-3.91 BD#F#	-5.87 F#A#C#	-3.91 C#FG#	-1.96 AbCEb	0.00 EbGBb	+1.96 BbDF	+3.91 FAC	+5.87 CEG
m3 ¢	9.78	9.78	9.78	13.69	17.60	21.51	21.51	21.51	21.51	17.60	13.69	9.78	9.78
M3 ¢	5.87	5.87	5.87	9.78	13.69	17.60	21.51	21.51	21.51	17.60	13.69	9.78	5.87
5th ¢	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91	0.00	0.00	0.00	0.00	0.00	0.00	-3.91
M3 bps	2.23	3.33	2.49	6.23	6.53	12.59	11.52	8.64	12.96	7.95	9.26	4.96	4.46
m3 bps	5.56	8.32	6.23	13.07	12.59	11.52	17.28	12.96	19.45	11.92	13.89	7.43	11.12
5th bps	0.89	1.33	0.99	1.49	1.11	1.67	0.00	0.00	0.00	0.00	0.00	0.00	1.78

Stanhope (Improved Kirnberger Equal-Beating Well, 1806)

Jorgensen, 291

When tuning by ear, Stanhope used the equal-beating method. In this temperament, the FA third is greatly improved to better match CE and GB. The G and B fifths have been compromised, however.



	+11.09 CEG	+13.05 GBD	+4.85 DF#A	0.00 AC#E	-2.59 EG#B	-0.64 BD#F#	+2.74 F#A#C#	+4.69 C#FG#	+6.65 AbCEb	+8.60 EbGBb	+7.18 BbDF	+9.14 FAC	+11.09 CEG
m3 ¢	0.00	10.15	18.38	22.93	22.93	21.51	18.13	18.13	18.13	21.51	11.35	4.55	0.00
M3 ¢	0.00	0.00	11.58	18.38	22.93	22.93	18.13	18.13	18.13	18.13	11.35	4.55	0.00
5th ¢	0.00	-10.15	-6.80	-4.55	0.00	1.42	0.00	0.00	0.00	-3.38	0.00	0.00	0.00
M3 bps	0.00	0.00	4.94	11.74	10.97	16.46	9.75	7.31	10.97	8.23	7.70	2.31	0.00
m3 bps	0.00	8.66	11.74	21.94	16.46	11.58	14.63	10.97	16.46	14.63	11.55	3.46	0.00
5th bps	0.00	3.46	1.73	1.73	0.00	-0.61	0.00	0.00	0.00	0.91	0.00	0.00	0.00

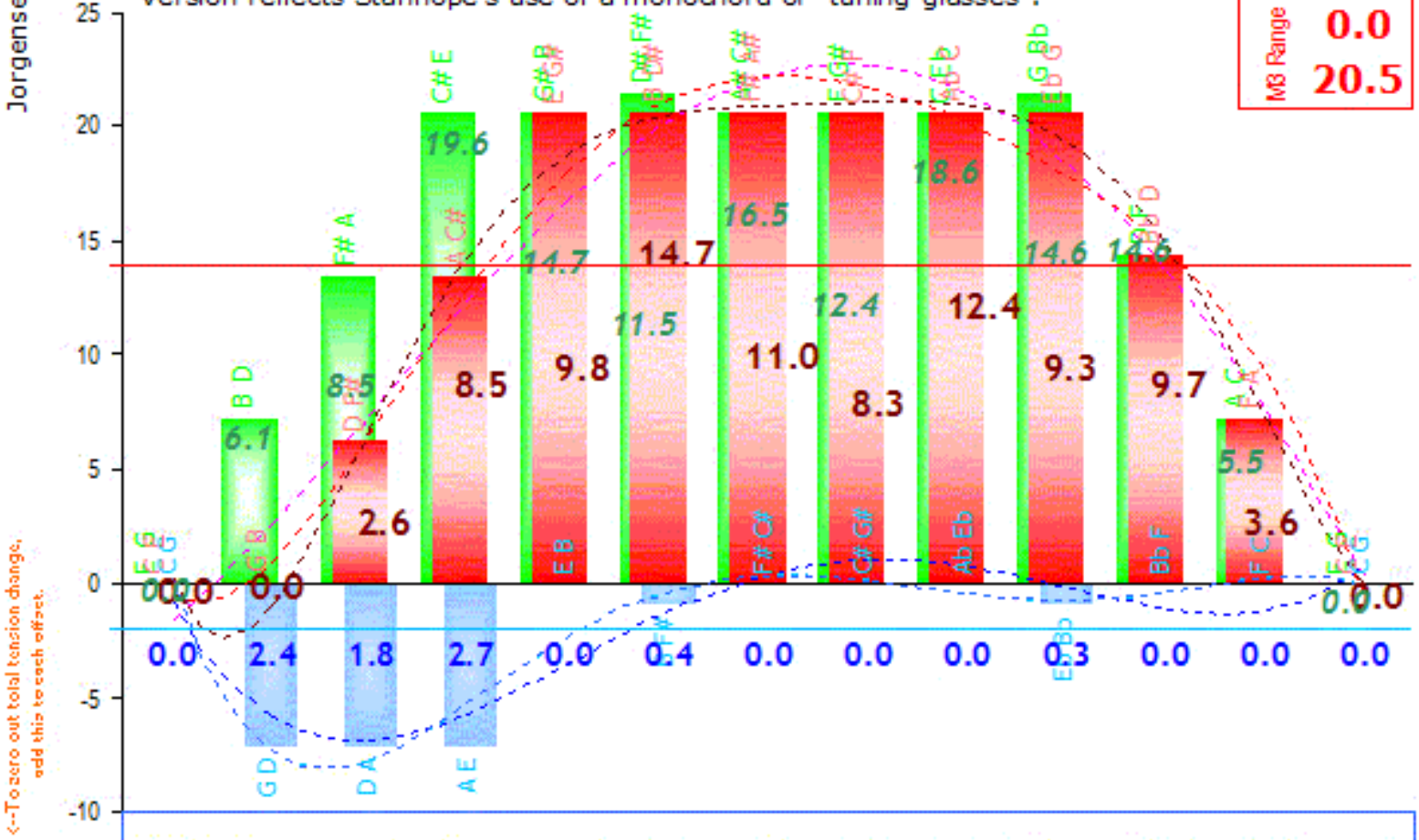
Stanhope (Improved Kirnberger Theoretical Well, 1806)

Jorgensen, 289

Stanhope was a scientist, inventor and politician. He disliked the D and A fifths of the Kirnberger, and proposed to temper the G fifth as well. The "theoretical" version reflects Stanhope's use of a monochord or "tuning-glasses".

Minor thirds
Major thirds
Fifths (CG)

M3 Range 0.0 20.5



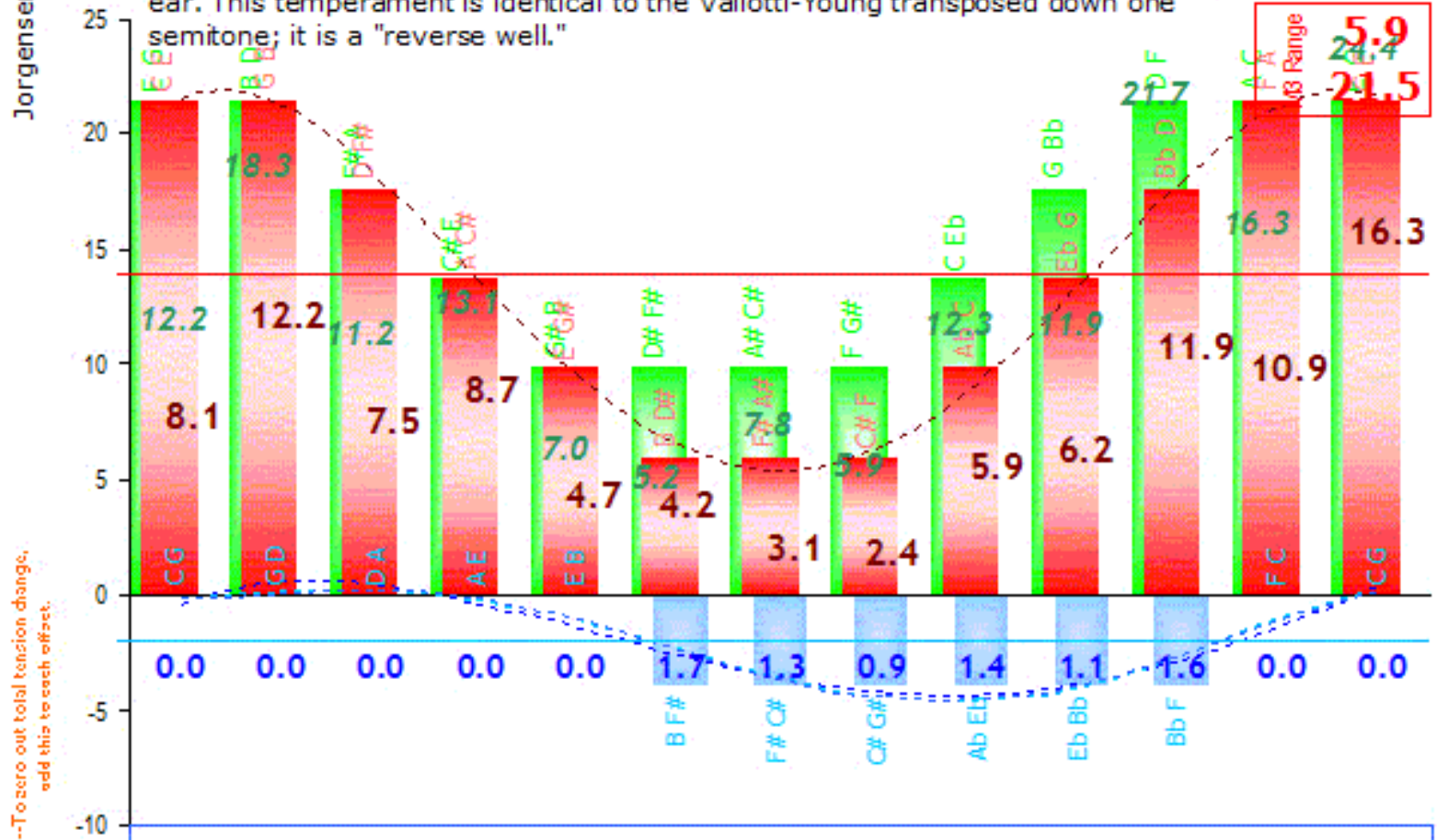
	+8.47 CEG	+10.43 GBD	+5.21 DF#A	0.00 AC#E	-5.21 EG#B	-3.26 BD#F#	-2.28 F#A#C#	-0.33 C#FG#	+1.63 AbCEb	+3.58 EbGBb	+4.56 BbDF	+6.52 FAC	+8.47 CEG
m3 ¢	0.00	7.17	13.36	20.53	20.53	21.51	20.53	20.53	20.53	21.51	14.34	7.17	0.00
M3 ¢	0.00	0.00	6.19	13.36	20.53	20.53	20.53	20.53	20.53	20.53	14.34	7.17	0.00
5th ¢	0.00	-7.17	-7.17	-7.17	0.00	-0.98	0.00	0.00	0.00	-0.98	0.00	0.00	0.00
M3 bps	0.00	0.00	2.64	8.52	9.80	14.70	11.02	8.26	12.40	9.30	9.72	3.64	0.00
m3 bps	0.00	6.11	8.52	19.60	14.70	11.55	16.53	12.40	18.60	14.61	14.58	5.45	0.00
5th bps	0.00	2.44	1.83	2.73	0.00	0.42	0.00	0.00	0.00	0.26	0.00	0.00	0.00

Anton Bemetzrieder (Reverse Well, 1808)

Jorgensen, 339

Minor thirds
Major thirds
Fifths (CG)

A French music teacher, Bemetztrieder regarded singing talent as a prerequisite for tuning, and his tuning method was to temper melodically by ear. This temperament is identical to the Vallotti-Young transposed down one semitone; it is a "reverse well."

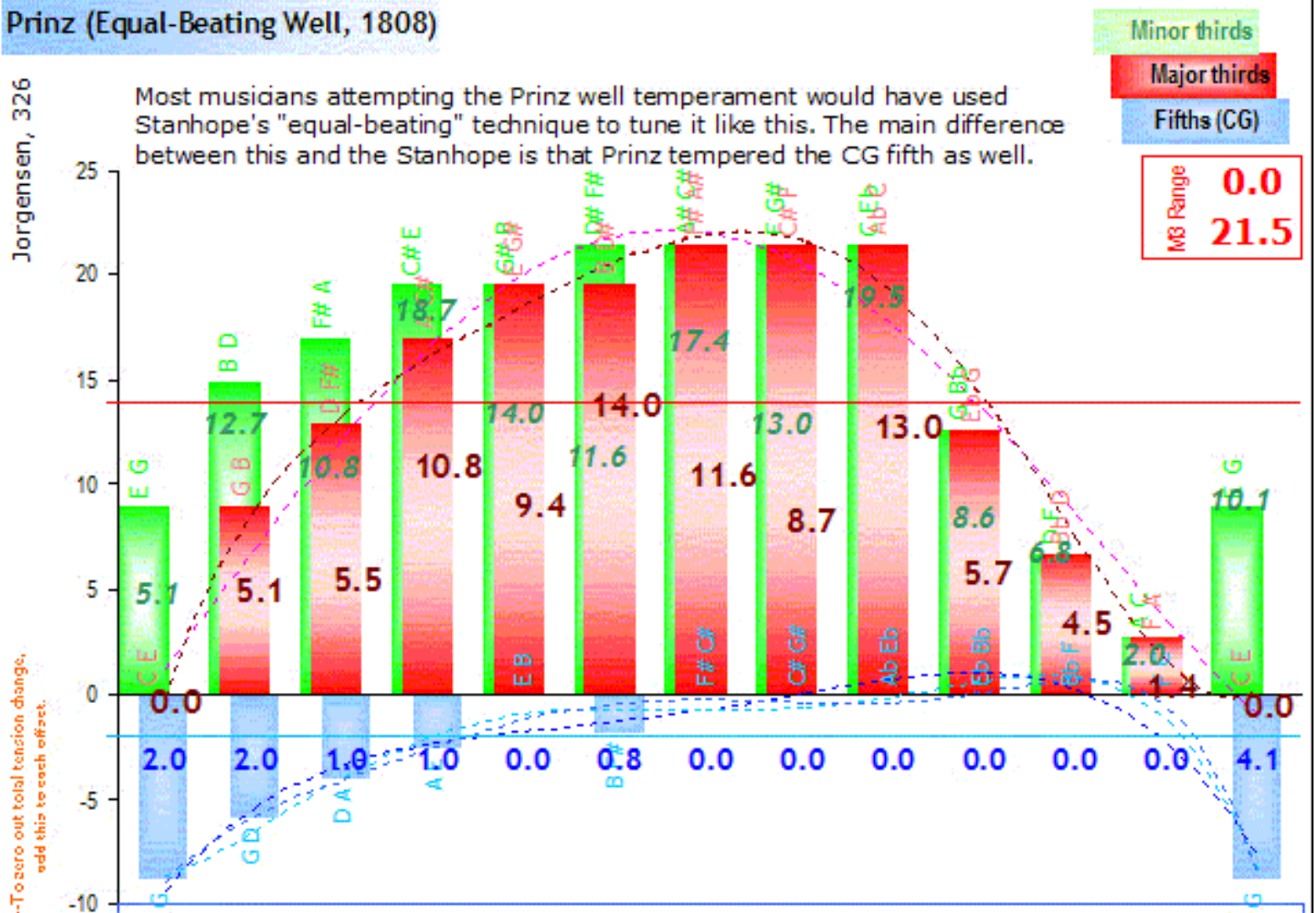


	-5.87 CEG	-3.91 GBD	-1.96 DF#A	0.00 AC#E	+1.96 EG#B	+3.91 BD#F#	+1.96 F#A#C#	0.00 C#FG#	-1.96 AbCEb	-3.91 EbGBb	-5.87 BbDF	-7.82 FAC	-5.87 CEG
m3 ¢	21.51	21.51	17.60	13.69	9.78	9.78	9.78	9.78	13.69	17.60	21.51	21.51	21.51
M3 ¢	21.51	21.51	17.60	13.69	9.78	5.87	5.87	5.87	9.78	13.69	17.60	21.51	21.51
5th ¢	0.00	0.00	0.00	0.00	0.00	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91	0.00	0.00
M3 bps	8.15	12.22	7.49	8.73	4.67	4.20	3.14	2.35	5.87	6.16	11.87	10.86	16.30
m3 bps	12.22	18.33	11.24	13.10	7.01	5.24	7.85	5.87	12.32	11.87	21.73	16.30	24.44
5th bps	0.00	0.00	0.00	0.00	0.00	1.68	1.25	0.94	1.40	1.05	1.57	0.00	0.00

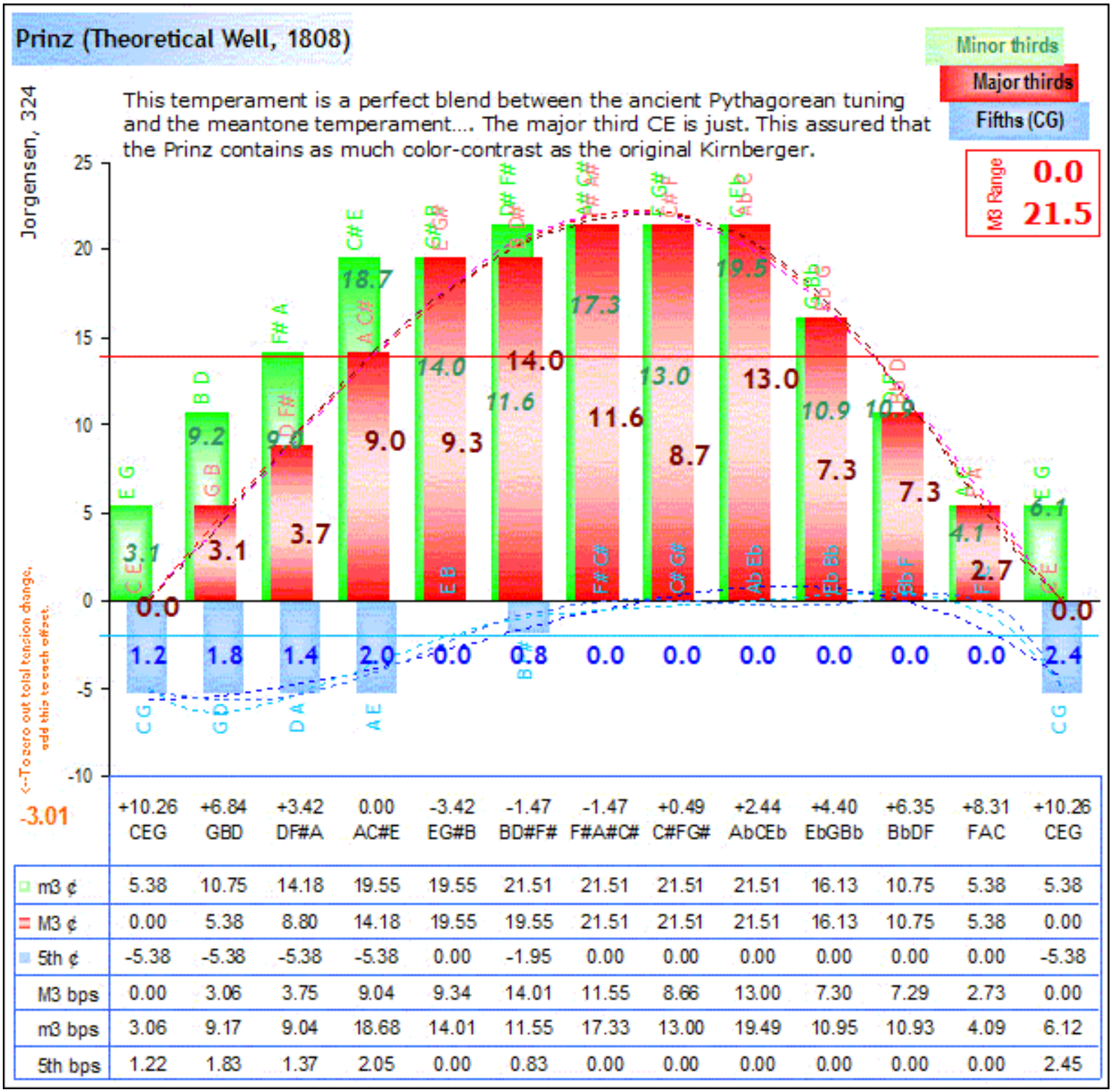
Prinz (Equal-Beating Well, 1808)

Jorgensen, 326

Most musicians attempting the Prinz well temperament would have used Stanhope's "equal-beating" technique to tune it like this. The main difference between this and the Stanhope is that Prinz tempered the CG fifth as well.



	+12.98 CEG	+6.03 GBD	+2.03 DF#A	0.00 AC#E	-0.71 EG#B	+1.25 BD#F#	+1.25 F#A#C#	+3.20 C#FG#	+5.16 AbCEb	+7.11 EbGBb	+9.07 BbDF	+11.02 FAC	+12.98 CEG
m3 ¢	8.90	14.86	16.89	19.55	19.55	21.51	21.51	21.51	21.51	12.61	6.65	2.66	8.90
M3 ¢	(0.00)	8.90	12.91	16.89	19.55	19.55	21.51	21.51	21.51	12.61	6.65	2.66	(0.00)
5th ¢	-8.90	-5.96	-3.98	-2.66	0.00	-1.95	0.00	0.00	0.00	0.00	0.00	0.00	-8.90
M3 bps	0.00	5.07	5.50	10.78	9.36	14.03	11.57	8.68	13.02	5.71	4.51	1.35	0.00
m3 bps	5.07	12.67	10.78	18.71	14.03	11.57	17.36	13.02	19.53	8.56	6.76	2.03	10.14
5th bps	2.03	2.03	1.01	1.01	0.00	0.84	0.00	0.00	0.00	0.00	0.00	0.00	4.06



	+10.26 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-1.47 BD#F#	-1.47 F#A#C#	+0.49 C#FG#	+2.44 AbCEb	+4.40 EbGBb	+6.35 BbDF	+8.31 FAC	+10.26 CEG
m3 ¢	5.38	10.75	14.18	19.55	19.55	21.51	21.51	21.51	21.51	16.13	10.75	5.38	5.38
M3 ¢	0.00	5.38	8.80	14.18	19.55	19.55	21.51	21.51	21.51	16.13	10.75	5.38	0.00
5th ¢	-5.38	-5.38	-5.38	-5.38	0.00	-1.95	0.00	0.00	0.00	0.00	0.00	0.00	-5.38
M3 bps	0.00	3.06	3.75	9.04	9.34	14.01	11.55	8.66	13.00	7.30	7.29	2.73	0.00
m3 bps	3.06	9.17	9.04	18.68	14.01	11.55	17.33	13.00	19.49	10.95	10.93	4.09	6.12
5th bps	1.22	1.83	1.37	2.05	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	2.45

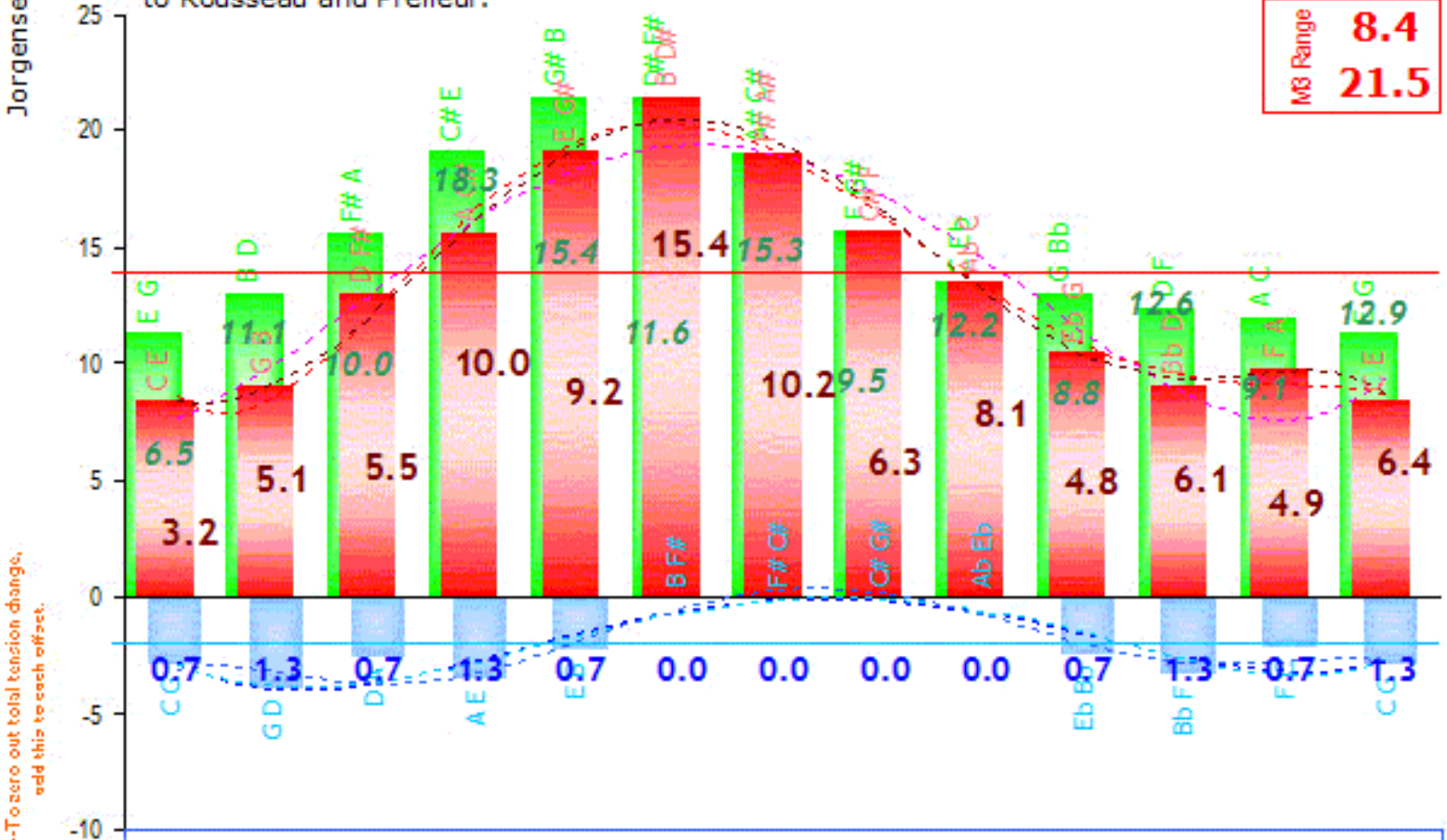
Jean Jousse (Well, 1832)

Minor thirds
Major thirds
Fifths (CG)

Jousse fled the French Revolution and went to London. He published two methods of tuning -- a well and a quasi-equal. Jorgensen finds this one similar to Rousseau and Prelleur.

M3 Range 8.4 21.5

Jorgensen, 422



<--To zero out total tension change, add this to each effect.

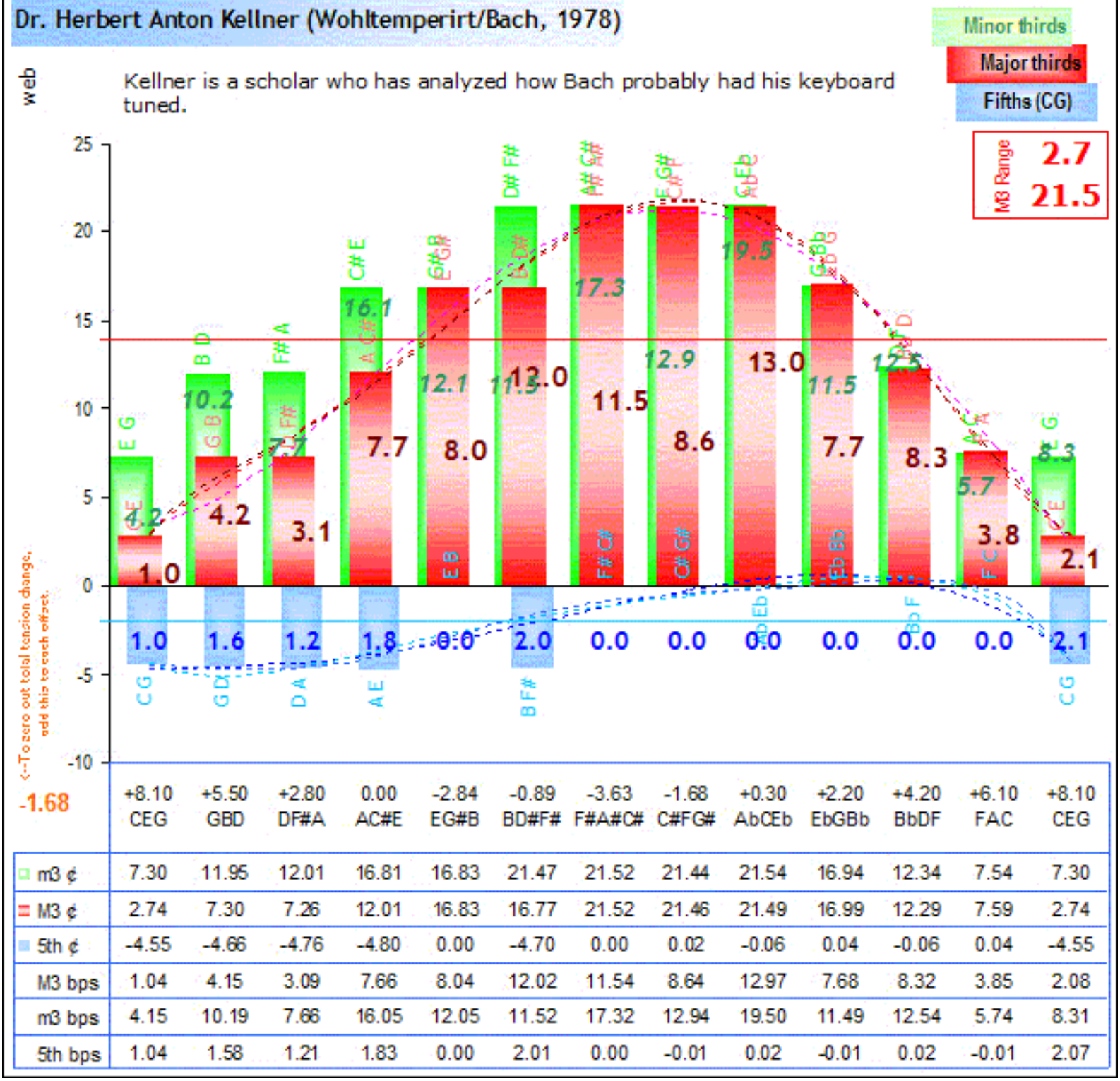
-2.04

	+3.69 CEG	+2.69 GBD	+0.69 DF#A	0.00 AC#E	-1.57 EG#B	-1.97 BD#F#	-0.02 F#A#C#	+1.94 C#FG#	+3.89 AbCEb	+5.85 EbGBb	+5.32 BbDF	+3.95 FAC	+3.69 CEG
m3 ¢	11.38	12.98	15.62	19.15	21.51	21.51	19.02	15.70	13.49	13.01	12.38	11.95	11.38
M3 ¢	8.42	9.03	12.98	15.62	19.15	21.51	19.02	15.70	13.49	10.53	9.06	9.73	8.42
5th ¢	-2.96	-3.95	-2.64	-3.53	-2.36	0.00	0.00	0.00	0.00	-2.49	-3.32	-2.22	-2.96
M3 bps	3.20	5.13	5.53	9.97	9.16	15.42	10.22	6.32	8.14	4.76	6.13	4.93	6.39
m3 bps	6.47	11.06	9.97	18.32	15.42	11.56	15.33	9.48	12.21	8.82	12.56	9.08	12.95
5th bps	0.67	1.34	0.67	1.34	0.67	0.00	0.00	0.00	0.00	0.67	1.34	0.67	1.34

Dr. Herbert Anton Kellner (Wohltemperirt/Bach, 1978)

web

Kellner is a scholar who has analyzed how Bach probably had his keyboard tuned.

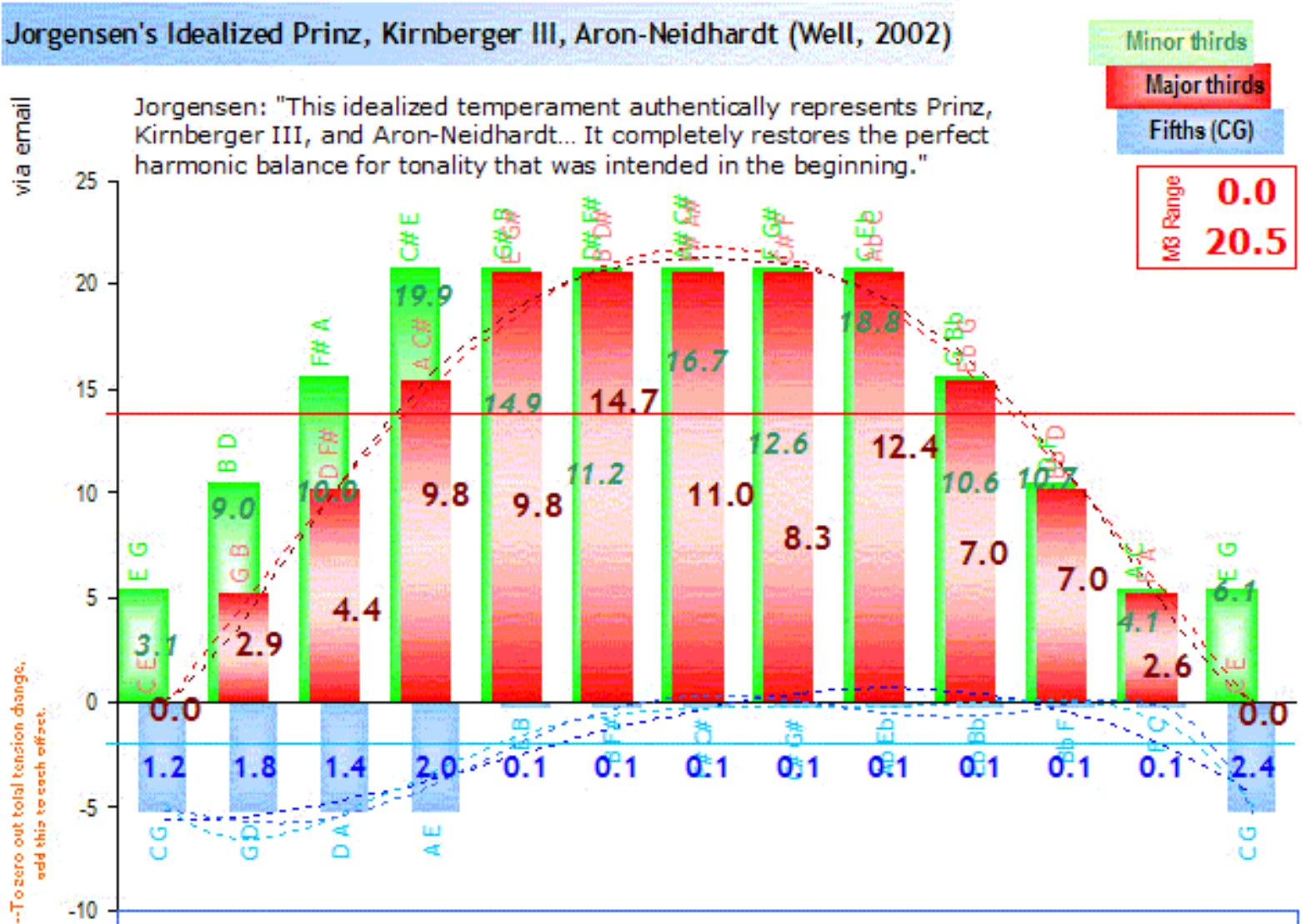


	+8.10 CEG	+5.50 GBD	+2.80 DF#A	0.00 AC#E	-2.84 EG#B	-0.89 BD#F#	-3.63 F#A#C#	-1.68 C#FG#	+0.30 AbCEb	+2.20 EbGBb	+4.20 BbDF	+6.10 FAC	+8.10 CEG
m3 ¢	7.30	11.95	12.01	16.81	16.83	21.47	21.52	21.44	21.54	16.94	12.34	7.54	7.30
M3 ¢	2.74	7.30	7.26	12.01	16.83	16.77	21.52	21.46	21.49	16.99	12.29	7.59	2.74
5th ¢	-4.55	-4.66	-4.76	-4.80	0.00	-4.70	0.00	0.02	-0.06	0.04	-0.06	0.04	-4.55
M3 bps	1.04	4.15	3.09	7.66	8.04	12.02	11.54	8.64	12.97	7.68	8.32	3.85	2.08
m3 bps	4.15	10.19	7.66	16.05	12.05	11.52	17.32	12.94	19.50	11.49	12.54	5.74	8.31
5th bps	1.04	1.58	1.21	1.83	0.00	2.01	0.00	-0.01	0.02	-0.01	0.02	-0.01	2.07

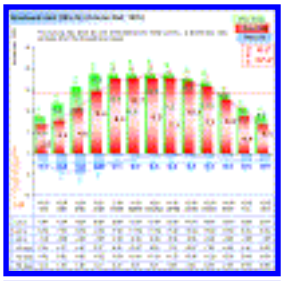
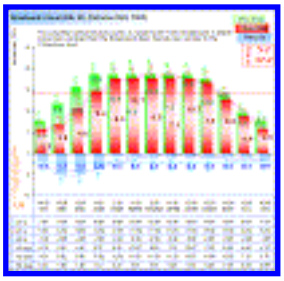
Jorgensen's Idealized Prinz, Kirnberger III, Aron-Neidhardt (Well, 2002)

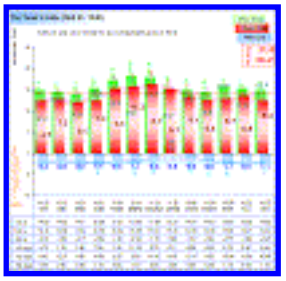
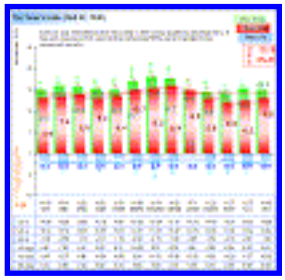
via email

Jorgensen: "This idealized temperament authentically represents Prinz, Kirnberger III, and Aron-Neidhardt... It completely restores the perfect harmonic balance for tonality that was intended in the beginning."



	+10.26 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-1.71 BD#F#	0.00 F#A#C#	+1.71 C#FG#	+3.42 AbCEb	+5.13 EbGBb	+6.84 BbDF	+8.55 FAC	+10.26 CEG
m3 ¢	5.38	10.51	15.64	20.77	20.77	20.77	20.77	20.77	20.77	15.64	10.51	5.38	5.38
M3 ¢	0.01	5.14	10.27	15.40	20.53	20.53	20.53	20.53	20.53	15.40	10.27	5.14	0.01
5th ¢	-5.38	-5.38	-5.38	-5.38	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-0.25	-5.38
M3 bps	0.00	2.92	4.38	9.83	9.81	14.71	11.03	8.27	12.41	6.97	6.96	2.61	0.00
m3 bps	3.06	8.96	9.98	19.85	14.89	11.16	16.74	12.56	18.83	10.62	10.69	4.10	6.13
5th bps	1.22	1.83	1.37	2.05	0.07	0.10	0.08	0.06	0.09	0.07	0.10	0.07	2.45

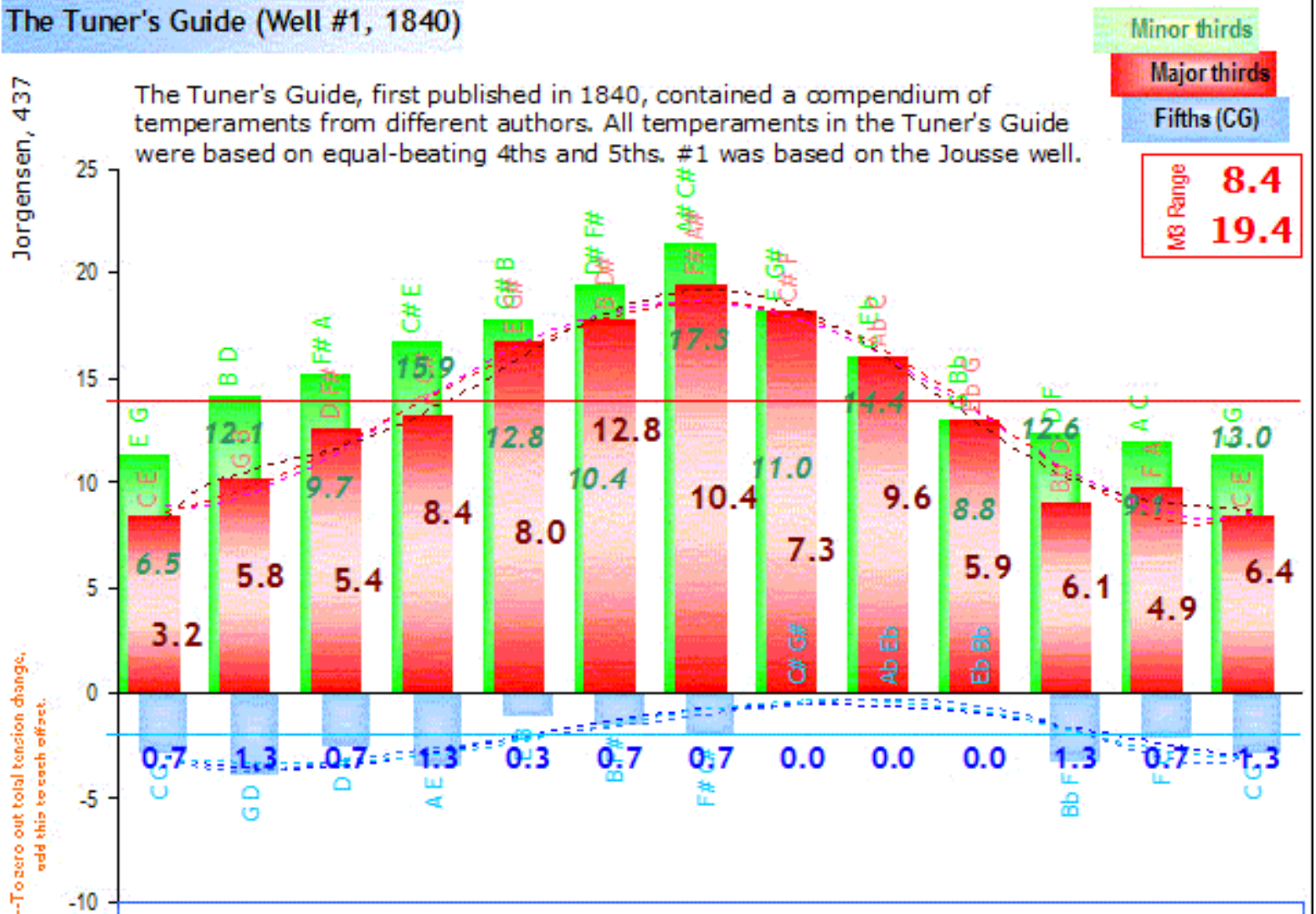





The Tuner's Guide (Well #1, 1840)

Jorgensen, 437

The Tuner's Guide, first published in 1840, contained a compendium of temperaments from different authors. All temperaments in the Tuner's Guide were based on equal-beating 4ths and 5ths. #1 was based on the Jousse well.



	+3.69 CEG	+2.68 GBD	+0.69 DF#A	0.00 AC#E	-1.57 EG#B	-0.79 BD#F#	-0.41 F#A#C#	-0.55 C#FG#	+1.40 AbCEb	+3.36 EbGBb	+5.31 BbDF	+3.95 FAC	+3.69 CEG
m3 ¢	11.39	14.16	15.23	16.66	17.84	19.41	21.51	18.19	15.97	13.01	12.38	11.95	11.39
M3 ¢	8.43	10.21	12.59	13.13	16.66	17.84	19.41	18.19	15.97	13.01	9.06	9.74	8.43
5th ¢	-2.96	-3.95	-2.64	-3.53	-1.18	-1.57	-2.10	0.00	0.00	0.00	-3.32	-2.22	-2.96
M3 bps	3.20	5.80	5.36	8.38	7.96	12.78	10.43	7.32	9.63	5.88	6.13	4.94	6.40
m3 bps	6.48	12.06	9.72	15.92	12.78	10.43	17.32	10.97	14.45	8.82	12.56	9.08	12.95
5th bps	0.67	1.34	0.67	1.34	0.34	0.67	0.67	0.00	0.00	0.00	1.34	0.67	1.34

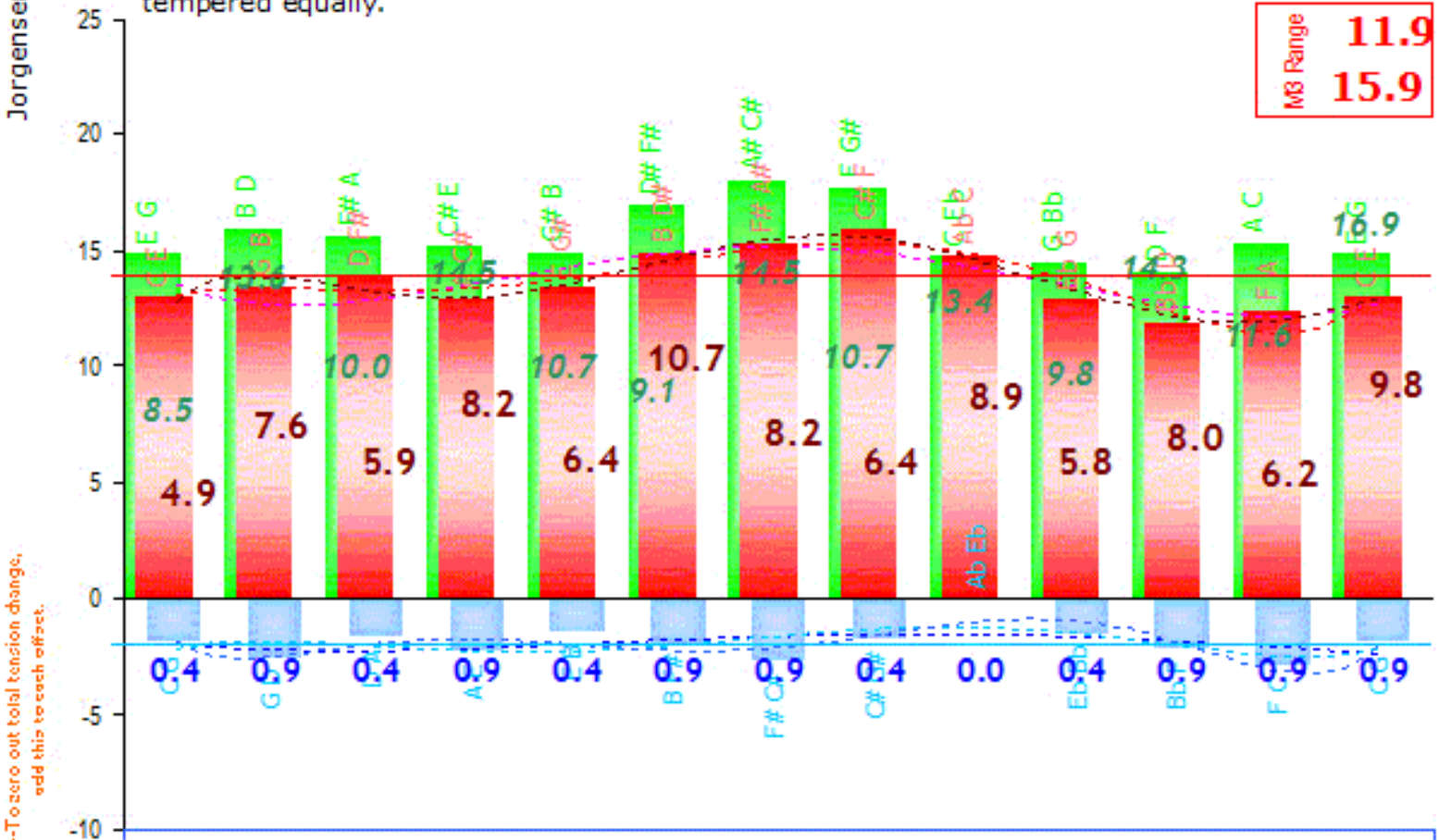
The Tuner's Guide (Well #2, 1840)

Jorgensen, 441

Well #2 was intended as the next step in the tuning student's development. It has only one pure 5th, and all the remaining fifths were intended to be tempered equally.

Minor thirds
Major thirds
Fifths (CG)

M3 Range 11.9 15.9

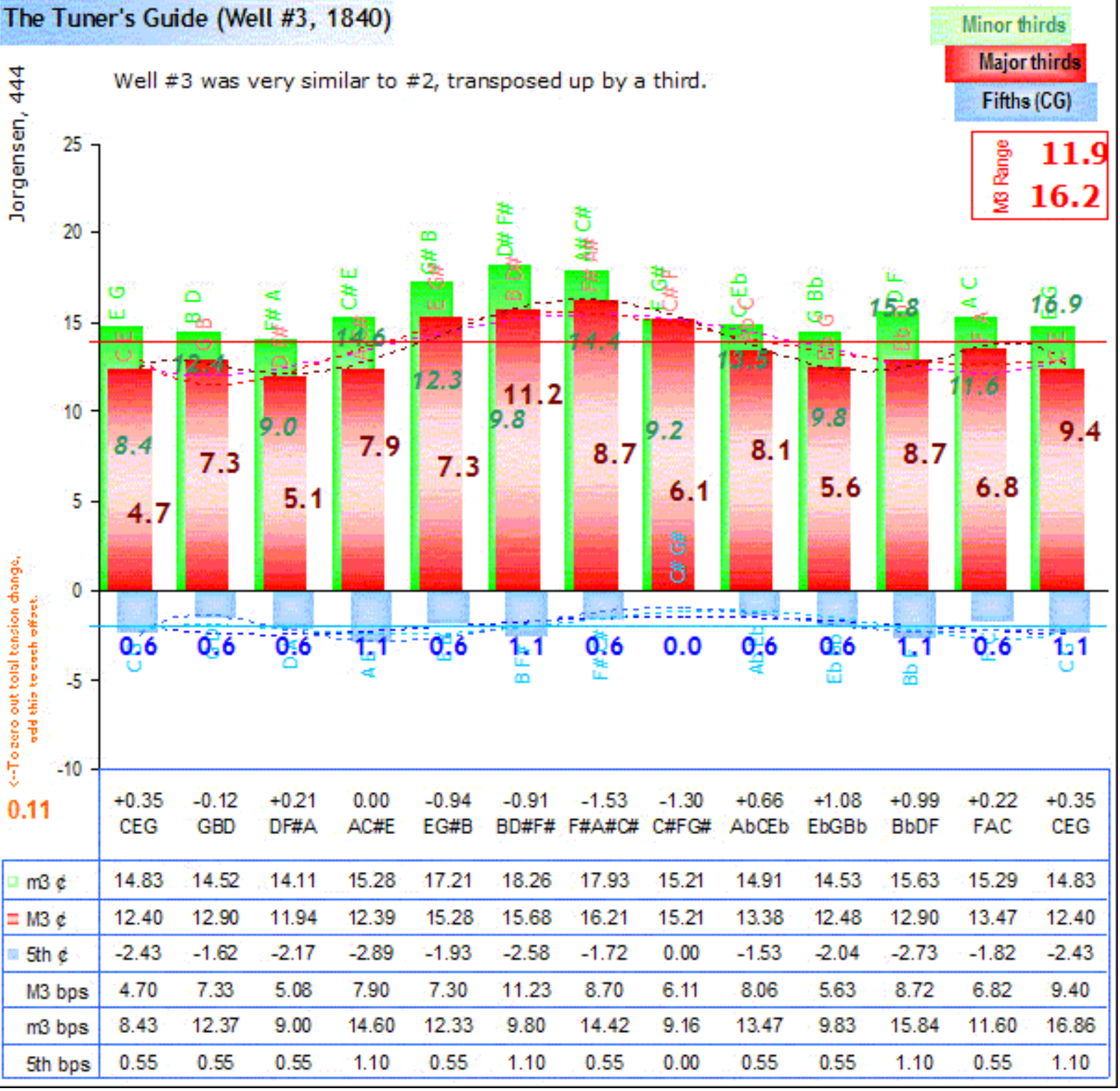


	+0.40 CEG	+0.41 GBD	-0.23 DF#A	0.00 AC#E	-0.35 EG#B	+0.06 BD#F#	-0.04 F#A#C#	-0.83 C#FG#	-0.71 AbCEb	+1.25 EbGBb	+1.57 BbDF	+1.35 FAC	+0.40 CEG
m3 ¢	14.88	15.93	15.60	15.16	14.87	16.93	18.04	17.70	14.79	14.48	14.07	15.25	14.88
M3 ¢	12.94	13.34	13.87	12.85	13.33	14.87	15.30	15.87	14.79	12.85	11.89	12.34	12.94
5th ¢	-1.94	-2.59	-1.73	-2.31	-1.54	-2.06	-2.75	-1.83	0.00	-1.63	-2.18	-2.91	-1.94
M3 bps	4.91	7.58	5.91	8.20	6.37	10.65	8.21	6.38	8.91	5.80	8.04	6.25	9.81
m3 bps	8.46	13.57	9.96	14.50	10.65	9.09	14.51	10.66	13.36	9.80	14.26	11.57	16.92
5th bps	0.44	0.88	0.44	0.88	0.44	0.88	0.88	0.44	0.00	0.44	0.88	0.88	0.88

The Tuner's Guide (Well #3, 1840)

Jorgensen, 444

Well #3 was very similar to #2, transposed up by a third.

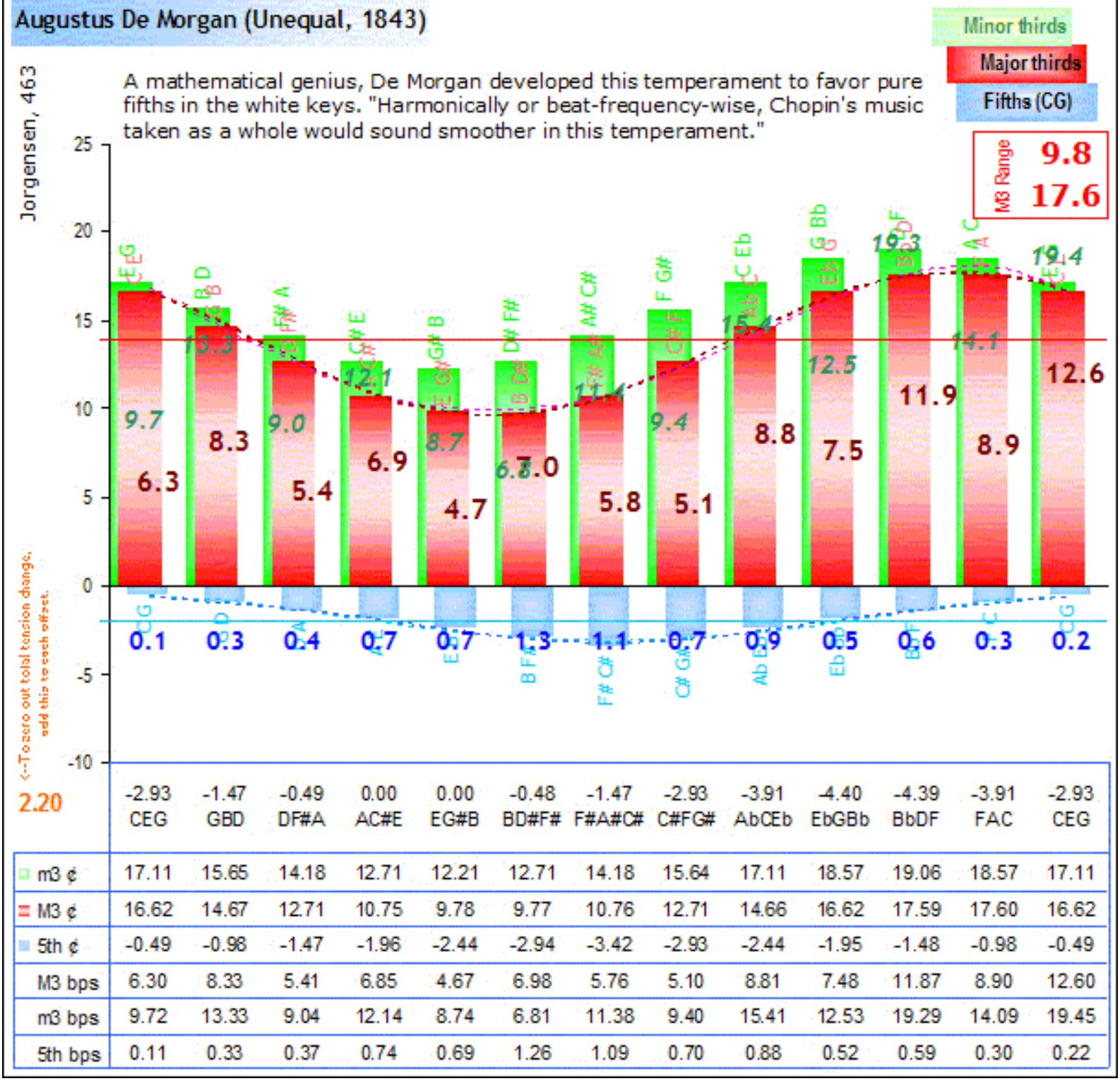


	+0.35 CEG	-0.12 GBD	+0.21 DF#A	0.00 AC#E	-0.94 EG#B	-0.91 BD#F#	-1.53 F#A#C#	-1.30 C#FG#	+0.66 AbCEb	+1.08 EbGBb	+0.99 BbDF	+0.22 FAC	+0.35 CEG
m3 ¢	14.83	14.52	14.11	15.28	17.21	18.26	17.93	15.21	14.91	14.53	15.63	15.29	14.83
M3 ¢	12.40	12.90	11.94	12.39	15.28	15.68	16.21	15.21	13.38	12.48	12.90	13.47	12.40
5th ¢	-2.43	-1.62	-2.17	-2.89	-1.93	-2.58	-1.72	0.00	-1.53	-2.04	-2.73	-1.82	-2.43
M3 bps	4.70	7.33	5.08	7.90	7.30	11.23	8.70	6.11	8.06	5.63	8.72	6.82	9.40
m3 bps	8.43	12.37	9.00	14.60	12.33	9.80	14.42	9.16	13.47	9.83	15.84	11.60	16.86
5th bps	0.55	0.55	0.55	1.10	0.55	1.10	0.55	0.00	0.55	0.55	1.10	0.55	1.10

Augustus De Morgan (Unequal, 1843)

Jorgensen, 463

A mathematical genius, De Morgan developed this temperament to favor pure fifths in the white keys. "Harmonically or beat-frequency-wise, Chopin's music taken as a whole would sound smoother in this temperament."

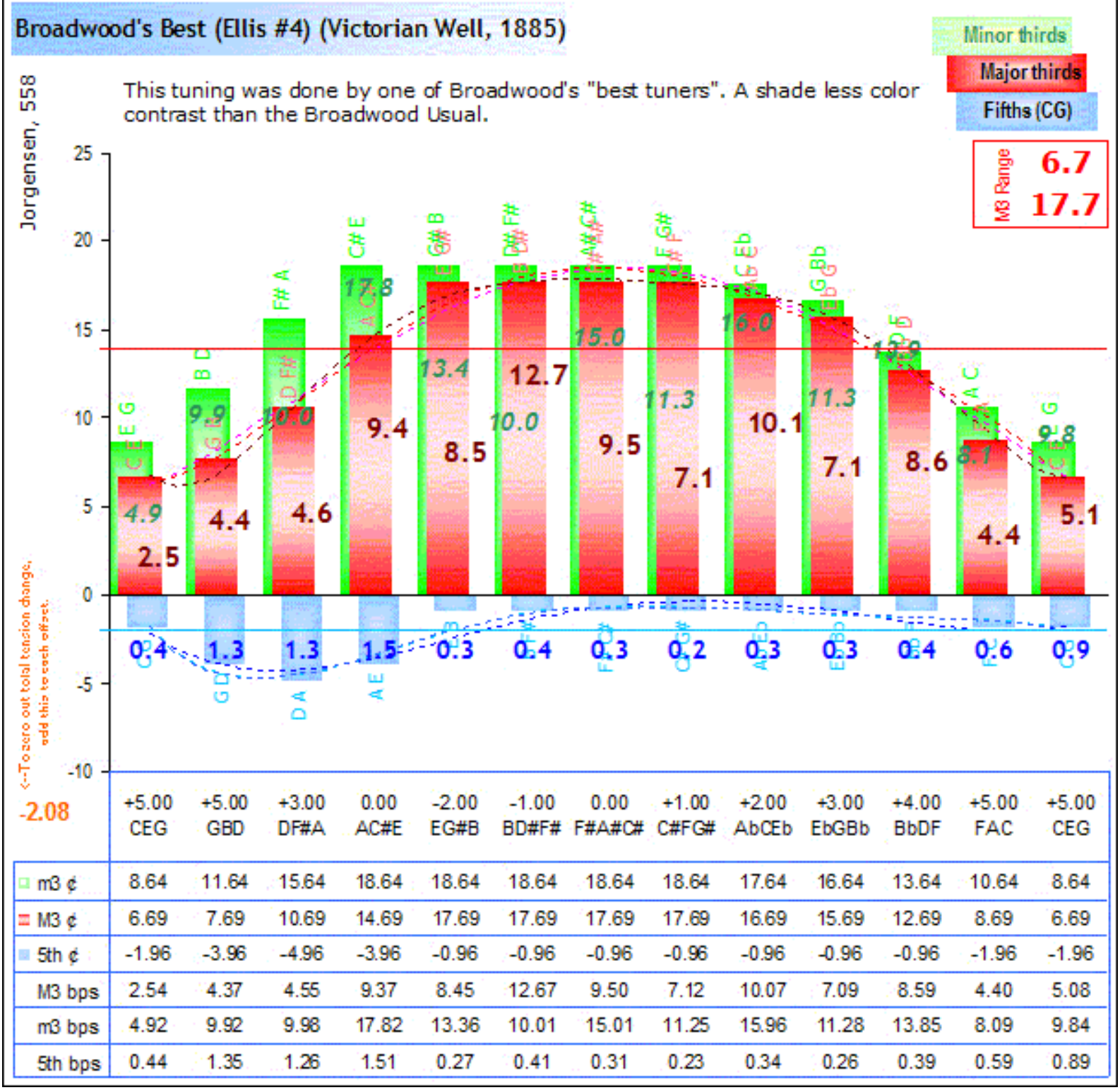


	-2.93 CEG	-1.47 GBD	-0.49 DF#A	0.00 AC#E	0.00 EG#B	-0.48 BD#F#	-1.47 F#A#C#	-2.93 C#FG#	-3.91 AbCEb	-4.40 EbGBb	-4.39 BbDF	-3.91 FAC	-2.93 CEG
m3 ¢	17.11	15.65	14.18	12.71	12.21	12.71	14.18	15.64	17.11	18.57	19.06	18.57	17.11
M3 ¢	16.62	14.67	12.71	10.75	9.78	9.77	10.76	12.71	14.66	16.62	17.59	17.60	16.62
5th ¢	-0.49	-0.98	-1.47	-1.96	-2.44	-2.94	-3.42	-2.93	-2.44	-1.95	-1.48	-0.98	-0.49
M3 bps	6.30	8.33	5.41	6.85	4.67	6.98	5.76	5.10	8.81	7.48	11.87	8.90	12.60
m3 bps	9.72	13.33	9.04	12.14	8.74	6.81	11.38	9.40	15.41	12.53	19.29	14.09	19.45
5th bps	0.11	0.33	0.37	0.74	0.69	1.26	1.09	0.70	0.88	0.52	0.59	0.30	0.22

Broadwood's Best (Ellis #4) (Victorian Well, 1885)

Jorgensen, 558

This tuning was done by one of Broadwood's "best tuners". A shade less color contrast than the Broadwood Usual.

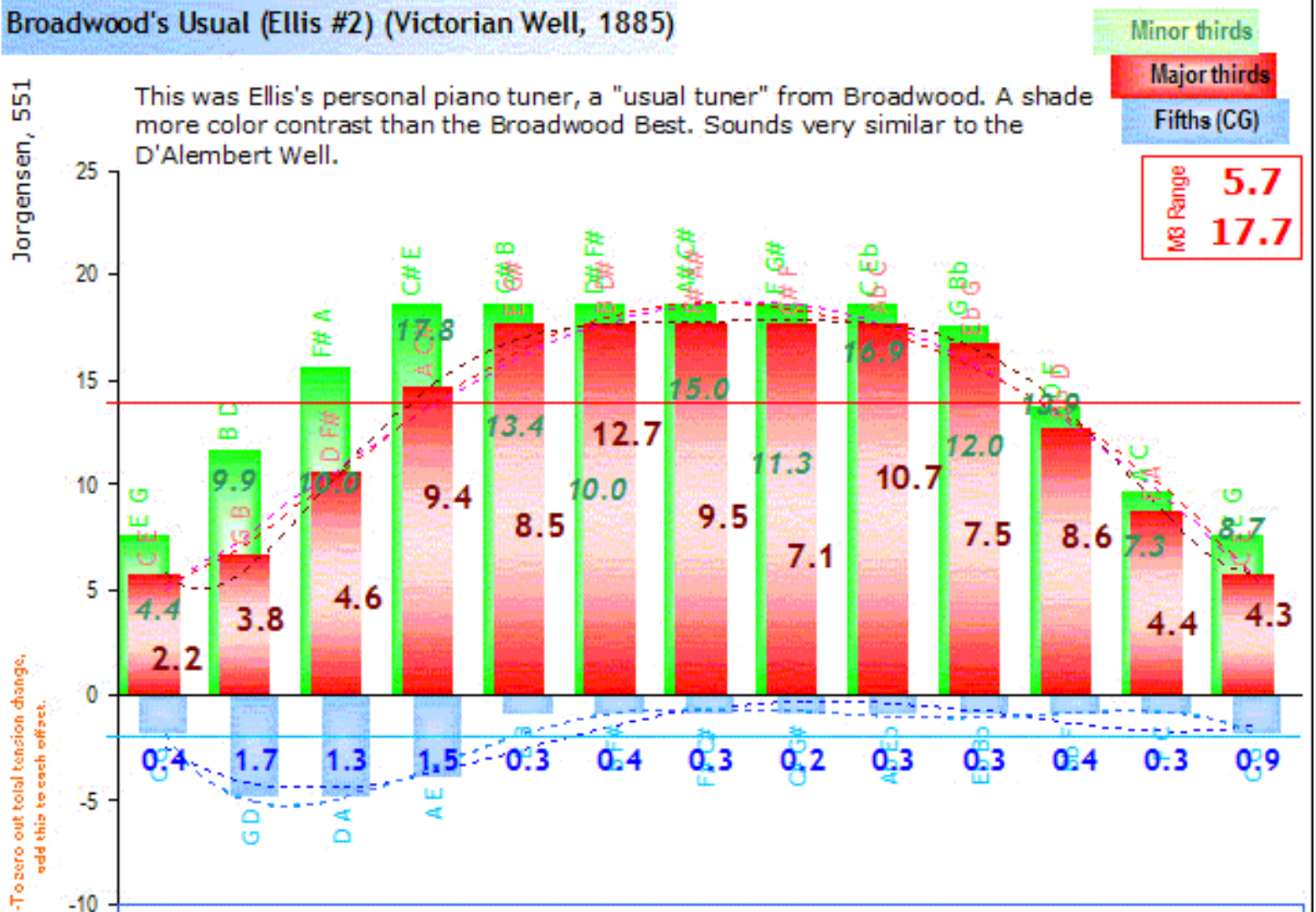


	+5.00 CEG	+5.00 GBD	+3.00 DF#A	0.00 AC#E	-2.00 EG#B	-1.00 BD#F#	0.00 F#A#C#	+1.00 C#FG#	+2.00 AbCEb	+3.00 EbGBb	+4.00 BbDF	+5.00 FAC	+5.00 CEG
m3 ¢	8.64	11.64	15.64	18.64	18.64	18.64	18.64	18.64	17.64	16.64	13.64	10.64	8.64
M3 ¢	6.69	7.69	10.69	14.69	17.69	17.69	17.69	17.69	16.69	15.69	12.69	8.69	6.69
5th ¢	-1.96	-3.96	-4.96	-3.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-1.96	-1.96
M3 bps	2.54	4.37	4.55	9.37	8.45	12.67	9.50	7.12	10.07	7.09	8.59	4.40	5.08
m3 bps	4.92	9.92	9.98	17.82	13.36	10.01	15.01	11.25	15.96	11.28	13.85	8.09	9.84
5th bps	0.44	1.35	1.26	1.51	0.27	0.41	0.31	0.23	0.34	0.26	0.39	0.59	0.89

Broadwood's Usual (Ellis #2) (Victorian Well, 1885)

Jorgensen, 551

This was Ellis's personal piano tuner, a "usual tuner" from Broadwood. A shade more color contrast than the Broadwood Best. Sounds very similar to the D'Alembert Well.



	+6.00 CEG	+6.00 GBD	+3.00 DF#A	0.00 AC#E	-2.00 EG#B	-1.00 BD#F#	0.00 F#A#C#	+1.00 C#FG#	+2.00 AbCEb	+3.00 EbGBb	+4.00 BbDF	+5.00 FAC	+6.00 CEG
m3 ¢	7.64	11.64	15.64	18.64	18.64	18.64	18.64	18.64	18.64	17.64	13.64	9.64	7.64
M3 ¢	5.69	6.69	10.69	14.69	17.69	17.69	17.69	17.69	17.69	16.69	12.69	8.69	5.69
5th ¢	-1.96	-4.96	-4.96	-3.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-0.96	-1.96
M3 bps	2.16	3.81	4.55	9.37	8.45	12.67	9.50	7.12	10.67	7.55	8.59	4.40	4.32
m3 bps	4.35	9.92	9.98	17.82	13.36	10.01	15.01	11.25	16.87	11.96	13.85	7.33	8.70
5th bps	0.44	1.69	1.26	1.51	0.27	0.41	0.31	0.23	0.34	0.26	0.39	0.29	0.89

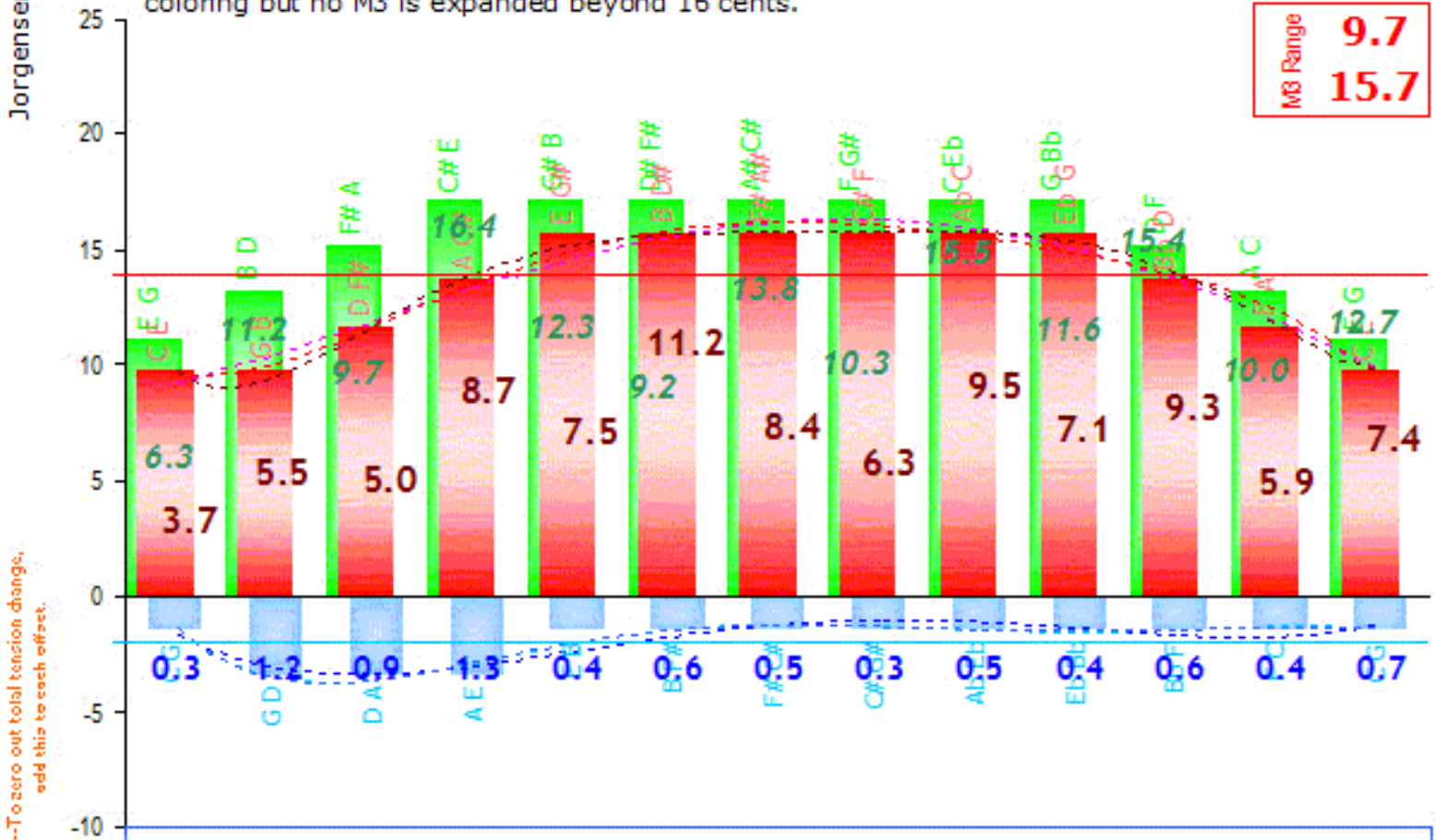
Moore (Representative Victorian Well, 1885)

Jorgensen, 544

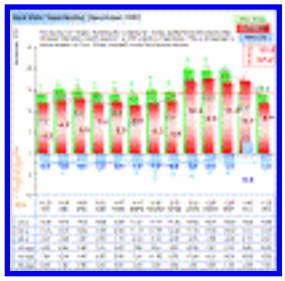
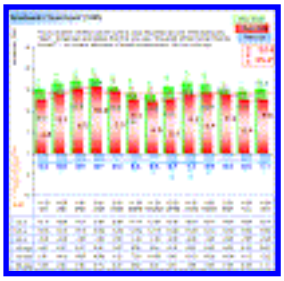
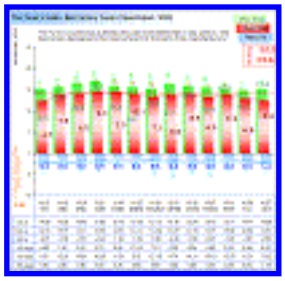
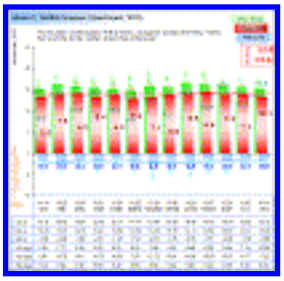
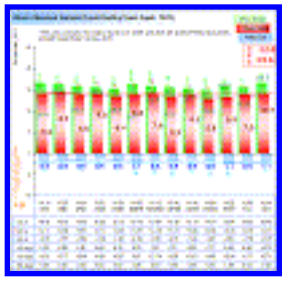
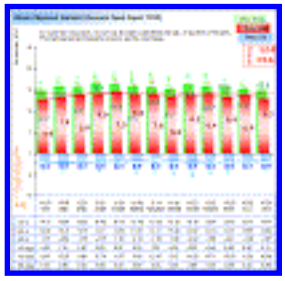
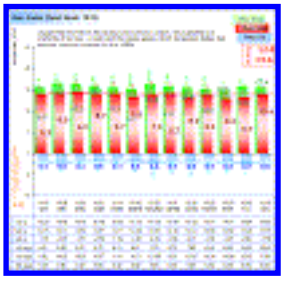
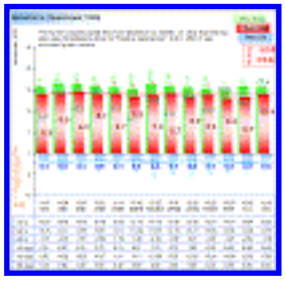
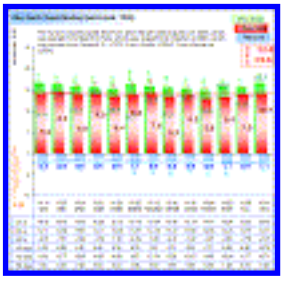
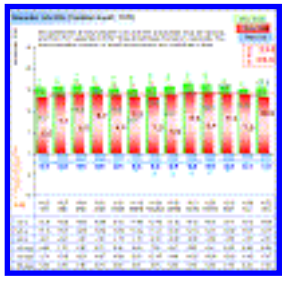
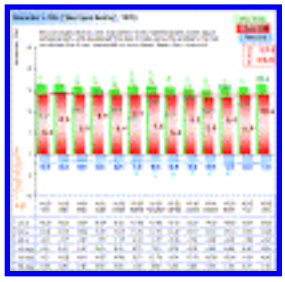
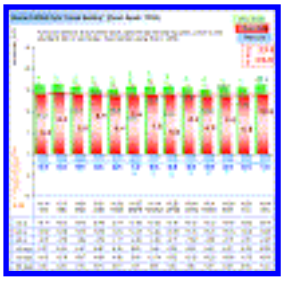
In 1885, Ellis analyzed the work of seven tuners. This tuning was done on a harmonium by a tuner from Moore & Moore. Note that there is some key-coloring but no M3 is expanded beyond 16 cents.

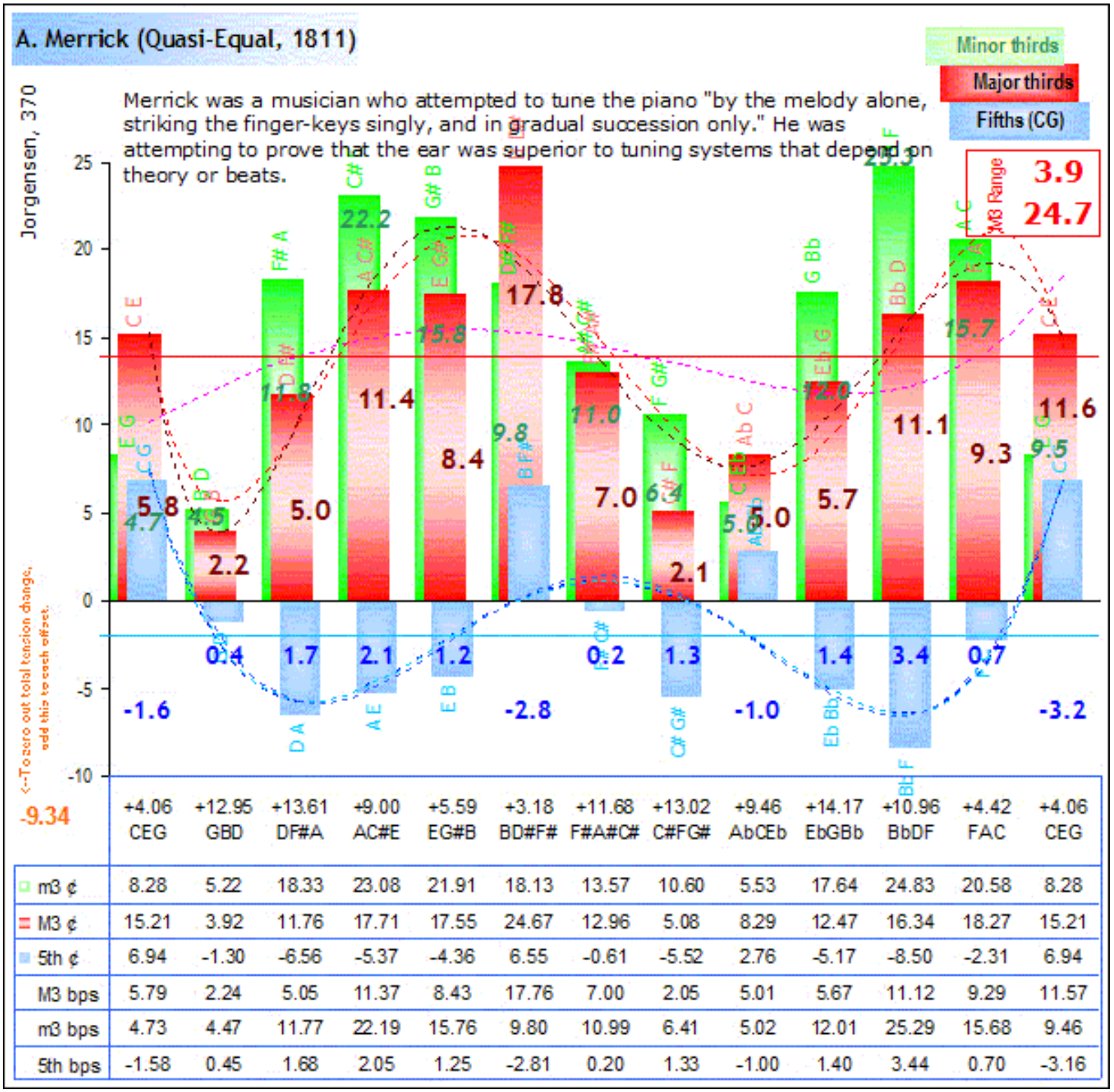
Minor thirds
Major thirds
Fifths (CG)

M3 Range 9.7 15.7



	+2.50 CEG	+3.00 GBD	+1.50 DF#A	0.00 AC#E	-1.50 EG#B	-1.00 BD#F#	-0.50 F#A#C#	0.00 C#FG#	+0.50 AbCEb	+1.00 EbGBb	+1.50 BbDF	+2.00 FAC	+2.50 CEG
m3 ¢	11.14	13.14	15.14	17.14	17.14	17.14	17.14	17.14	17.14	17.14	15.14	13.14	11.14
M3 ¢	9.69	9.69	11.69	13.69	15.69	15.69	15.69	15.69	15.69	15.69	13.69	11.69	9.69
5th ¢	-1.46	-3.46	-3.46	-3.46	-1.46	-1.46	-1.46	-1.46	-1.46	-1.46	-1.46	-1.46	-1.46
M3 bps	3.68	5.51	4.98	8.73	7.49	11.23	8.42	6.31	9.45	7.08	9.26	5.92	7.35
m3 bps	6.34	11.20	9.66	16.39	12.28	9.20	13.79	10.33	15.49	11.61	15.36	9.98	12.68
5th bps	0.33	1.17	0.88	1.32	0.42	0.62	0.47	0.35	0.52	0.39	0.59	0.44	0.66

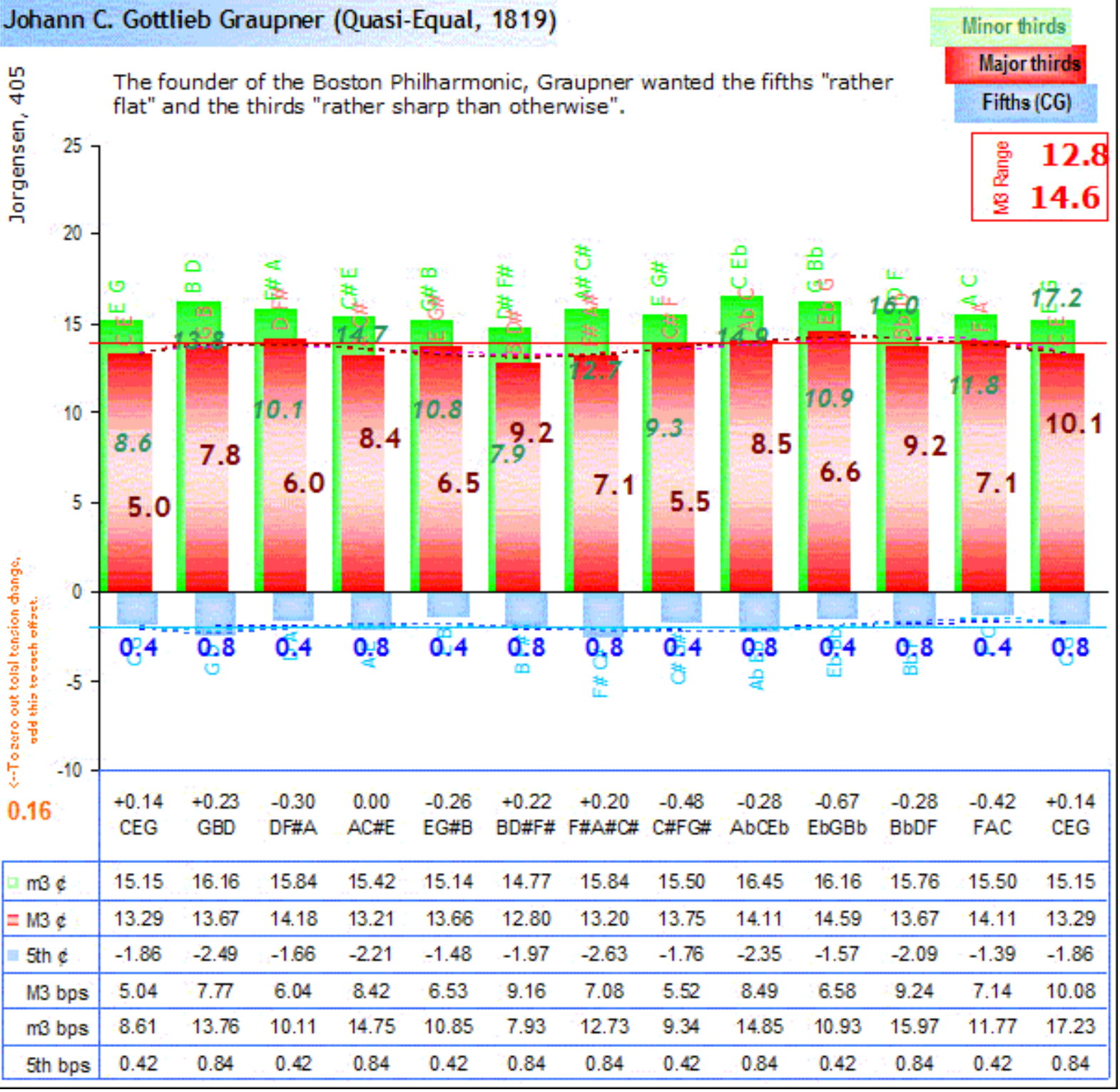



	+4.06 CEG	+12.95 GBD	+13.61 DF#A	+9.00 AC#E	+5.59 EG#B	+3.18 BD#F#	+11.68 F#A#C#	+13.02 C#FG#	+9.46 AbCEb	+14.17 EbGBb	+10.96 BbDF	+4.42 FAC	+4.06 CEG
m3 ¢	8.28	5.22	18.33	23.08	21.91	18.13	13.57	10.60	5.53	17.64	24.83	20.58	8.28
M3 ¢	15.21	3.92	11.76	17.71	17.55	24.67	12.96	5.08	8.29	12.47	16.34	18.27	15.21
5th ¢	6.94	-1.30	-6.56	-5.37	-4.36	6.55	-0.61	-5.52	2.76	-5.17	-8.50	-2.31	6.94
M3 bps	5.79	2.24	5.05	11.37	8.43	17.76	7.00	2.05	5.01	5.67	11.12	9.29	11.57
m3 bps	4.73	4.47	11.77	22.19	15.76	9.80	10.99	6.41	5.02	12.01	25.29	15.68	9.46
5th bps	-1.58	0.45	1.68	2.05	1.25	-2.81	0.20	1.33	-1.00	1.40	3.44	0.70	-3.16

Johann C. Gottlieb Graupner (Quasi-Equal, 1819)

Jorgensen, 405

The founder of the Boston Philharmonic, Graupner wanted the fifths "rather flat" and the thirds "rather sharp than otherwise".

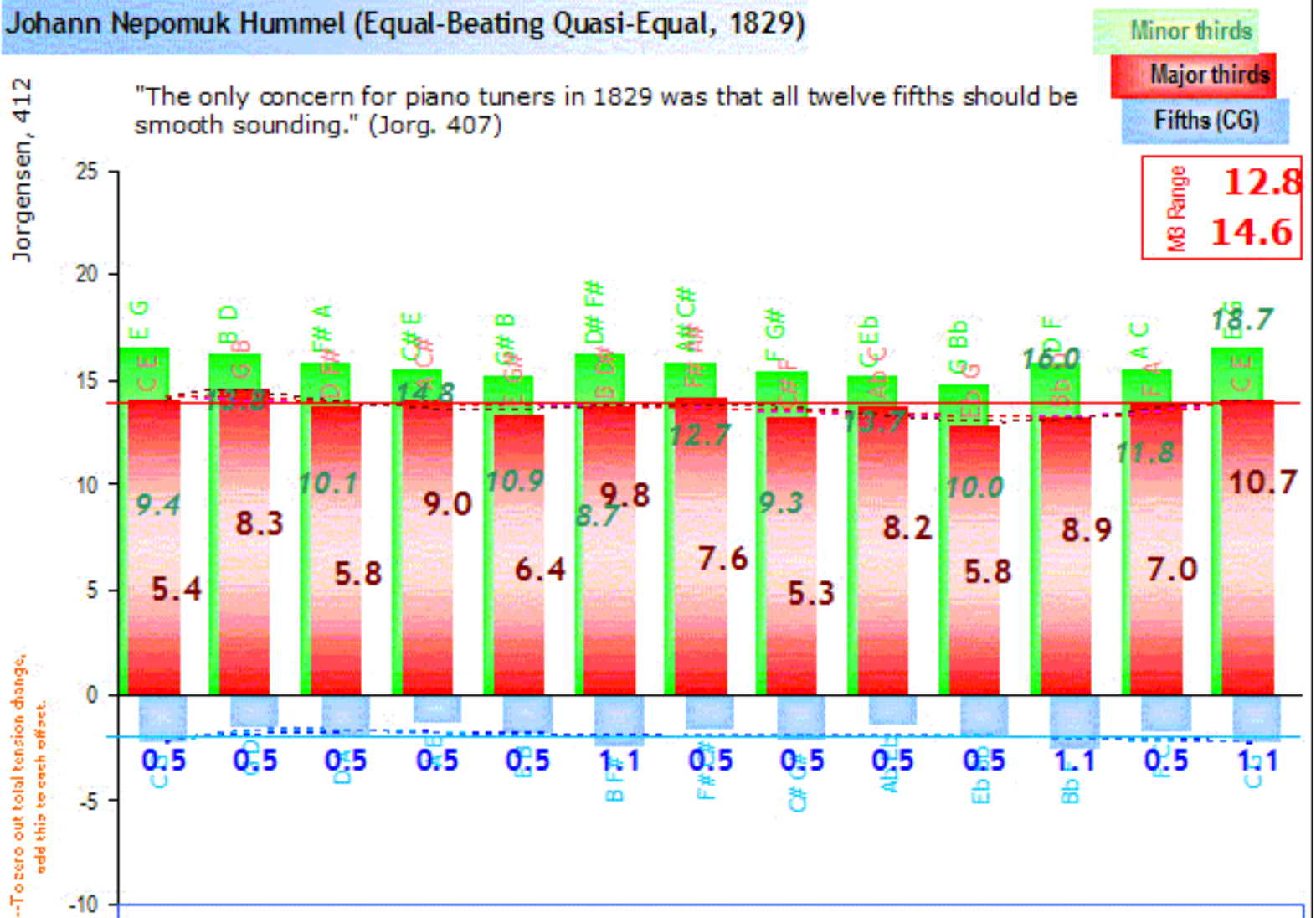


	+0.14 CEG	+0.23 GBD	-0.30 DF#A	0.00 AC#E	-0.26 EG#B	+0.22 BD#F#	+0.20 F#A#C#	-0.48 C#FG#	-0.28 AbCEb	-0.67 EbGBb	-0.28 BbDF	-0.42 FAC	+0.14 CEG
m3 ¢	15.15	16.16	15.84	15.42	15.14	14.77	15.84	15.50	16.45	16.16	15.76	15.50	15.15
M3 ¢	13.29	13.67	14.18	13.21	13.66	12.80	13.20	13.75	14.11	14.59	13.67	14.11	13.29
5th ¢	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97	-2.63	-1.76	-2.35	-1.57	-2.09	-1.39	-1.86
M3 bps	5.04	7.77	6.04	8.42	6.53	9.16	7.08	5.52	8.49	6.58	9.24	7.14	10.08
m3 bps	8.61	13.76	10.11	14.75	10.85	7.93	12.73	9.34	14.85	10.93	15.97	11.77	17.23
5th bps	0.42	0.84	0.42	0.84	0.42	0.84	0.84	0.42	0.84	0.42	0.84	0.42	0.84

Johann Nepomuk Hummel (Equal-Beating Quasi-Equal, 1829)

Jorgensen, 412

"The only concern for piano tuners in 1829 was that all twelve fifths should be smooth sounding." (Jorg. 407)



	+0.14 CEG	-0.25 GBD	+0.14 DF#A	0.00 AC#E	+0.56 EG#B	+0.65 BD#F#	+0.12 F#A#C#	+0.42 C#FG#	+0.16 AbCEb	+0.64 EbGBb	+0.62 BbDF	-0.06 FAC	+0.14 CEG
m3 ¢	16.45	16.16	15.76	15.50	15.15	16.16	15.84	15.42	15.14	14.77	15.84	15.50	16.45
M3 ¢	14.11	14.59	13.67	14.11	13.29	13.67	14.18	13.21	13.66	12.80	13.20	13.75	14.11
5th ¢	-2.35	-1.57	-2.09	-1.39	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97	-2.63	-1.76	-2.35
M3 bps	5.35	8.29	5.82	9.00	6.35	9.79	7.61	5.31	8.23	5.77	8.92	6.96	10.70
m3 bps	9.36	13.77	10.06	14.83	10.85	8.67	12.74	9.29	13.67	9.99	16.04	11.77	18.71
5th bps	0.53	0.53	0.53	0.53	0.53	1.06	0.53	0.53	0.53	0.53	1.06	0.53	1.06

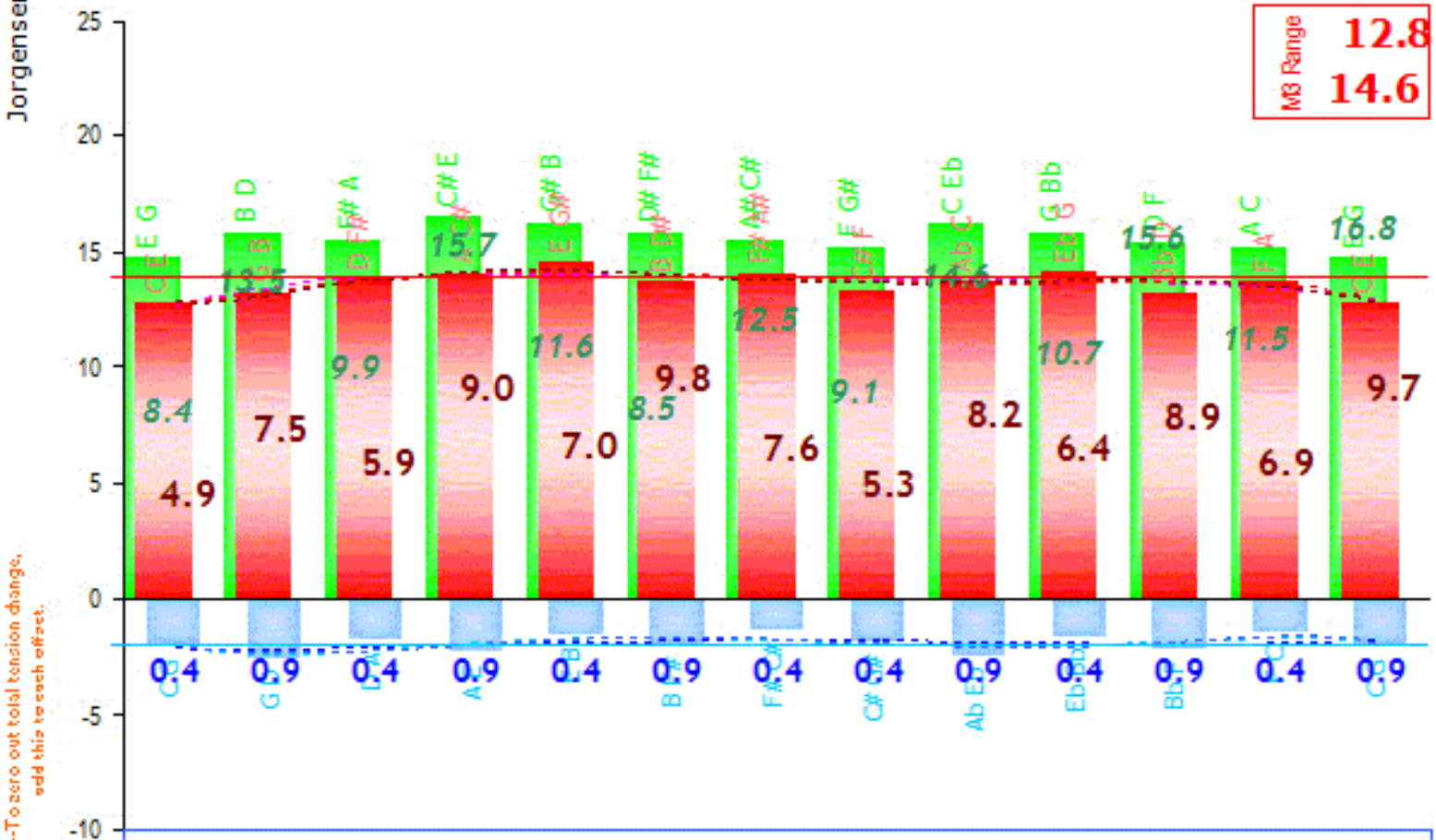
Johann Nepomuk Hummel (Viennese Quasi-Equal, 1829)

Minor thirds
Major thirds
Fifths (CG)

An Austrian musician, known as Europe's greatest pianist, a student of Mozart.
This temperament became known as the Viennese.

Jorgensen, 410

M3 Range 12.8 14.6

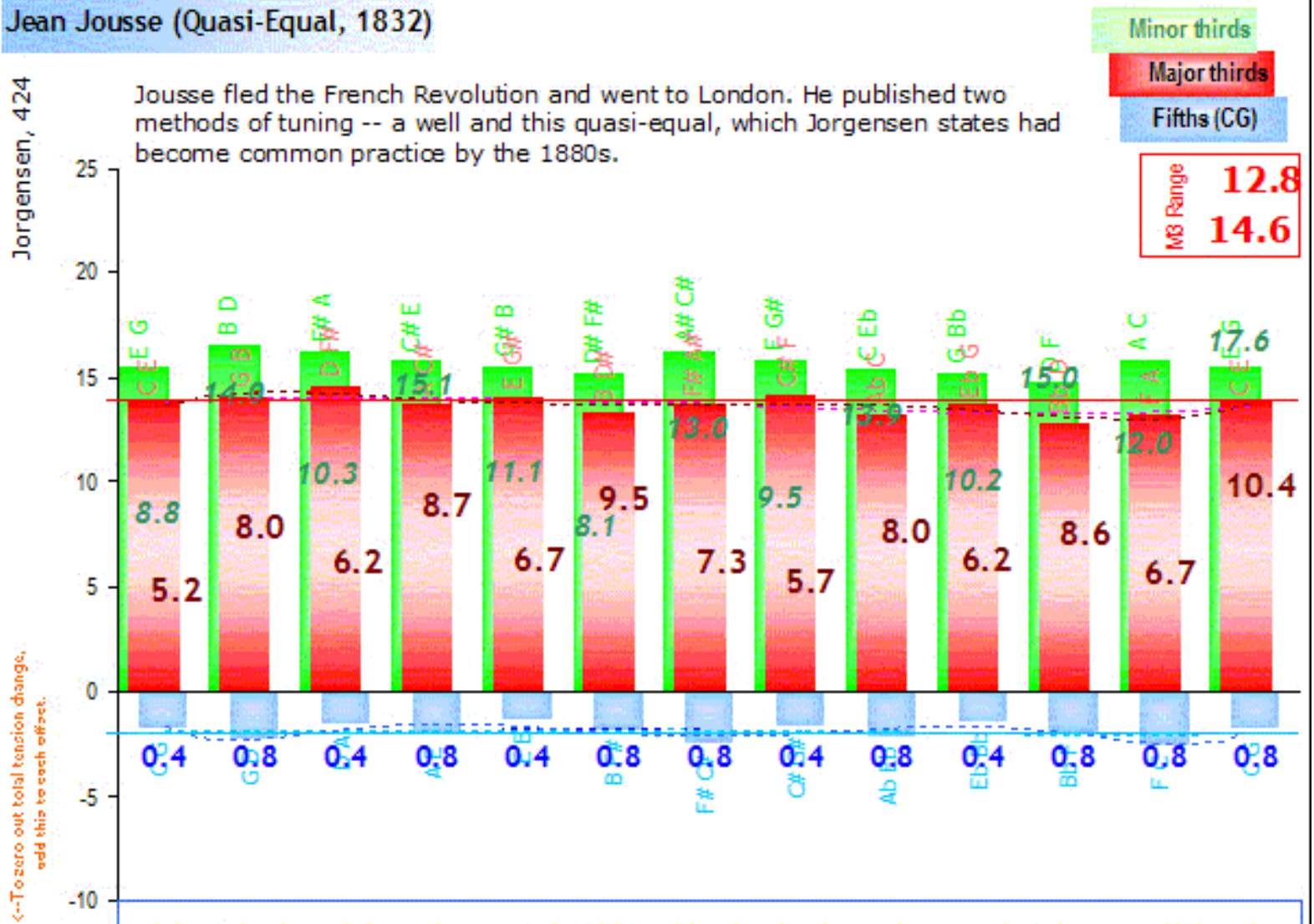


	+0.50 CEG	+0.48 GBD	-0.20 DF#A	0.00 AC#E	-0.39 EG#B	+0.00 BD#F#	-0.14 F#A#C#	+0.42 C#FG#	+0.52 AbCEb	-0.02 EbGBb	+0.28 BbDF	+0.02 FAC	+0.50 CEG
m3 ¢	14.77	15.84	15.50	16.45	16.15	15.76	15.50	15.15	16.16	15.84	15.42	15.14	14.77
M3 ¢	12.80	13.21	13.75	14.11	14.59	13.67	14.11	13.29	13.67	14.18	13.21	13.66	12.80
5th ¢	-1.97	-2.63	-1.76	-2.35	-1.56	-2.10	-1.39	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97
M3 bps	4.85	7.51	5.85	9.00	6.97	9.79	7.57	5.34	8.23	6.40	8.93	6.92	9.71
m3 bps	8.40	13.50	9.89	15.74	11.57	8.46	12.47	9.13	14.58	10.71	15.63	11.50	16.80
5th bps	0.45	0.89	0.45	0.89	0.45	0.90	0.45	0.45	0.89	0.45	0.89	0.45	0.89

Jean Jousse (Quasi-Equal, 1832)

Jousse fled the French Revolution and went to London. He published two methods of tuning -- a well and this quasi-equal, which Jorgensen states had become common practice by the 1880s.

Jorgensen, 424



	-0.19 CEG	+0.00 GBD	-0.39 DF#A	0.00 AC#E	-0.14 EG#B	+0.42 BD#F#	+0.52 F#A#C#	-0.01 C#FG#	+0.28 AbCEb	+0.02 EbGBb	+0.50 BbDF	+0.48 FAC	-0.19 CEG
m3 ¢	15.50	16.45	16.16	15.76	15.50	15.15	16.16	15.84	15.42	15.14	14.77	15.84	15.50
M3 ¢	13.75	14.11	14.59	13.67	14.11	13.29	13.67	14.18	13.21	13.66	12.80	13.20	13.75
5th ¢	-1.76	-2.35	-1.57	-2.09	-1.39	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97	-2.63	-1.76
M3 bps	5.21	8.02	6.21	8.72	6.74	9.51	7.33	5.70	7.95	6.16	8.65	6.69	10.43
m3 bps	8.82	14.02	10.32	15.07	11.11	8.13	12.99	9.55	13.92	10.24	14.96	12.02	17.63
5th bps	0.40	0.80	0.40	0.80	0.40	0.80	0.80	0.40	0.80	0.40	0.80	0.80	0.80

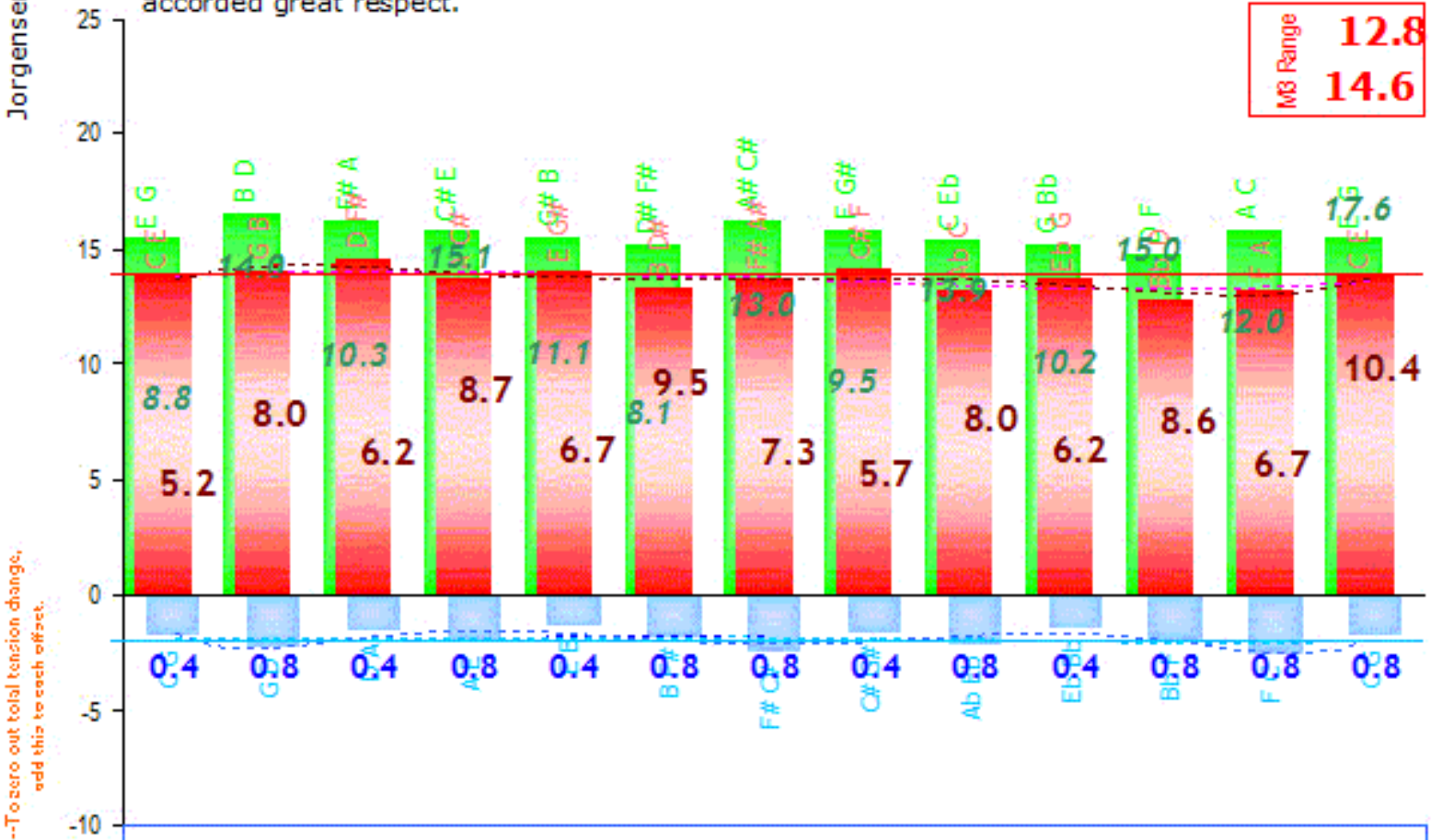
Becket & Co. (Quasi-Equal, 1840)

Minor thirds
Major thirds
Fifths (CG)

The Tuner's Guide copied this from Becket & Co (1809). In 1810 this bearing plan was considered a joke by "Musicus Ignoramus", but in 1840 it was accorded great respect.

Jorgensen, 450

M3 Range 12.8 14.6



	-0.19 CEG	+0.00 GBD	-0.39 DF#A	0.00 AC#E	-0.14 EG#B	+0.42 BD#F#	+0.52 F#A#C#	-0.01 C#FG#	+0.28 AbCEb	+0.02 EbGBb	+0.50 BbDF	+0.48 FAC	-0.19 CEG
m3 ¢	15.50	16.45	16.16	15.76	15.50	15.15	16.16	15.84	15.42	15.14	14.77	15.84	15.50
M3 ¢	13.75	14.11	14.59	13.67	14.11	13.29	13.67	14.18	13.21	13.66	12.80	13.20	13.75
5th ¢	-1.76	-2.35	-1.57	-2.09	-1.39	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97	-2.63	-1.76
M3 bps	5.21	8.02	6.21	8.72	6.74	9.51	7.33	5.70	7.95	6.16	8.65	6.69	10.43
m3 bps	8.82	14.02	10.32	15.07	11.11	8.13	12.99	9.55	13.92	10.24	14.96	12.02	17.63
5th bps	0.40	0.80	0.40	0.80	0.40	0.80	0.80	0.40	0.80	0.40	0.80	0.80	0.80

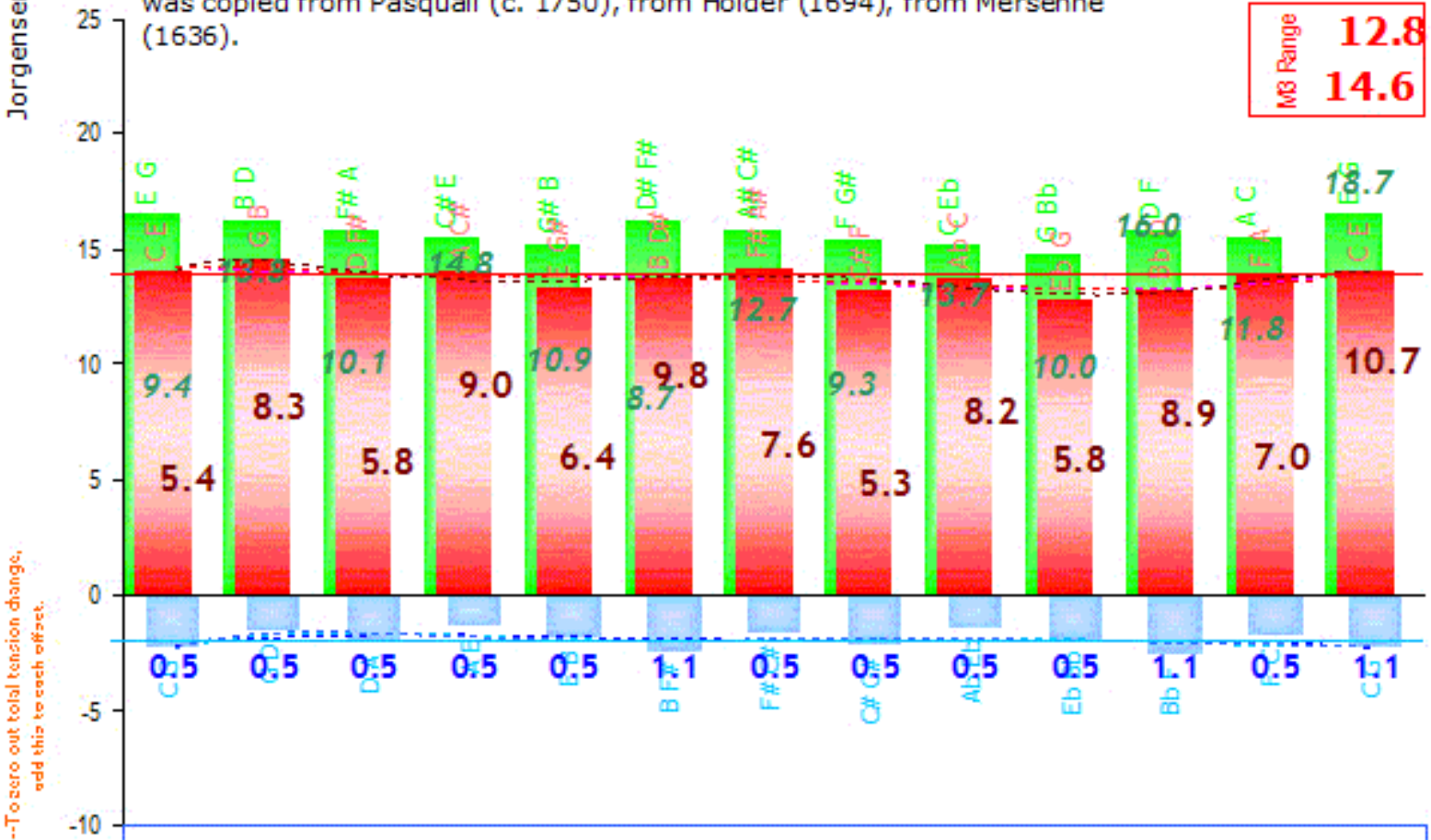
John Marsh (Equal-Beating Quasi-Equal, 1840)

Jorgensen, 446

The Tuner's Guide copied this from John Marsh's bearing plan of 1809, which was copied from Bland (1790), which was copied from Preston (1785), which was copied from Pasquali (c. 1750), from Holder (1694), from Mersenne (1636).

Minor thirds
Major thirds
Fifths (CG)

M3 Range 12.8 14.6

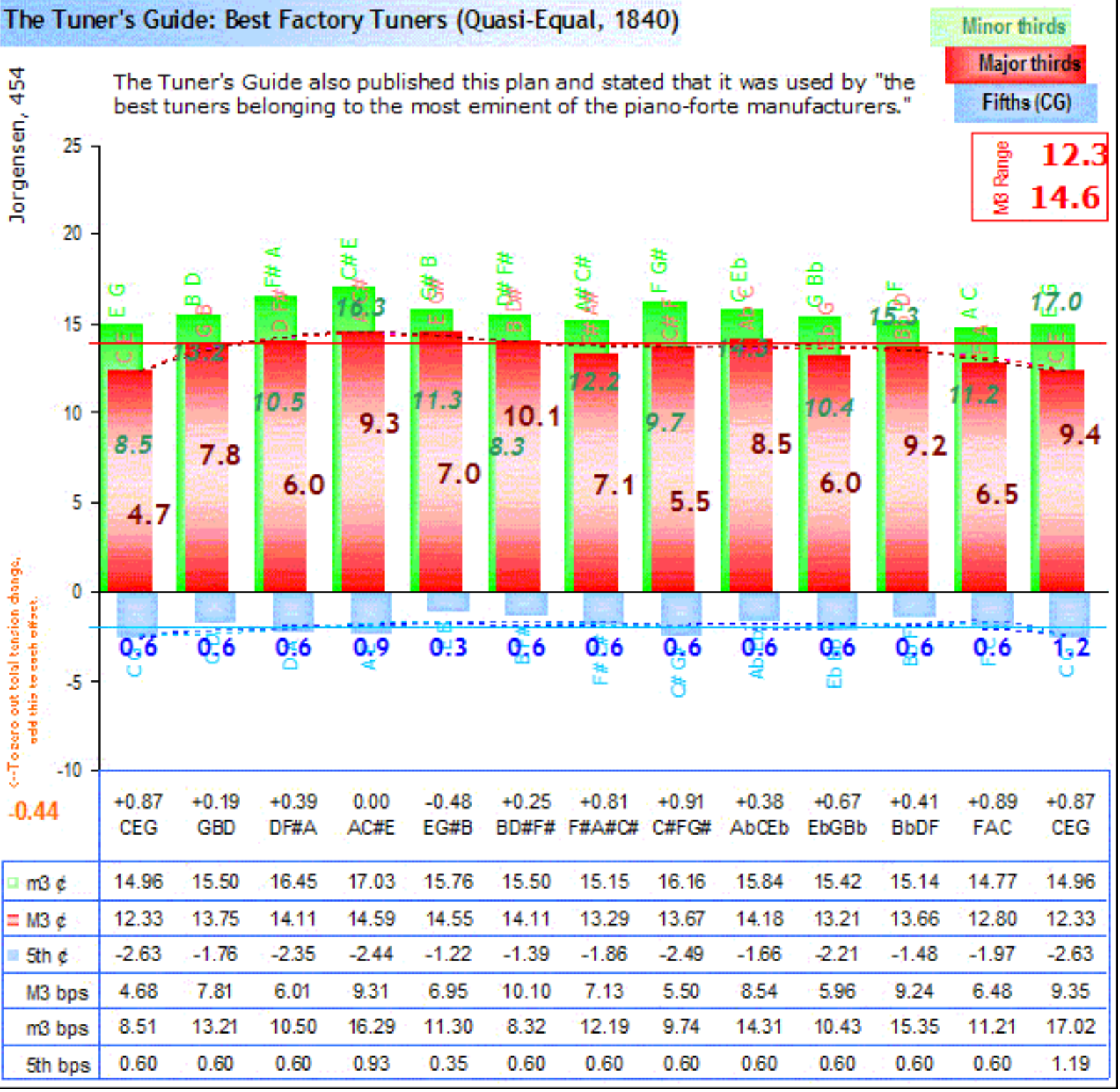


	+0.14 CEG	-0.25 GBD	+0.14 DF#A	0.00 AC#E	+0.56 EG#B	+0.65 BD#F#	+0.12 F#A#C#	+0.42 C#FG#	+0.16 AbCEb	+0.64 EbGBb	+0.62 BbDF	-0.06 FAC	+0.14 CEG
m3 ¢	16.45	16.16	15.76	15.50	15.15	16.16	15.84	15.42	15.14	14.77	15.84	15.50	16.45
M3 ¢	14.11	14.59	13.67	14.11	13.29	13.67	14.18	13.21	13.66	12.80	13.20	13.75	14.11
5th ¢	-2.35	-1.57	-2.09	-1.39	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97	-2.63	-1.76	-2.35
M3 bps	5.35	8.29	5.82	9.00	6.35	9.79	7.61	5.31	8.23	5.77	8.92	6.96	10.70
m3 bps	9.36	13.77	10.06	14.83	10.85	8.67	12.74	9.29	13.67	9.99	16.04	11.77	18.71
5th bps	0.53	0.53	0.53	0.53	0.53	1.06	0.53	0.53	0.53	0.53	1.06	0.53	1.06

The Tuner's Guide: Best Factory Tuners (Quasi-Equal, 1840)

Jorgensen, 454

The Tuner's Guide also published this plan and stated that it was used by "the best tuners belonging to the most eminent of the piano-forte manufacturers."

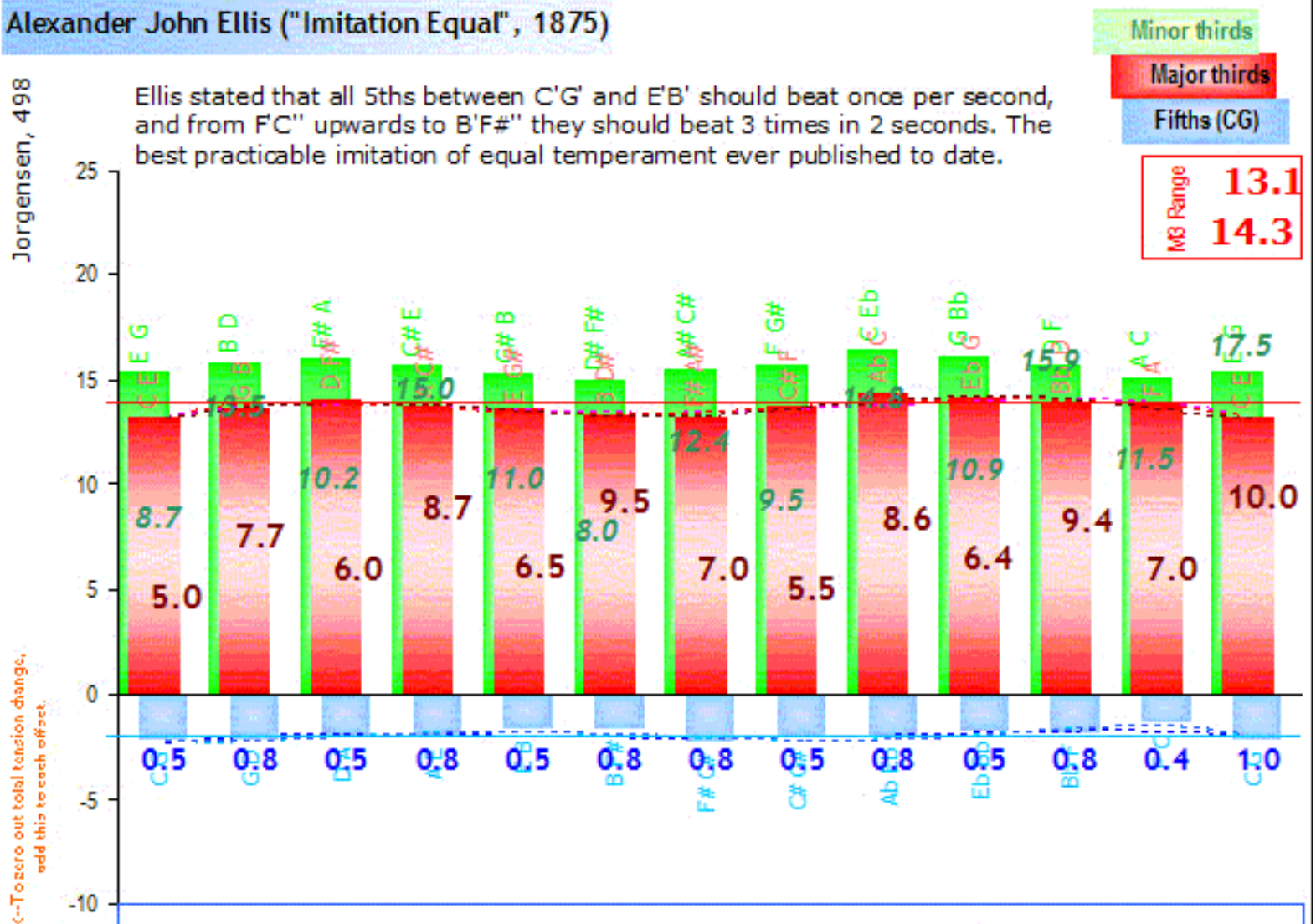


	+0.87 CEG	+0.19 GBD	+0.39 DF#A	0.00 AC#E	-0.48 EG#B	+0.25 BD#F#	+0.81 F#A#C#	+0.91 C#FG#	+0.38 AbCEb	+0.67 EbGBb	+0.41 BbDF	+0.89 FAC	+0.87 CEG
m3 ¢	14.96	15.50	16.45	17.03	15.76	15.50	15.15	16.16	15.84	15.42	15.14	14.77	14.96
M3 ¢	12.33	13.75	14.11	14.59	14.55	14.11	13.29	13.67	14.18	13.21	13.66	12.80	12.33
5th ¢	-2.63	-1.76	-2.35	-2.44	-1.22	-1.39	-1.86	-2.49	-1.66	-2.21	-1.48	-1.97	-2.63
M3 bps	4.68	7.81	6.01	9.31	6.95	10.10	7.13	5.50	8.54	5.96	9.24	6.48	9.35
m3 bps	8.51	13.21	10.50	16.29	11.30	8.32	12.19	9.74	14.31	10.43	15.35	11.21	17.02
5th bps	0.60	0.60	0.60	0.93	0.35	0.60	0.60	0.60	0.60	0.60	0.60	0.60	1.19

Alexander John Ellis ("Imitation Equal", 1875)

Jorgensen, 498

Ellis stated that all 5ths between C'G' and E'B' should beat once per second, and from F'C'' upwards to B'F#'' they should beat 3 times in 2 seconds. The best practicable imitation of equal temperament ever published to date.

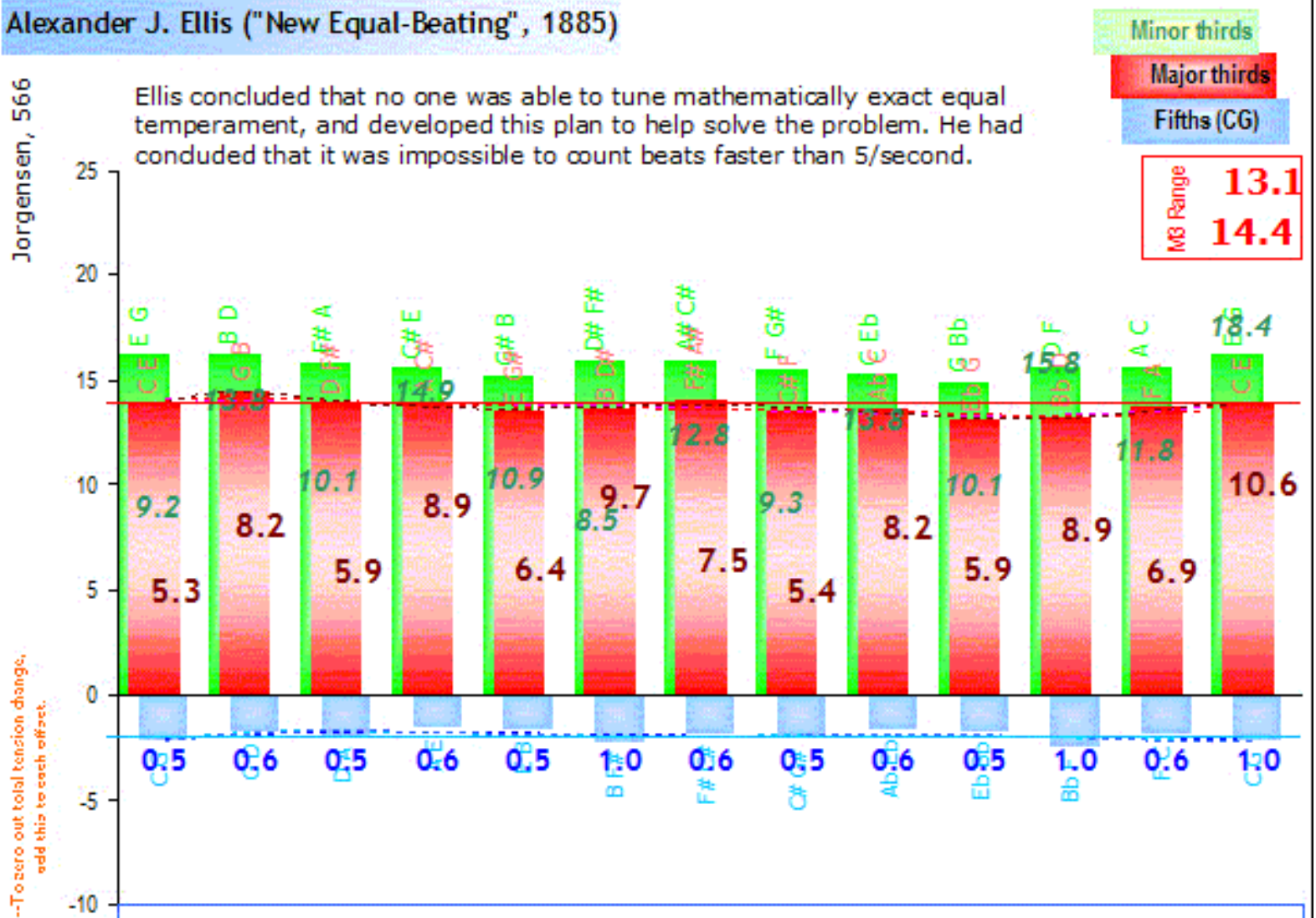


	+0.52 CEG	+0.27 GBD	+0.01 DF#A	0.00 AC#E	-0.01 EG#B	+0.19 BD#F#	+0.39 F#A#C#	+0.00 C#FG#	-0.13 AbCEb	-0.26 EbGBb	-0.16 BbDF	-0.06 FAC	+0.52 CEG
m3 ¢	15.36	15.82	16.03	15.66	15.33	14.99	15.48	15.70	16.42	16.07	15.71	15.12	15.36
M3 ¢	13.15	13.61	14.06	13.69	13.58	13.24	13.14	13.62	14.33	14.21	13.86	13.75	13.15
5th ¢	-2.21	-2.21	-1.97	-1.97	-1.75	-1.75	-2.34	-2.08	-2.09	-1.86	-1.86	-1.37	-2.21
M3 bps	4.99	7.73	5.99	8.73	6.49	9.48	7.05	5.47	8.63	6.41	9.36	6.96	9.98
m3 bps	8.74	13.48	10.23	14.97	10.98	8.05	12.45	9.46	14.82	10.86	15.92	11.48	17.47
5th bps	0.50	0.75	0.50	0.75	0.50	0.75	0.75	0.50	0.75	0.50	0.75	0.42	1.00

Alexander J. Ellis ("New Equal-Beating", 1885)

Jorgensen, 566

Ellis concluded that no one was able to tune mathematically exact equal temperament, and developed this plan to help solve the problem. He had concluded that it was impossible to count beats faster than 5/second.

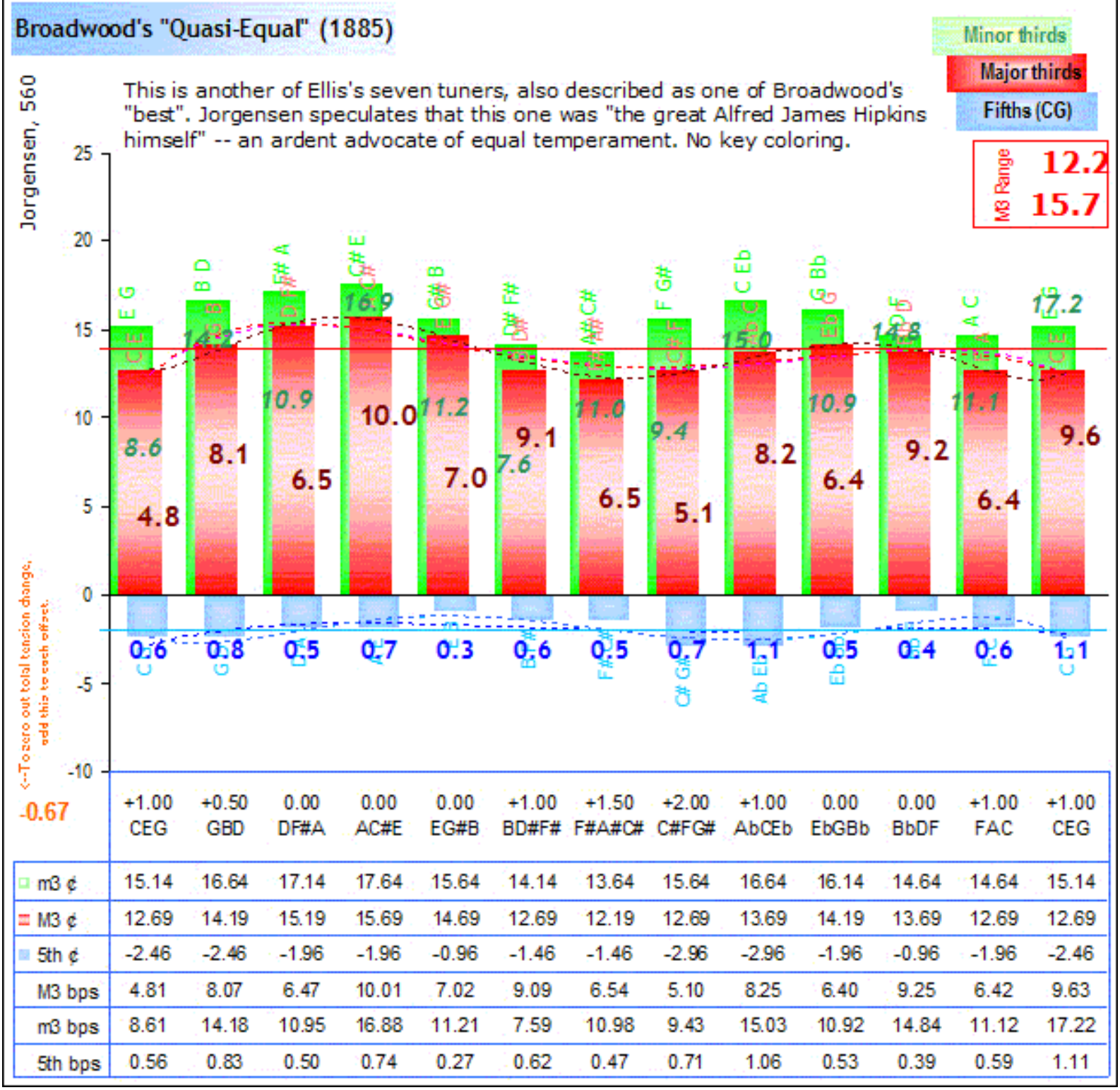


	+0.08 CEG	-0.18 GBD	+0.01 DF#A	0.00 AC#E	+0.38 EG#B	+0.58 BD#F#	+0.20 F#A#C#	+0.28 C#FG#	+0.16 AbCEb	+0.44 EbGBb	+0.54 BbDF	+0.02 FAC	+0.08 CEG
m3 ¢	16.20	16.21	15.84	15.54	15.21	15.88	15.90	15.51	15.27	14.92	15.63	15.57	16.20
M3 ¢	13.99	14.45	13.88	13.97	13.46	13.54	14.03	13.42	13.61	13.07	13.16	13.67	13.99
5th ¢	-2.21	-1.77	-1.97	-1.57	-1.75	-2.34	-1.87	-2.08	-1.67	-1.86	-2.48	-1.90	-2.21
M3 bps	5.31	8.21	5.91	8.91	6.43	9.70	7.53	5.39	8.19	5.89	8.89	6.92	10.61
m3 bps	9.21	13.82	10.11	14.87	10.90	8.53	12.79	9.34	13.79	10.09	15.84	11.81	18.42
5th bps	0.50	0.60	0.50	0.60	0.50	1.00	0.60	0.50	0.60	0.50	1.00	0.57	1.00

Broadwood's "Quasi-Equal" (1885)

Jorgensen, 560

This is another of Ellis's seven tuners, also described as one of Broadwood's "best". Jorgensen speculates that this one was "the great Alfred James Hipkins himself" -- an ardent advocate of equal temperament. No key coloring.

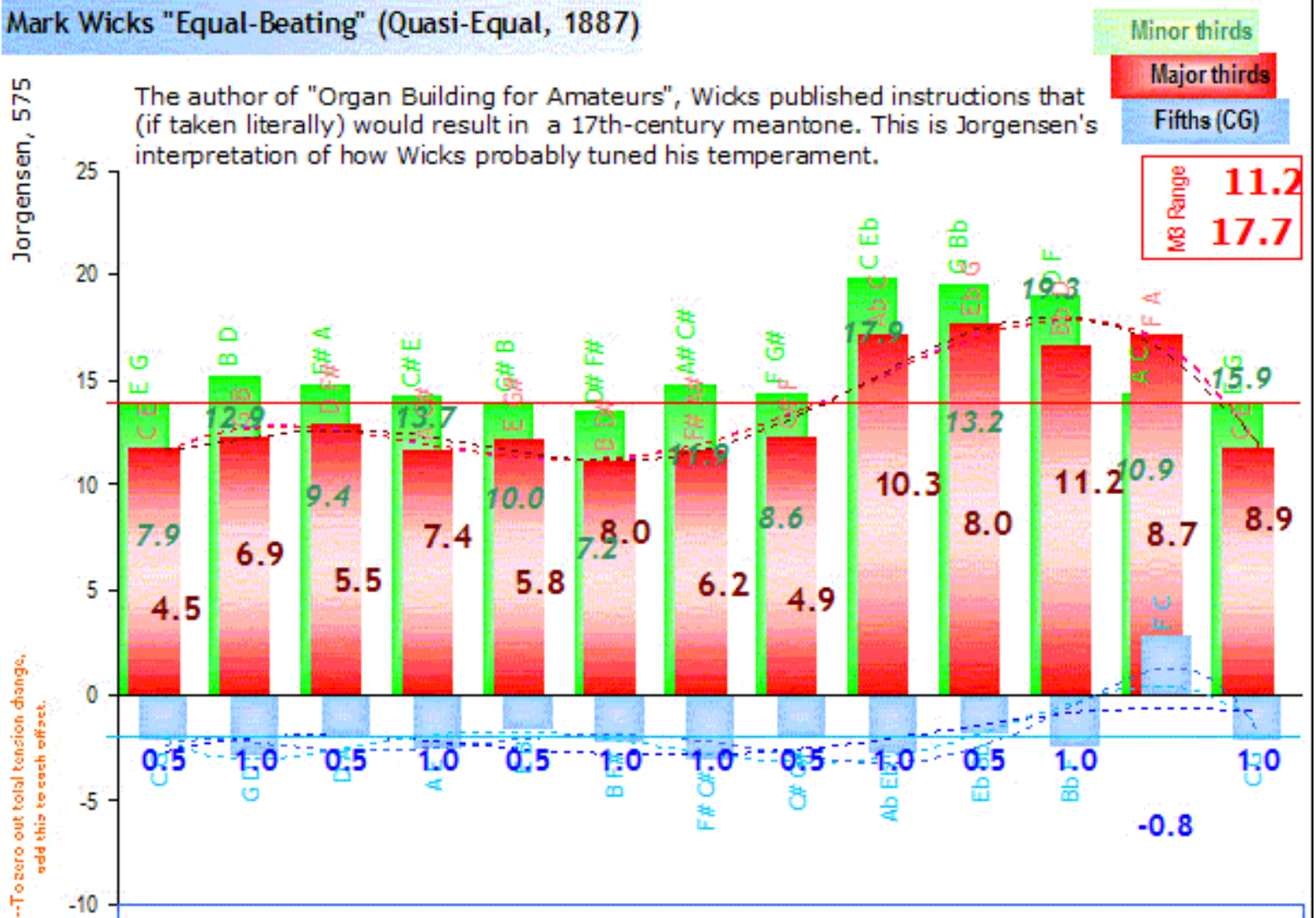


	+1.00 CEG	+0.50 GBD	0.00 DF#A	0.00 AC#E	0.00 EG#B	+1.00 BD#F#	+1.50 F#A#C#	+2.00 C#FG#	+1.00 AbCEb	0.00 EbGBb	0.00 BbDF	+1.00 FAC	+1.00 CEG
m3 ¢	15.14	16.64	17.14	17.64	15.64	14.14	13.64	15.64	16.64	16.14	14.64	14.64	15.14
M3 ¢	12.69	14.19	15.19	15.69	14.69	12.69	12.19	12.69	13.69	14.19	13.69	12.69	12.69
5th ¢	-2.46	-2.46	-1.96	-1.96	-0.96	-1.46	-1.46	-2.96	-2.96	-1.96	-0.96	-1.96	-2.46
M3 bps	4.81	8.07	6.47	10.01	7.02	9.09	6.54	5.10	8.25	6.40	9.25	6.42	9.63
m3 bps	8.61	14.18	10.95	16.88	11.21	7.59	10.98	9.43	15.03	10.92	14.84	11.12	17.22
5th bps	0.56	0.83	0.50	0.74	0.27	0.62	0.47	0.71	1.06	0.53	0.39	0.59	1.11

Mark Wicks "Equal-Beating" (Quasi-Equal, 1887)

Jorgensen, 575

The author of "Organ Building for Amateurs", Wicks published instructions that (if taken literally) would result in a 17th-century meantone. This is Jorgensen's interpretation of how Wicks probably tuned his temperament.



	+1.26 CEG	+1.00 GBD	+0.01 DF#A	0.00 AC#E	-0.67 EG#B	-0.47 BD#F#	-0.86 F#A#C#	-2.03 C#FG#	-2.16 AbCEb	-2.99 EbGBb	-2.90 BbDF	-3.43 FAC	+1.26 CEG
m3 ¢	13.96	15.16	14.78	14.29	13.95	13.51	14.77	14.38	19.89	19.54	19.08	14.38	13.96
M3 ¢	11.76	12.21	12.82	11.66	12.20	11.17	11.65	12.29	17.10	17.68	16.60	17.11	11.76
5th ¢	-2.21	-2.95	-1.97	-2.63	-1.75	-2.34	-3.13	-2.09	-2.79	-1.86	-2.48	2.73	-2.21
M3 bps	4.46	6.94	5.46	7.43	5.82	7.99	6.24	4.93	10.29	7.97	11.21	8.66	8.92
m3 bps	7.94	12.91	9.43	13.65	9.99	7.24	11.86	8.65	17.94	13.21	19.31	10.92	15.88
5th bps	0.50	1.00	0.50	1.00	0.50	1.00	1.00	0.50	1.00	0.50	1.00	-0.82	1.00

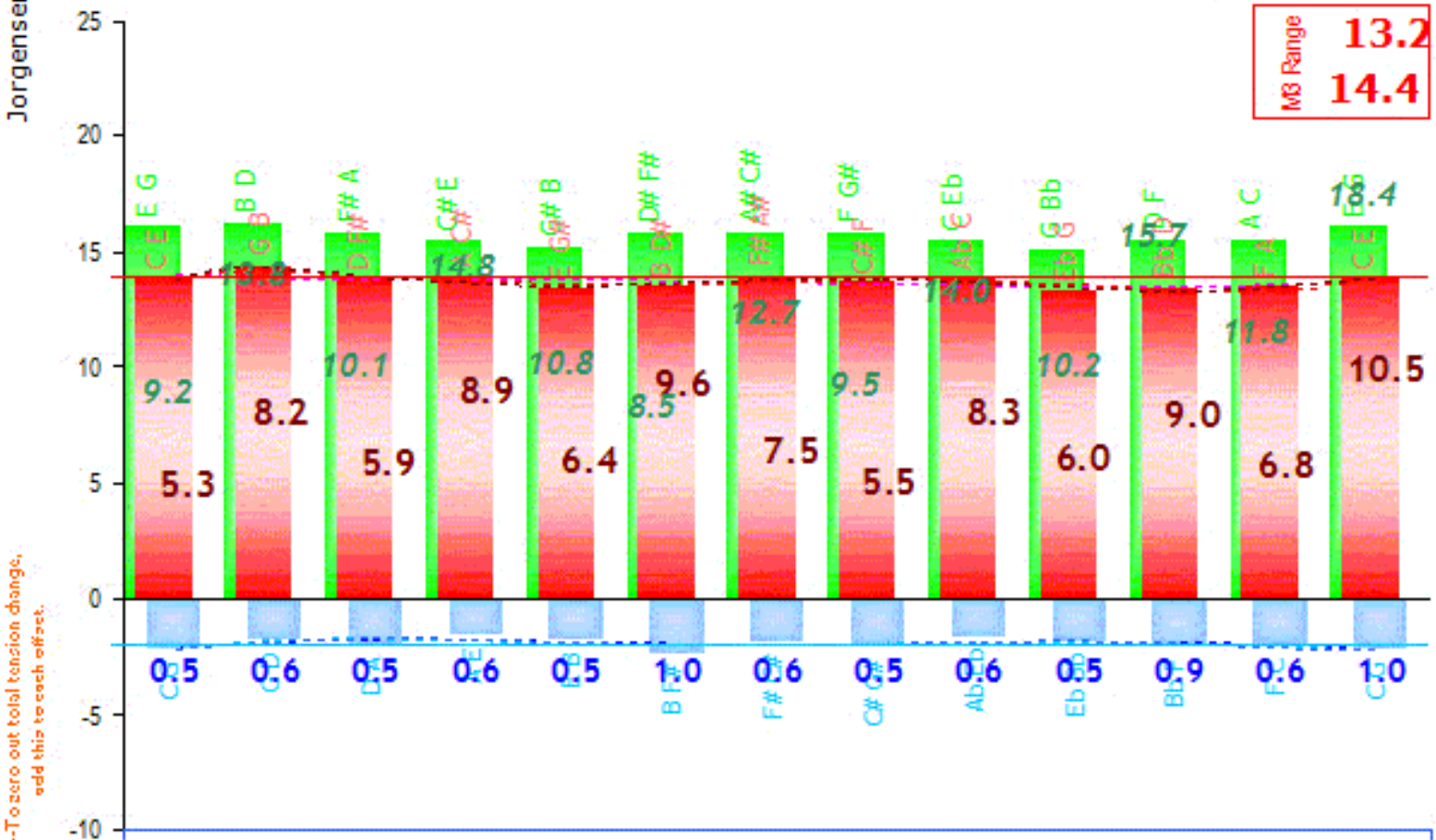
Howard Willet Pyle "Equal-Beating" (Quasi-Equal, 1906)

Minor thirds
Major thirds
Fifths (CG)

Pyle and William Braid White both used the same bearing plan, which is the standard still in use today. Pyle started using this in 1884.

Jorgensen, 633

M3 Range 13.2 14.4



<--To zero out total tension change, add this to each effect.

-0.19

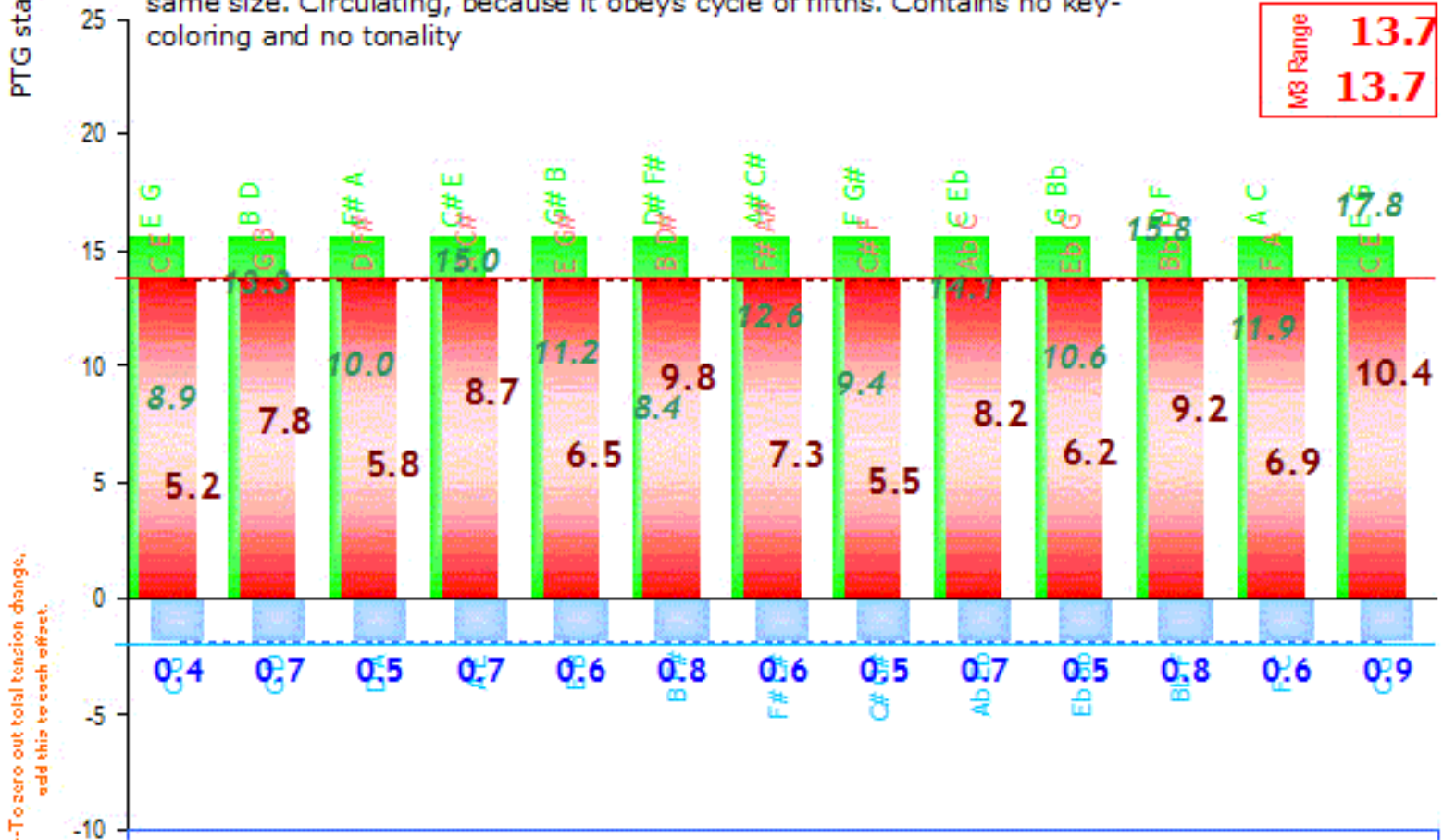
	+0.14 CEG	-0.13 GBD	+0.03 DF#A	0.00 AC#E	+0.36 EG#B	+0.55 BD#F#	+0.14 F#A#C#	+0.20 C#FG#	+0.04 AbCEb	+0.31 EbGBb	+0.39 BbDF	+0.20 FAC	+0.14 CEG
m3 ¢	16.14	16.15	15.78	15.48	15.14	15.82	15.83	15.79	15.47	15.12	15.48	15.50	16.14
M3 ¢	13.90	14.36	13.79	13.88	13.37	13.45	13.94	13.69	13.79	13.24	13.33	13.49	13.90
5th ¢	-2.23	-1.79	-1.99	-1.59	-1.77	-2.36	-1.89	-2.11	-1.69	-1.88	-2.15	-2.01	-2.23
M3 bps	5.27	8.16	5.87	8.86	6.39	9.63	7.48	5.50	8.30	5.97	9.01	6.83	10.55
m3 bps	9.18	13.76	10.07	14.80	10.85	8.49	12.74	9.52	13.97	10.22	15.68	11.76	18.35
5th bps	0.51	0.61	0.51	0.61	0.51	1.01	0.61	0.51	0.61	0.51	0.87	0.61	1.01

Equal Temperament

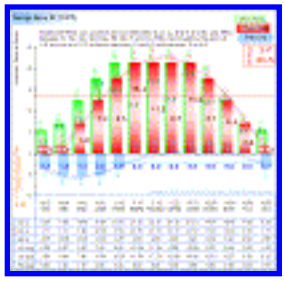
Minor thirds
Major thirds
Fifths (CG)

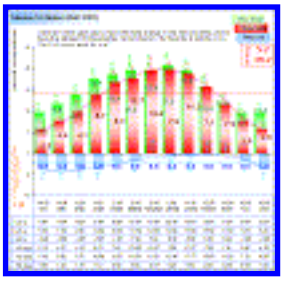
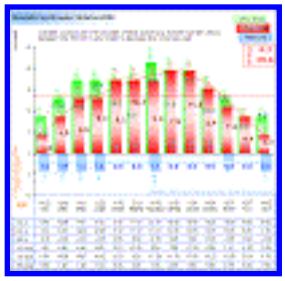
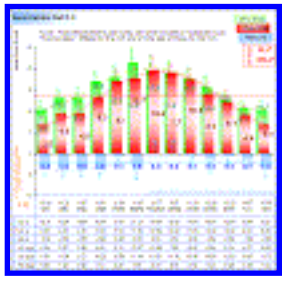
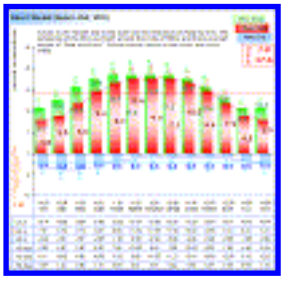
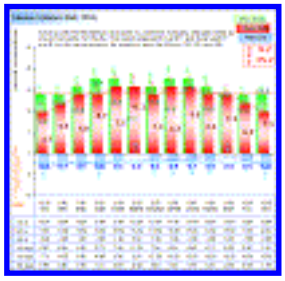
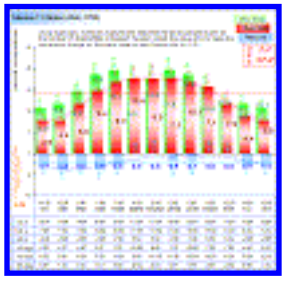
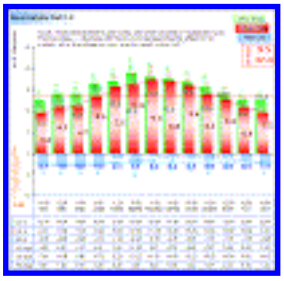
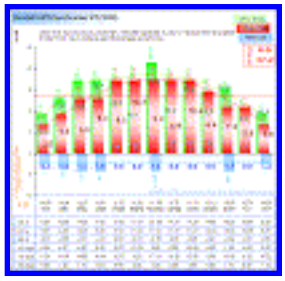
All semitones are exactly the same size. Unrestrictive, because modulation through all keys is free from wolf intervals. Regular, because all fifths are the same size. Circulating, because it obeys cycle of fifths. Contains no key-coloring and no tonality

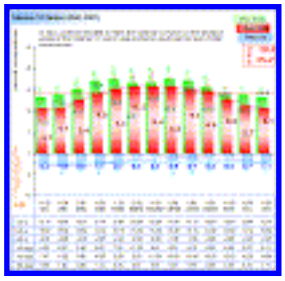
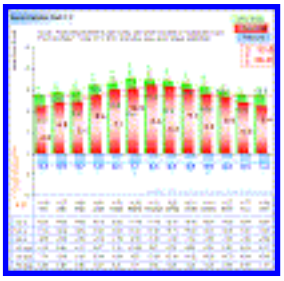
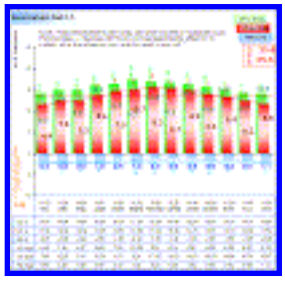
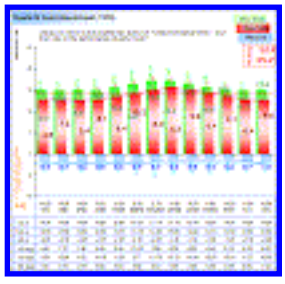
M3 Range 13.7 13.7

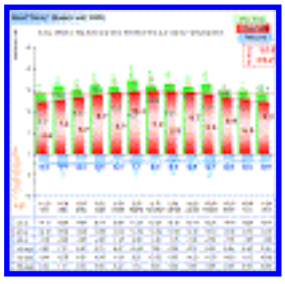


	0.00 CEG	0.00 GBD	0.00 DF#A	0.00 AC#E	0.00 EG#B	0.00 BD#F#	0.00 F#A#C#	0.00 C#FG#	0.00 AbCEb	0.00 EbGBb	0.00 BbDF	0.00 FAC	0.00 CEG
m3 ¢	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64	15.64
M3 ¢	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69	13.69
5th ¢	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96	-1.96
M3 bps	5.19	7.78	5.83	8.73	6.54	9.80	7.34	5.50	8.24	6.17	9.25	6.93	10.38
m3 bps	8.89	13.33	9.98	14.96	11.21	8.39	12.58	9.42	14.12	10.58	15.85	11.87	17.79
5th bps	0.44	0.66	0.50	0.74	0.56	0.84	0.63	0.47	0.70	0.53	0.79	0.59	0.89

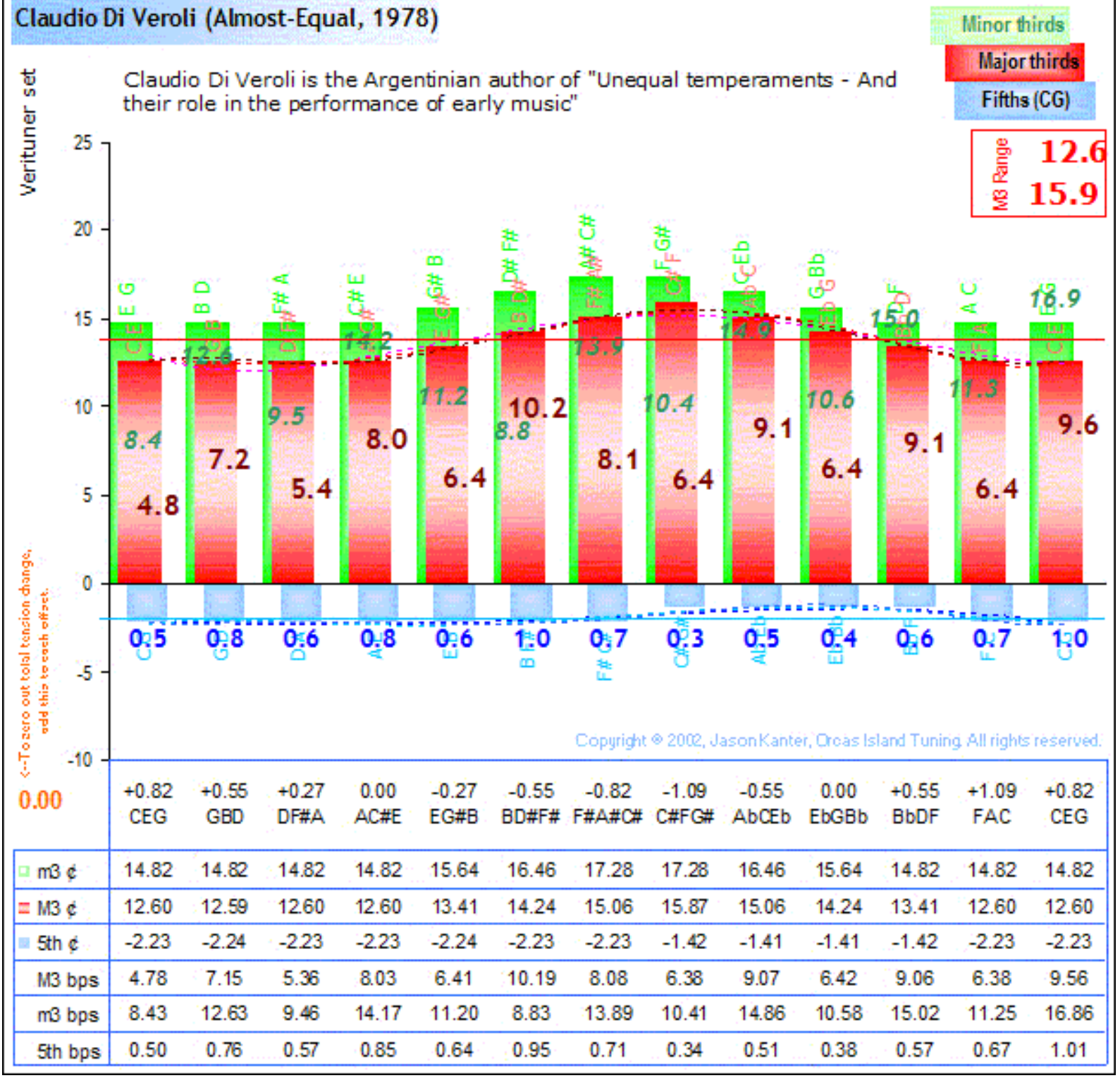


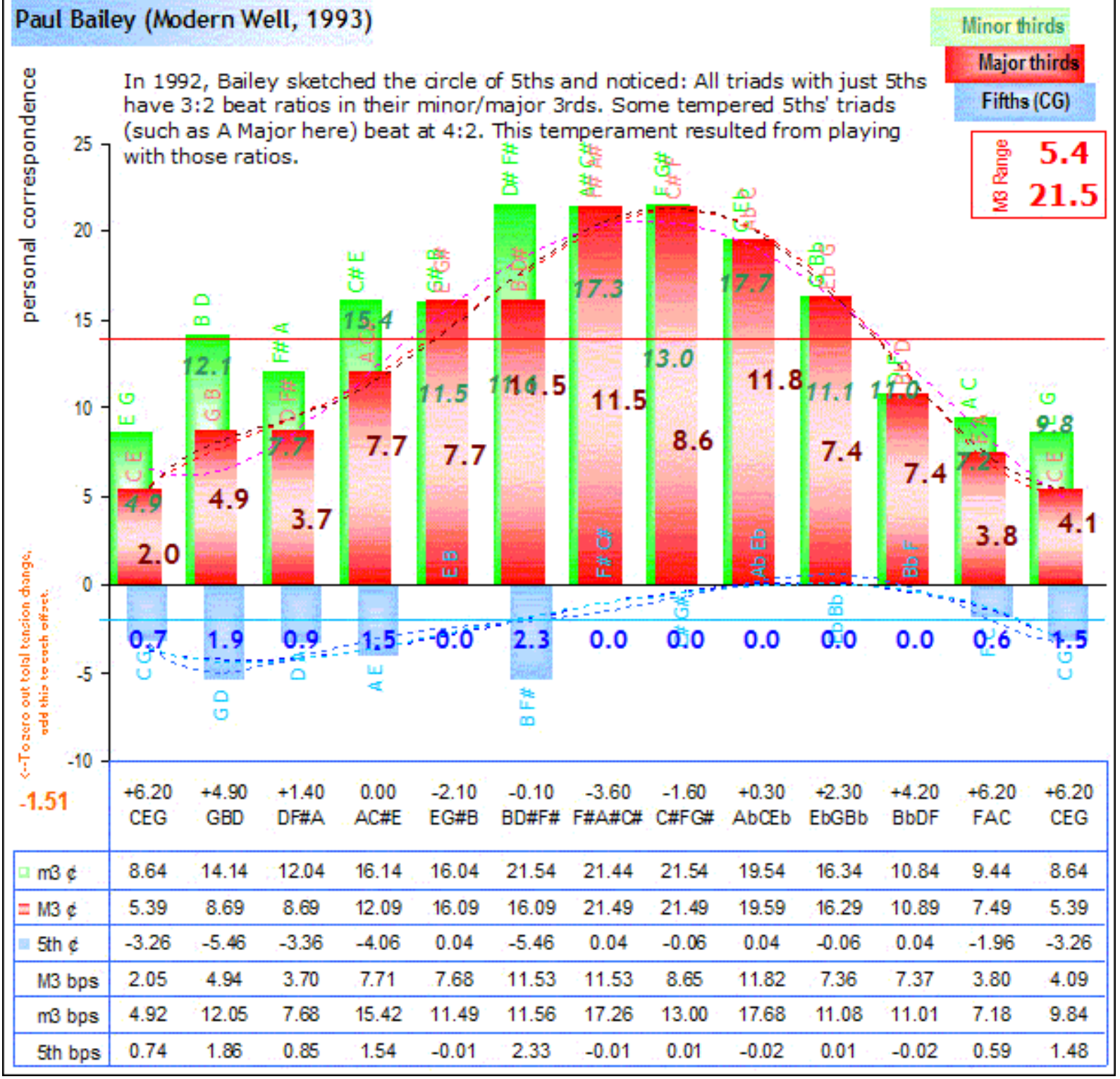


Claudio Di Veroli (Almost-Equal, 1978)



	+0.82 CEG	+0.55 GBD	+0.27 DF#A	0.00 AC#E	-0.27 EG#B	-0.55 BD#F#	-0.82 F#A#C#	-1.09 C#FG#	-0.55 AbCEb	0.00 EbGBb	+0.55 BbDF	+1.09 FAC	+0.82 CEG
m3 ¢	14.82	14.82	14.82	14.82	15.64	16.46	17.28	17.28	16.46	15.64	14.82	14.82	14.82
M3 ¢	12.60	12.59	12.60	12.60	13.41	14.24	15.06	15.87	15.06	14.24	13.41	12.60	12.60
5th ¢	-2.23	-2.24	-2.23	-2.23	-2.24	-2.23	-2.23	-1.42	-1.41	-1.41	-1.42	-2.23	-2.23
M3 bps	4.78	7.15	5.36	8.03	6.41	10.19	8.08	6.38	9.07	6.42	9.06	6.38	9.56
m3 bps	8.43	12.63	9.46	14.17	11.20	8.83	13.89	10.41	14.86	10.58	15.02	11.25	16.86
5th bps	0.50	0.76	0.57	0.85	0.64	0.95	0.71	0.34	0.51	0.38	0.57	0.67	1.01

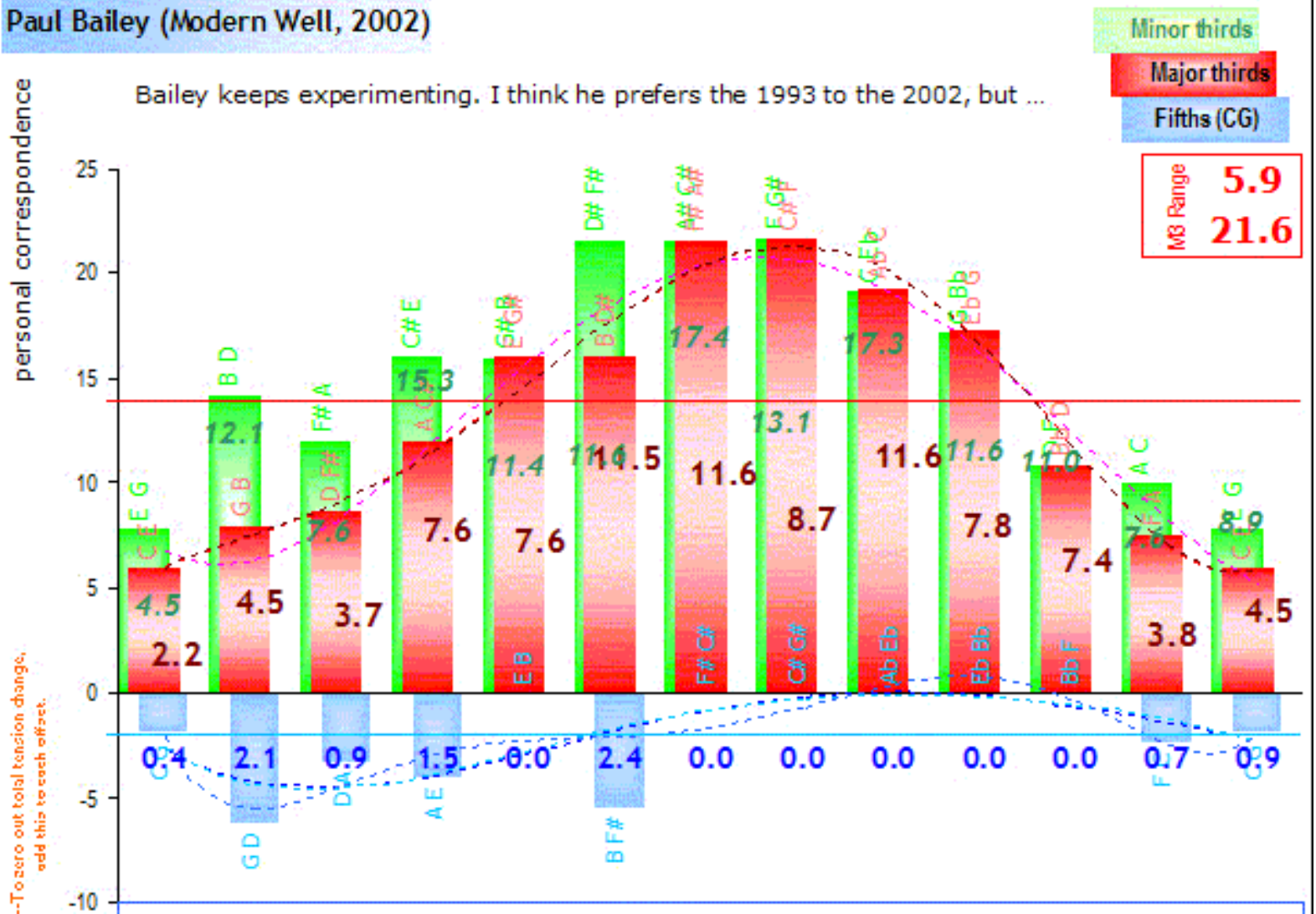
Paul Bailey (Modern Well, 1993)



	+6.20 CEG	+4.90 GBD	+1.40 DF#A	0.00 AC#E	-2.10 EG#B	-0.10 BD#F#	-3.60 F#A#C#	-1.60 C#FG#	+0.30 AbCEb	+2.30 EbGBb	+4.20 BbDF	+6.20 FAC	+6.20 CEG
m3 ¢	8.64	14.14	12.04	16.14	16.04	21.54	21.44	21.54	19.54	16.34	10.84	9.44	8.64
M3 ¢	5.39	8.69	8.69	12.09	16.09	16.09	21.49	21.49	19.59	16.29	10.89	7.49	5.39
5th ¢	-3.26	-5.46	-3.36	-4.06	0.04	-5.46	0.04	-0.06	0.04	-0.06	0.04	-1.96	-3.26
M3 bps	2.05	4.94	3.70	7.71	7.68	11.53	11.53	8.65	11.82	7.36	7.37	3.80	4.09
m3 bps	4.92	12.05	7.68	15.42	11.49	11.56	17.26	13.00	17.68	11.08	11.01	7.18	9.84
5th bps	0.74	1.86	0.85	1.54	-0.01	2.33	-0.01	0.01	-0.02	0.01	-0.02	0.59	1.48

Paul Bailey (Modern Well, 2002)

Bailey keeps experimenting. I think he prefers the 1993 to the 2002, but ...



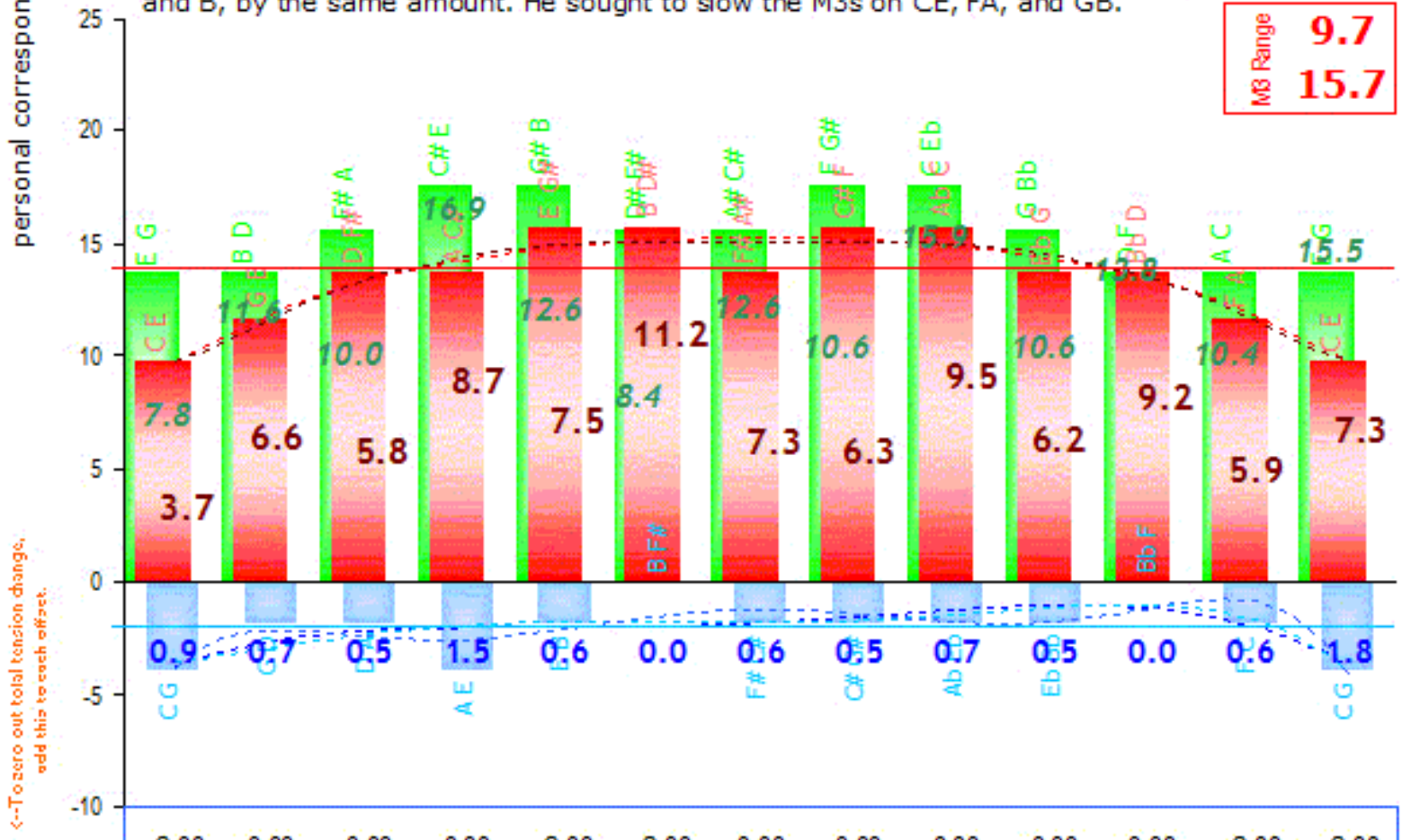
	+5.70 CEG	+5.70 GBD	+1.40 DF#A	0.00 AC#E	-2.10 EG#B	-0.10 BD#F#	-3.70 F#A#C#	-1.75 C#FG#	+0.20 AbCEb	+2.20 EbGBb	+4.20 BbDF	+6.20 FAC	+5.70 CEG
m3 ¢	7.84	14.14	11.94	15.99	15.94	21.54	21.59	21.64	19.14	17.14	10.84	9.94	7.84
M3 ¢	5.89	7.89	8.59	11.94	15.99	15.99	21.59	21.64	19.19	17.19	10.89	7.49	5.89
5th ¢	-1.96	-6.26	-3.36	-4.06	0.04	-5.56	-0.01	-0.01	0.04	0.04	0.04	-2.46	-1.96
M3 bps	2.23	4.49	3.65	7.61	7.64	11.45	11.58	8.71	11.57	7.77	7.37	3.80	4.47
m3 bps	4.46	12.05	7.61	15.28	11.42	11.56	17.38	13.06	17.32	11.62	11.01	7.56	8.93
5th bps	0.44	2.13	0.85	1.54	-0.01	2.37	0.00	0.00	-0.02	-0.01	-0.02	0.74	0.89

Coleman 4 (Modern Well, 1994)

Minor thirds
Major thirds
Fifths (CG)

Working with the Sanderson Accutuner II, Coleman manually changed notes by one or two cents "on the fly." He would raise each C and F, and lower each E and B, by the same amount. He sought to slow the M3s on CE, FA, and GB.

M3 Range 9.7 15.7



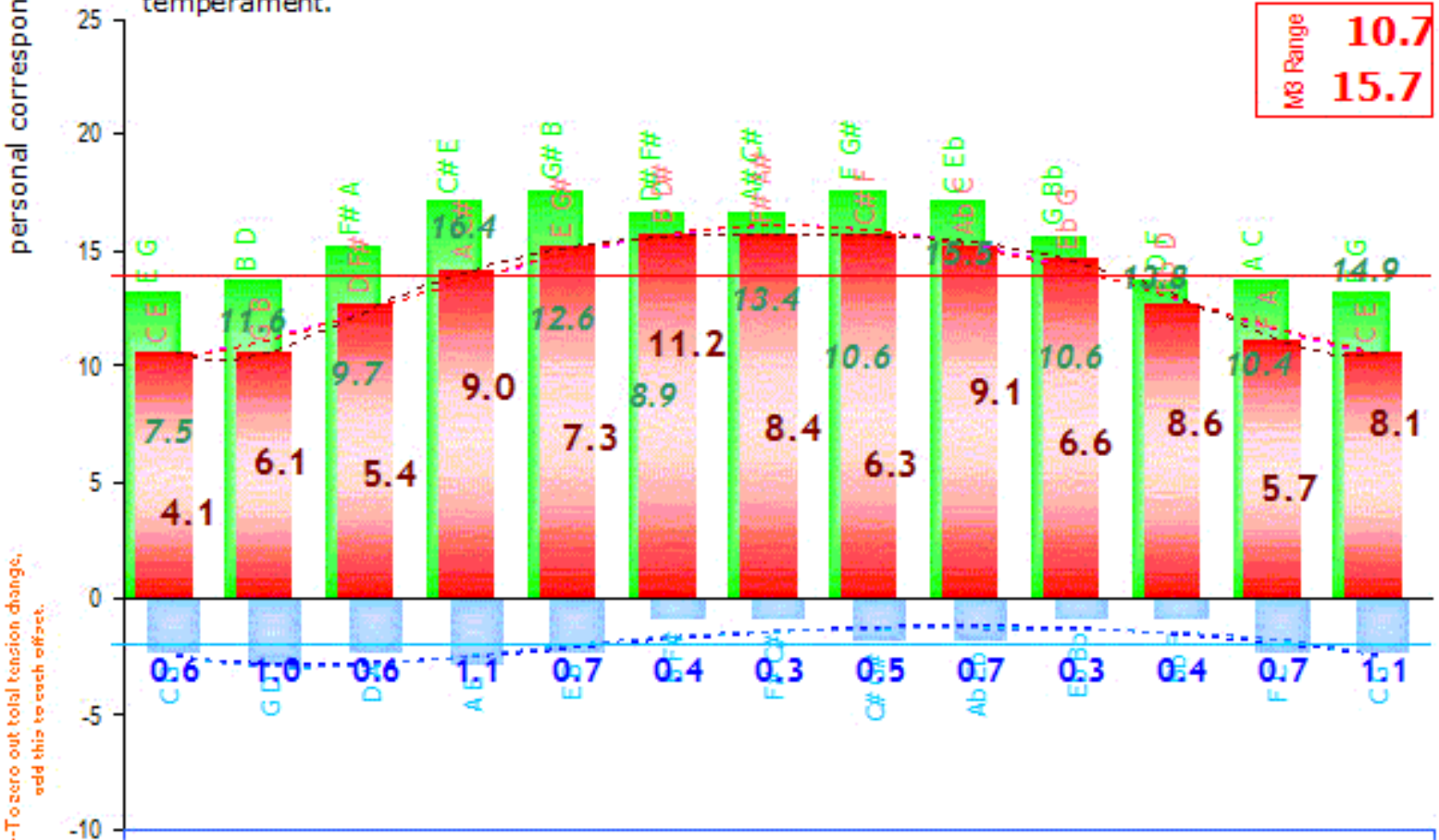
	+2.00 CEG	0.00 GBD	0.00 DF#A	0.00 AC#E	-2.00 EG#B	-2.00 BD#F#	0.00 F#A#C#	0.00 C#FG#	0.00 AbCEb	0.00 EbGBb	0.00 BbDF	+2.00 FAC	+2.00 CEG
m3 ¢	13.64	13.64	15.64	17.64	17.64	15.64	15.64	17.64	17.64	15.64	13.64	13.64	13.64
M3 ¢	9.69	11.69	13.69	13.69	15.69	15.69	13.69	15.69	15.69	13.69	13.69	11.69	9.69
5th ¢	-3.96	-1.96	-1.96	-3.96	-1.96	0.04	-1.96	-1.96	-1.96	-1.96	0.04	-1.96	-3.96
M3 bps	3.67	6.64	5.83	8.73	7.49	11.23	7.34	6.31	9.45	6.17	9.25	5.92	7.35
m3 bps	7.75	11.62	9.98	16.86	12.63	8.39	12.58	10.63	15.93	10.58	13.83	10.36	15.50
5th bps	0.90	0.66	0.50	1.51	0.56	-0.02	0.63	0.47	0.70	0.53	-0.02	0.59	1.79

Coleman 10 (Modern Well, 2001)

Minor thirds
Major thirds
Fifths (CG)

In 2001, Coleman decided to make the Coleman 10 have 1/2 the deviation values of the Coleman 11 just in case someone would want an even milder temperament.

M3 Range 10.7 15.7



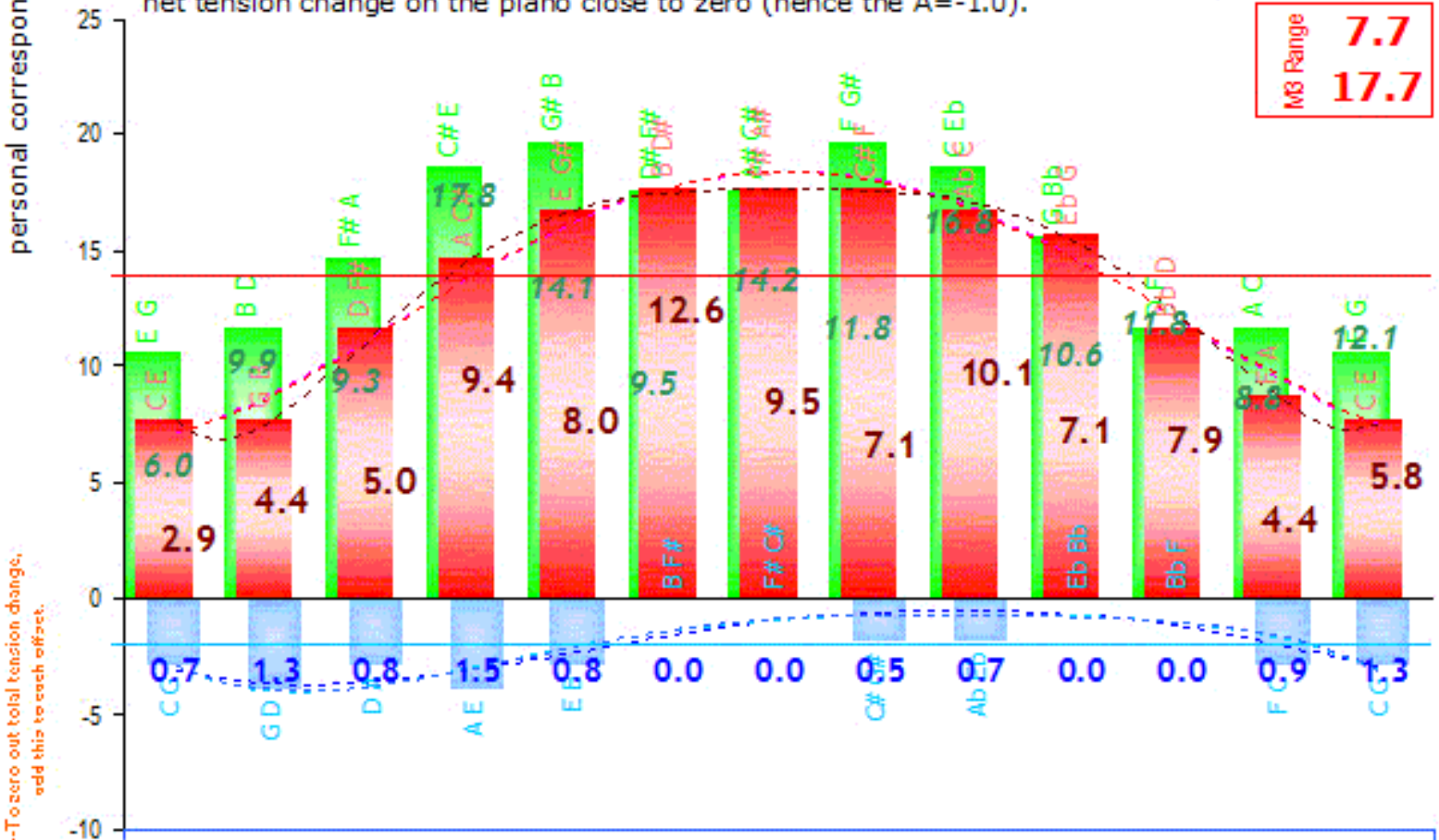
	+1.50 CEG	+1.00 GBD	0.00 DF#A	-0.50 AC#E	-1.50 EG#B	-2.00 BD#F#	-1.00 F#A#C#	0.00 C#FG#	0.00 AbCEb	0.00 EbGBb	+1.00 BbDF	+2.00 FAC	+1.50 CEG
m3 ¢	13.14	13.64	15.14	17.14	17.64	16.64	16.64	17.64	17.14	15.64	13.64	13.64	13.14
M3 ¢	10.69	10.69	12.69	14.19	15.19	15.69	15.69	15.69	15.19	14.69	12.69	11.19	10.69
5th ¢	-2.46	-2.96	-2.46	-2.96	-2.46	-0.96	-0.96	-1.96	-1.96	-0.96	-0.96	-2.46	-2.46
M3 bps	4.05	6.07	5.40	9.05	7.25	11.23	8.41	6.31	9.15	6.63	8.58	5.67	8.11
m3 bps	7.47	11.62	9.66	16.39	12.63	8.93	13.39	10.63	15.48	10.58	13.83	10.36	14.94
5th bps	0.56	1.00	0.62	1.13	0.70	0.41	0.31	0.47	0.70	0.26	0.39	0.74	1.11

Coleman 11 (Modern Well, 1999)

Minor thirds
Major thirds
Fifths (CG)

Using Supercalc, Coleman explored the idea that M3rds should get busier as the number of sharps/flats increased. He also varied the value of A to keep the net tension change on the piano close to zero (hence the A=-1.0).

M3 Range 7.7 17.7



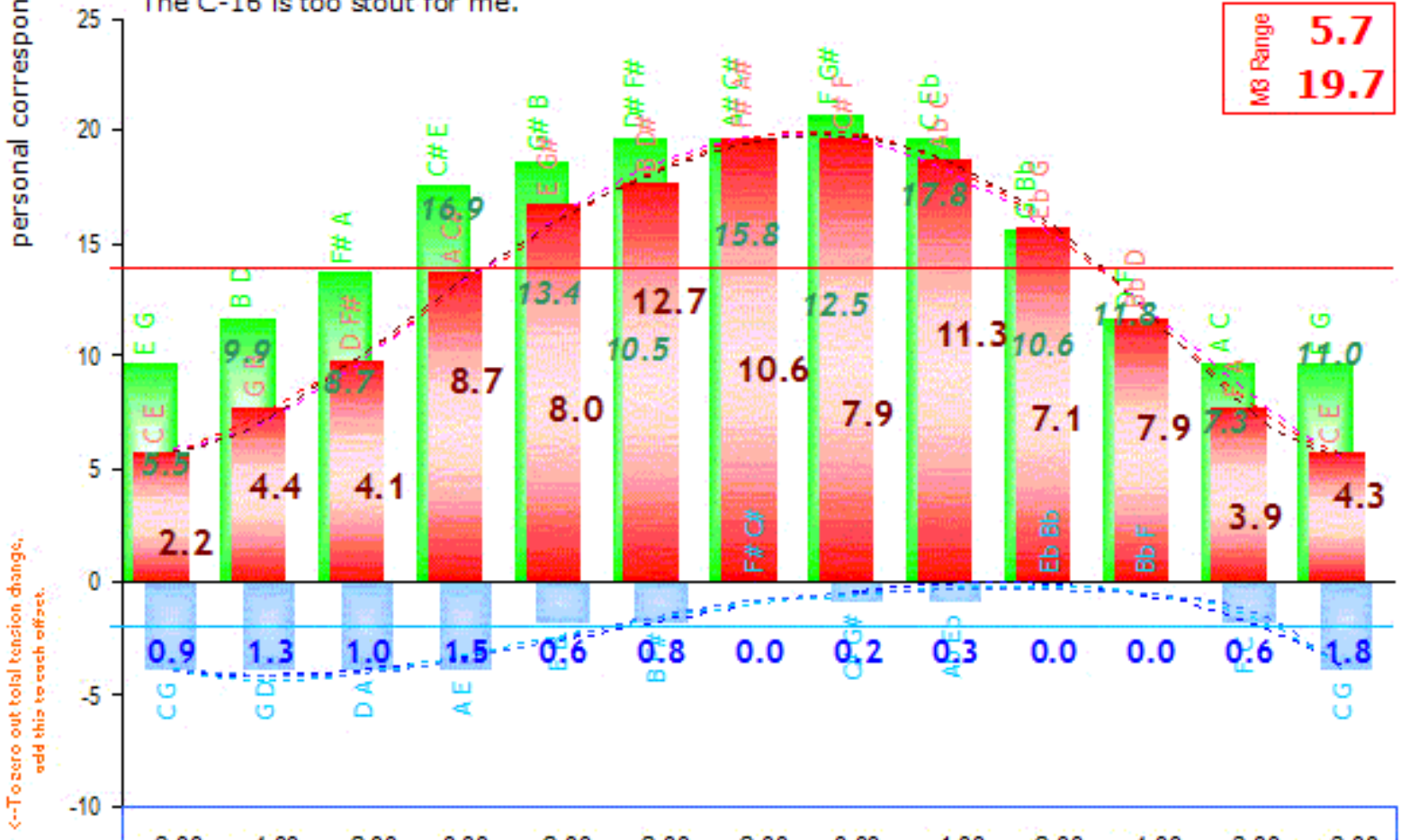
	+3.00 CEG	+2.00 GBD	0.00 DF#A	-1.00 AC#E	-3.00 EG#B	-4.00 BD#F#	-2.00 F#A#C#	0.00 C#FG#	0.00 AbCEb	0.00 EbGBb	+2.00 BbDF	+4.00 FAC	+3.00 CEG
m3 ¢	10.64	11.64	14.64	18.64	19.64	17.64	17.64	19.64	18.64	15.64	11.64	11.64	10.64
M3 ¢	7.69	7.69	11.69	14.69	16.69	17.69	17.69	17.69	16.69	15.69	11.69	8.69	7.69
5th ¢	-2.96	-3.96	-2.96	-3.96	-2.96	0.04	0.04	-1.96	-1.96	0.04	0.04	-2.96	-2.96
M3 bps	2.92	4.37	4.97	9.37	7.97	12.65	9.49	7.12	10.06	7.08	7.90	4.40	5.83
m3 bps	6.05	9.91	9.34	17.81	14.06	9.46	14.19	11.85	16.84	10.59	11.81	8.84	12.10
5th bps	0.67	1.34	0.75	1.51	0.84	-0.02	-0.01	0.47	0.70	-0.01	-0.02	0.90	1.34

Coleman 16 (Modern Well, 2001)

Minor thirds
Major thirds
Fifths (CG)

Coleman's later goal was to have the least change in the 4ths and 5ths, and to have the calmest M3rds possible. He comments: "My favorite is still the C-11. The C-16 is too stout for me."

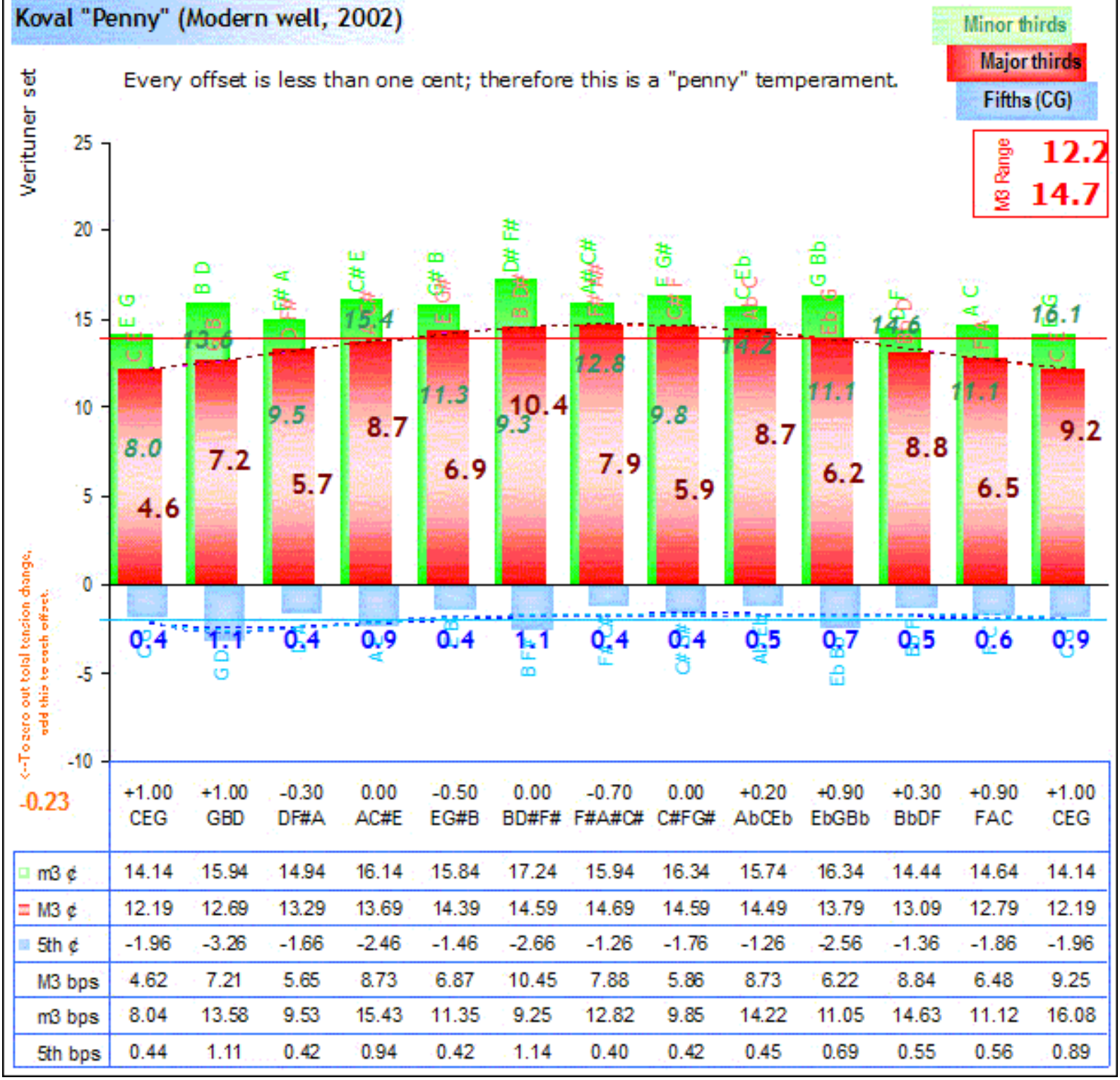
M3 Range 5.7 19.7



	+6.00 CEG	+4.00 GBD	+2.00 DF#A	0.00 AC#E	-2.00 EG#B	-2.00 BD#F#	-2.00 F#A#C#	0.00 C#FG#	+1.00 AbCEb	+2.00 EbGBb	+4.00 BbDF	+6.00 FAC	+6.00 CEG
m3 ¢	9.64	11.64	13.64	17.64	18.64	19.64	19.64	20.64	19.64	15.64	11.64	9.64	9.64
M3 ¢	5.69	7.69	9.69	13.69	16.69	17.69	19.69	19.69	18.69	15.69	11.69	7.69	5.69
5th ¢	-3.96	-3.96	-3.96	-3.96	-1.96	-1.96	0.04	-0.96	-0.96	0.04	0.04	-1.96	-3.96
M3 bps	2.16	4.37	4.12	8.73	7.97	12.66	10.57	7.92	11.27	7.09	7.91	3.90	4.32
m3 bps	5.49	9.92	8.70	16.86	13.35	10.54	15.81	12.46	17.77	10.60	11.82	7.33	10.97
5th bps	0.90	1.34	1.01	1.51	0.56	0.84	-0.01	0.23	0.34	-0.01	-0.02	0.59	1.80

Koval "Penny" (Modern well, 2002)

Every offset is less than one cent; therefore this is a "penny" temperament.

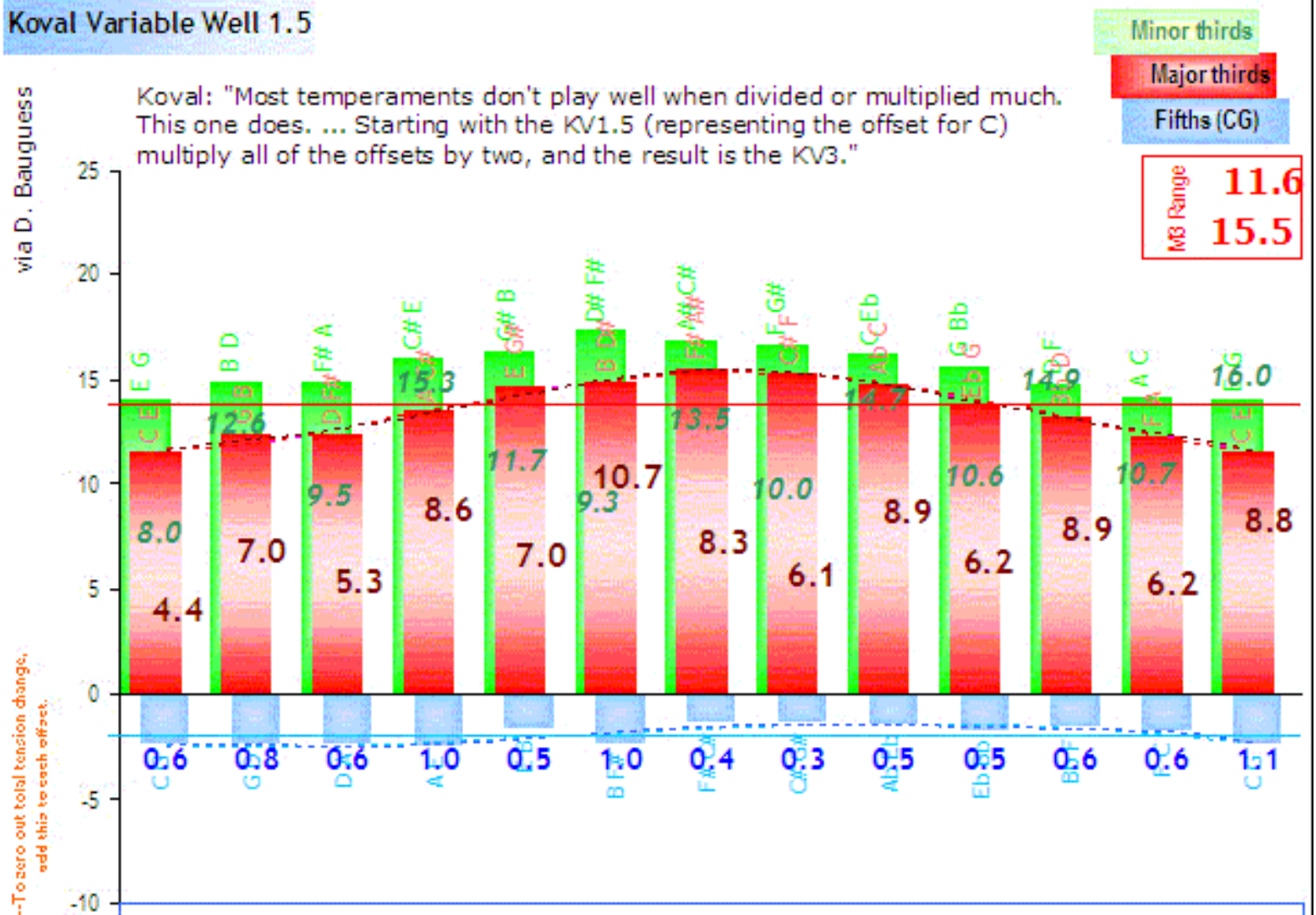


	+1.00 CEG	+1.00 GBD	-0.30 DF#A	0.00 AC#E	-0.50 EG#B	0.00 BD#F#	-0.70 F#A#C#	0.00 C#FG#	+0.20 AbCEb	+0.90 EbGBb	+0.30 BbDF	+0.90 FAC	+1.00 CEG
m3 ¢	14.14	15.94	14.94	16.14	15.84	17.24	15.94	16.34	15.74	16.34	14.44	14.64	14.14
M3 ¢	12.19	12.69	13.29	13.69	14.39	14.59	14.69	14.59	14.49	13.79	13.09	12.79	12.19
5th ¢	-1.96	-3.26	-1.66	-2.46	-1.46	-2.66	-1.26	-1.76	-1.26	-2.56	-1.36	-1.86	-1.96
M3 bps	4.62	7.21	5.65	8.73	6.87	10.45	7.88	5.86	8.73	6.22	8.84	6.48	9.25
m3 bps	8.04	13.58	9.53	15.43	11.35	9.25	12.82	9.85	14.22	11.05	14.63	11.12	16.08
5th bps	0.44	1.11	0.42	0.94	0.42	1.14	0.40	0.42	0.45	0.69	0.55	0.56	0.89

Koval Variable Well 1.5

via D. Bauguess

Koval: "Most temperaments don't play well when divided or multiplied much. This one does. ... Starting with the KV1.5 (representing the offset for C) multiply all of the offsets by two, and the result is the KV3."



	+1.50 CEG	+1.00 GBD	+0.50 DF#A	0.00 AC#E	-0.60 EG#B	-0.30 BD#F#	-0.80 F#A#C#	-0.20 C#FG#	+0.40 AbCEb	+0.90 EbGBb	+1.00 BbDF	+1.40 FAC	+1.50 CEG
m3 ¢	14.04	14.84	14.84	16.04	16.34	17.34	16.84	16.64	16.24	15.64	14.74	14.14	14.04
M3 ¢	11.59	12.39	12.39	13.49	14.69	14.89	15.49	15.29	14.79	13.79	13.19	12.29	11.59
5th ¢	-2.46	-2.46	-2.46	-2.56	-1.66	-2.46	-1.36	-1.36	-1.46	-1.86	-1.56	-1.86	-2.46
M3 bps	4.40	7.04	5.27	8.60	7.02	10.66	8.31	6.14	8.91	6.22	8.92	6.22	8.79
m3 bps	7.99	12.65	9.47	15.34	11.71	9.31	13.55	10.03	14.67	10.58	14.94	10.74	15.97
5th bps	0.56	0.83	0.62	0.97	0.47	1.05	0.43	0.33	0.52	0.50	0.63	0.56	1.11

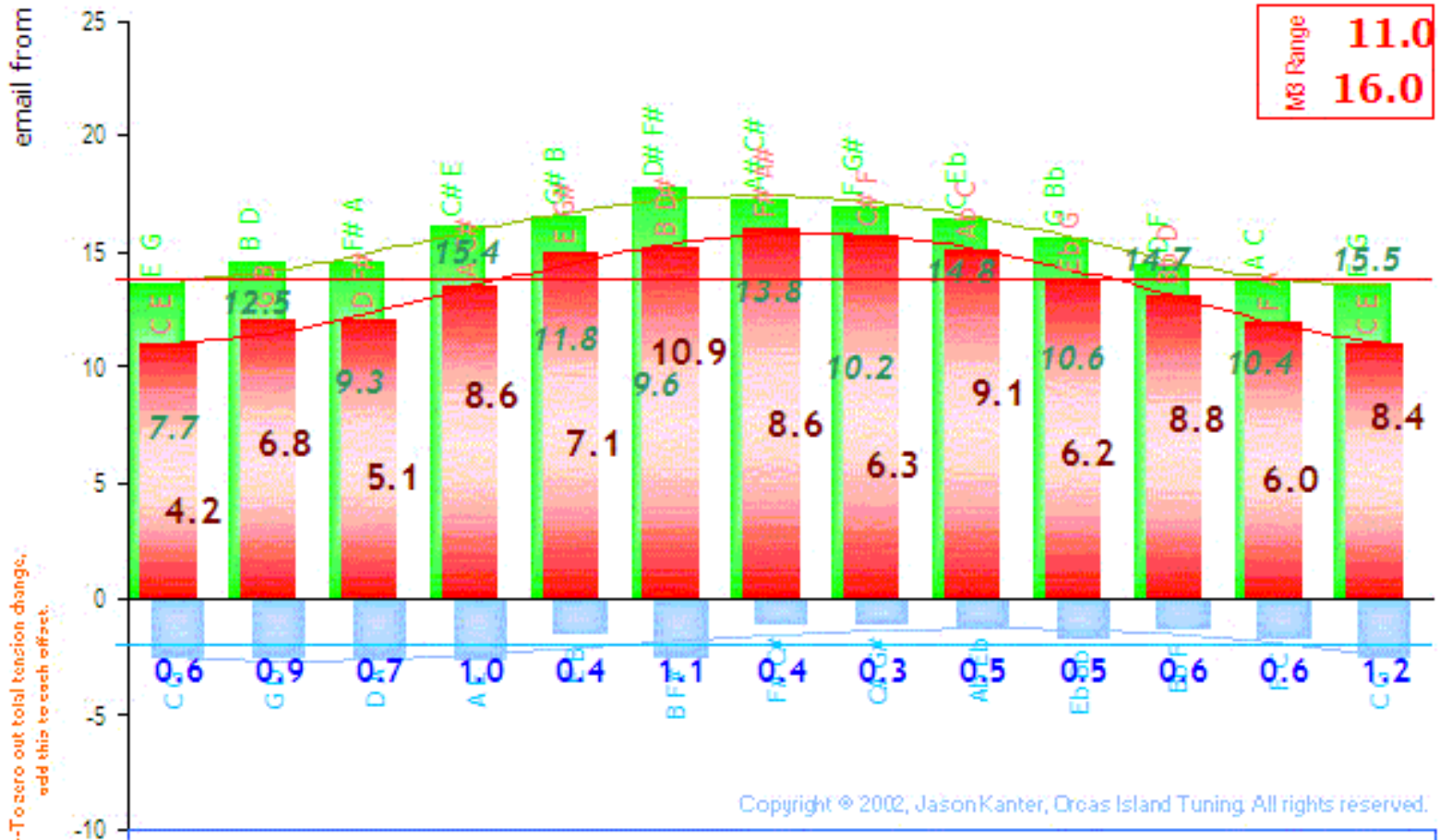
Koval Variable Well 1.9

Minor thirds
Major thirds
Fifths (CG)

email from Koval

Koval: "Most temperaments don't play well when divided or multiplied much. This one does." "I use KV 1.9 for everyday use, as an equal substitute"

M3 Range 11.0 16.0



<--To zero out total tension change, add this to each offset.

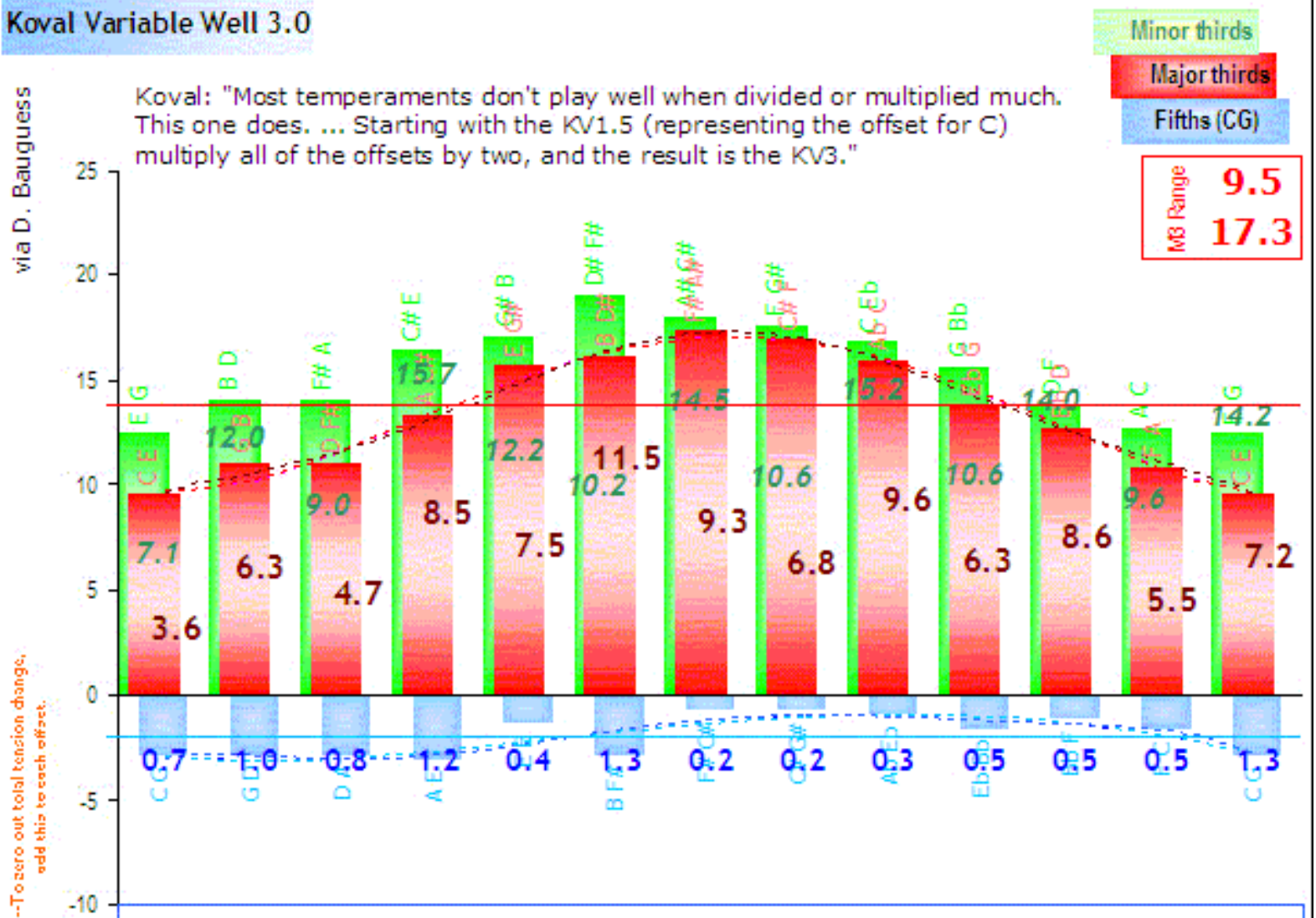
-0.51

	+1.90 CEG	+1.27 GBD	+0.63 DF#A	0.00 AC#E	-0.76 EG#B	-0.38 BD#F#	-1.01 F#A#C#	-0.25 C#FG#	+0.51 AbCEb	+1.14 EbGBb	+1.27 BbDF	+1.77 FAC	+1.90 CEG
m3 ¢	13.61	14.63	14.63	16.15	16.53	17.79	17.16	16.91	16.40	15.64	14.50	13.74	13.61
M3 ¢	11.03	12.04	12.04	13.43	14.95	15.21	15.97	15.71	15.08	13.81	13.05	11.91	11.03
5th ¢	-2.59	-2.59	-2.59	-2.72	-1.58	-2.59	-1.20	-1.20	-1.32	-1.83	-1.45	-1.83	-2.59
M3 bps	4.18	6.84	5.13	8.57	7.15	10.89	8.57	6.32	9.09	6.23	8.83	6.03	8.37
m3 bps	7.74	12.46	9.33	15.44	11.84	9.55	13.80	10.19	14.82	10.58	14.70	10.44	15.49
5th bps	0.59	0.88	0.66	1.03	0.45	1.11	0.38	0.29	0.48	0.49	0.59	0.55	1.17

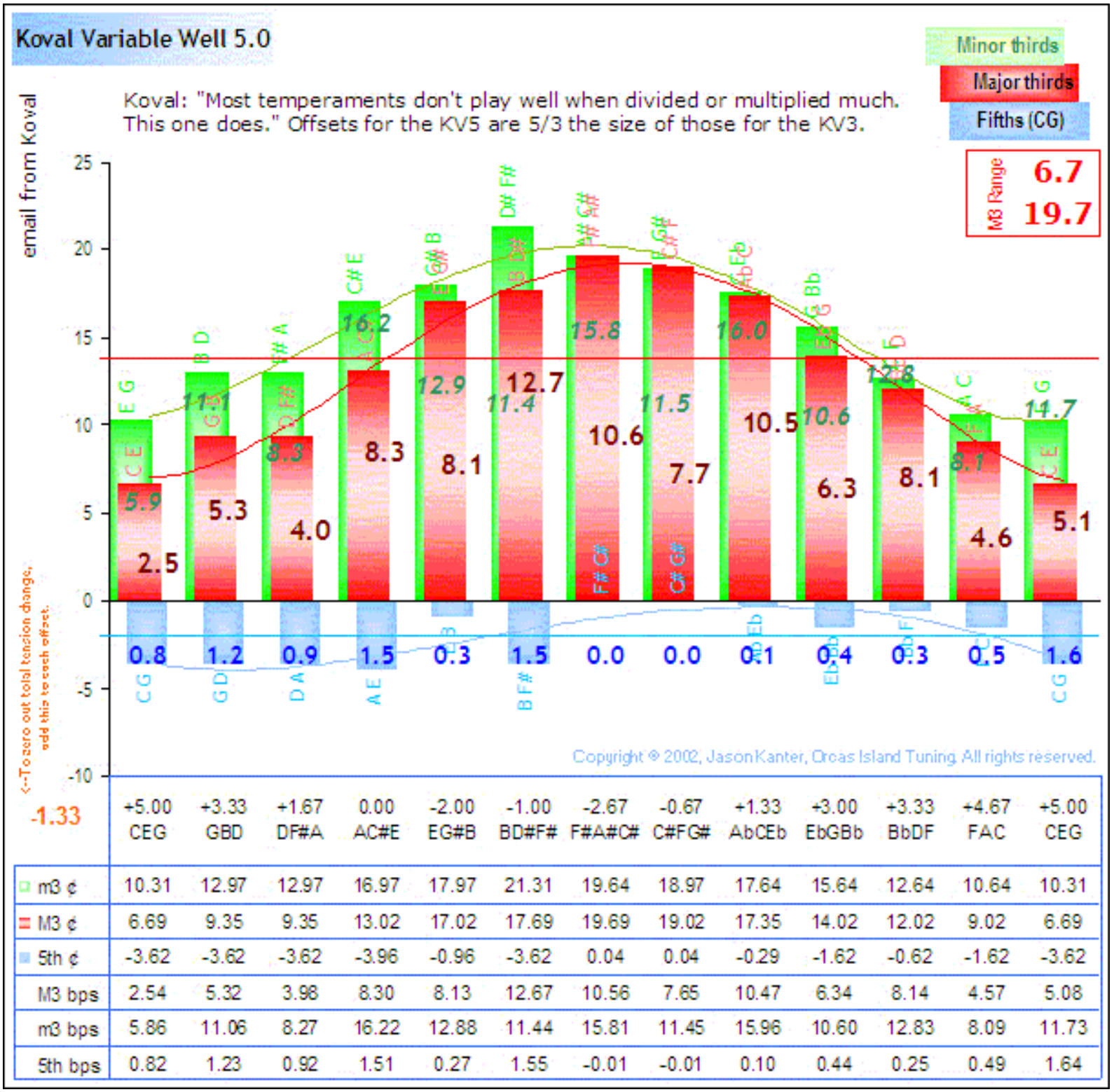
Koval Variable Well 3.0

via D. Bauguess

Koval: "Most temperaments don't play well when divided or multiplied much. This one does. ... Starting with the KV1.5 (representing the offset for C) multiply all of the offsets by two, and the result is the KV3."



	+3.00 CEG	+2.00 GBD	+1.00 DF#A	0.00 AC#E	-1.20 EG#B	-0.60 BD#F#	-1.60 F#A#C#	-0.40 C#FG#	+0.80 AbCEb	+1.80 EbGBb	+2.00 BbDF	+2.80 FAC	+3.00 CEG
m3 ¢	12.44	14.04	14.04	16.44	17.04	19.04	18.04	17.64	16.84	15.64	13.84	12.64	12.44
M3 ¢	9.49	11.09	11.09	13.29	15.69	16.09	17.29	16.89	15.89	13.89	12.69	10.89	9.49
5th ¢	-2.96	-2.96	-2.96	-3.16	-1.36	-2.96	-0.76	-0.76	-0.96	-1.76	-1.16	-1.76	-2.96
M3 bps	3.60	6.30	4.72	8.47	7.50	11.52	9.27	6.79	9.58	6.27	8.58	5.52	7.20
m3 bps	7.08	11.96	8.96	15.72	12.21	10.22	14.51	10.64	15.22	10.59	14.04	9.60	14.15
5th bps	0.67	1.00	0.75	1.20	0.39	1.26	0.24	0.18	0.34	0.47	0.47	0.53	1.34



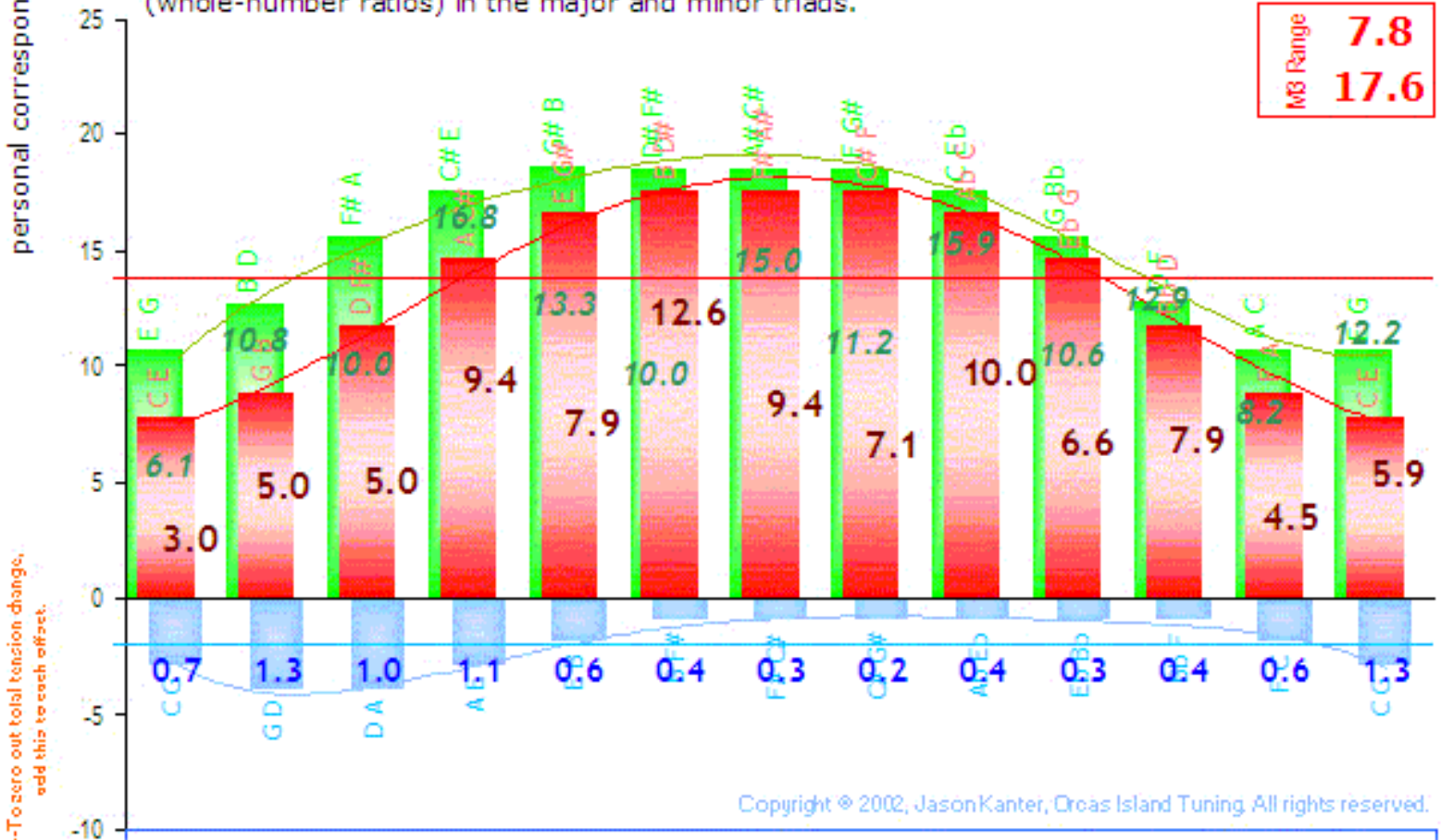
	+5.00 CEG	+3.33 GBD	+1.67 DF#A	0.00 AC#E	-2.00 EG#B	-1.00 BD#F#	-2.67 F#A#C#	-0.67 C#FG#	+1.33 AbCEb	+3.00 EbGBb	+3.33 BbDF	+4.67 FAC	+5.00 CEG
m3 ¢	10.31	12.97	12.97	16.97	17.97	21.31	19.64	18.97	17.64	15.64	12.64	10.64	10.31
M3 ¢	6.69	9.35	9.35	13.02	17.02	17.69	19.69	19.02	17.35	14.02	12.02	9.02	6.69
5th ¢	-3.62	-3.62	-3.62	-3.96	-0.96	-3.62	0.04	0.04	-0.29	-1.62	-0.62	-1.62	-3.62
M3 bps	2.54	5.32	3.98	8.30	8.13	12.67	10.56	7.65	10.47	6.34	8.14	4.57	5.08
m3 bps	5.86	11.06	8.27	16.22	12.88	11.44	15.81	11.45	15.96	10.60	12.83	8.09	11.73
5th bps	0.82	1.23	0.92	1.51	0.27	1.55	-0.01	-0.01	0.10	0.44	0.25	0.49	1.64

Robert Wendell (Modern Well, 2002)

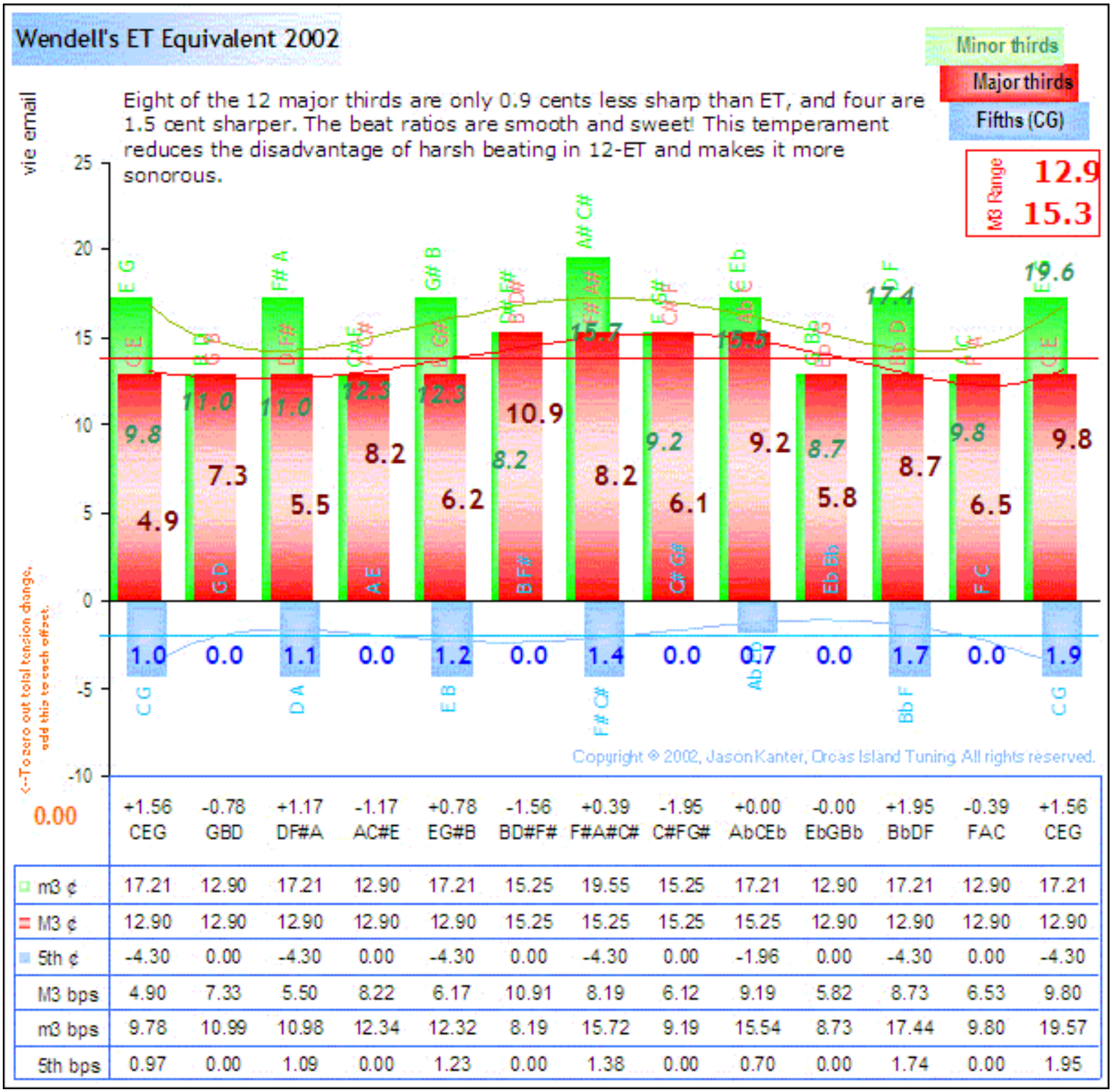
Minor thirds
Major thirds
Fifths (CG)

Close to the Handel in its key color range, and the keys around C are close to the sixth-comma meantone of Mozart's time. A high degree of "beat synchrony" (whole-number ratios) in the major and minor triads.

M3 Range 7.8 17.6



	+4.89 CEG	+3.91 GBD	+1.96 DF#A	0.00 AC#E	-0.98 EG#B	-0.98 BD#F#	0.00 F#A#C#	+0.98 C#FG#	+1.96 AbCEb	+2.93 EbGBb	+3.91 BbDF	+4.89 FAC	+4.89 CEG
m3 ¢	10.75	12.70	15.64	17.60	18.58	18.57	18.57	18.57	17.60	15.64	12.71	10.75	10.75
M3 ¢	7.82	8.80	11.73	14.67	16.63	17.60	17.60	17.60	16.62	14.67	11.74	8.80	7.82
5th ¢	-2.94	-3.91	-3.92	-2.94	-1.96	-0.98	-0.98	-0.98	-0.99	-0.98	-0.98	-1.96	-2.94
M3 bps	2.97	5.00	5.00	9.36	7.95	12.61	9.45	7.08	10.02	6.63	7.95	4.46	5.94
m3 bps	6.12	10.82	9.98	16.83	13.32	9.98	14.96	11.21	15.92	10.60	12.90	8.17	12.24
5th bps	0.67	1.33	1.00	1.12	0.56	0.42	0.31	0.23	0.35	0.26	0.39	0.59	1.33



	+1.56 CEG	-0.78 GBD	+1.17 DF#A	-1.17 AC#E	+0.78 EG#B	-1.56 BD#F#	+0.39 F#A#C#	-1.95 C#FG#	+0.00 AbCEb	-0.00 EbGBb	+1.95 BbDF	-0.39 FAC	+1.56 CEG
m3 ¢	17.21	12.90	17.21	12.90	17.21	15.25	19.55	15.25	17.21	12.90	17.21	12.90	17.21
M3 ¢	12.90	12.90	12.90	12.90	12.90	15.25	15.25	15.25	15.25	12.90	12.90	12.90	12.90
5th ¢	-4.30	0.00	-4.30	0.00	-4.30	0.00	-4.30	0.00	-1.96	0.00	-4.30	0.00	-4.30
M3 bps	4.90	7.33	5.50	8.22	6.17	10.91	8.19	6.12	9.19	5.82	8.73	6.53	9.80
m3 bps	9.78	10.99	10.98	12.34	12.32	8.19	15.72	9.19	15.54	8.73	17.44	9.80	19.57
5th bps	0.97	0.00	1.09	0.00	1.23	0.00	1.38	0.00	0.70	0.00	1.74	0.00	1.95

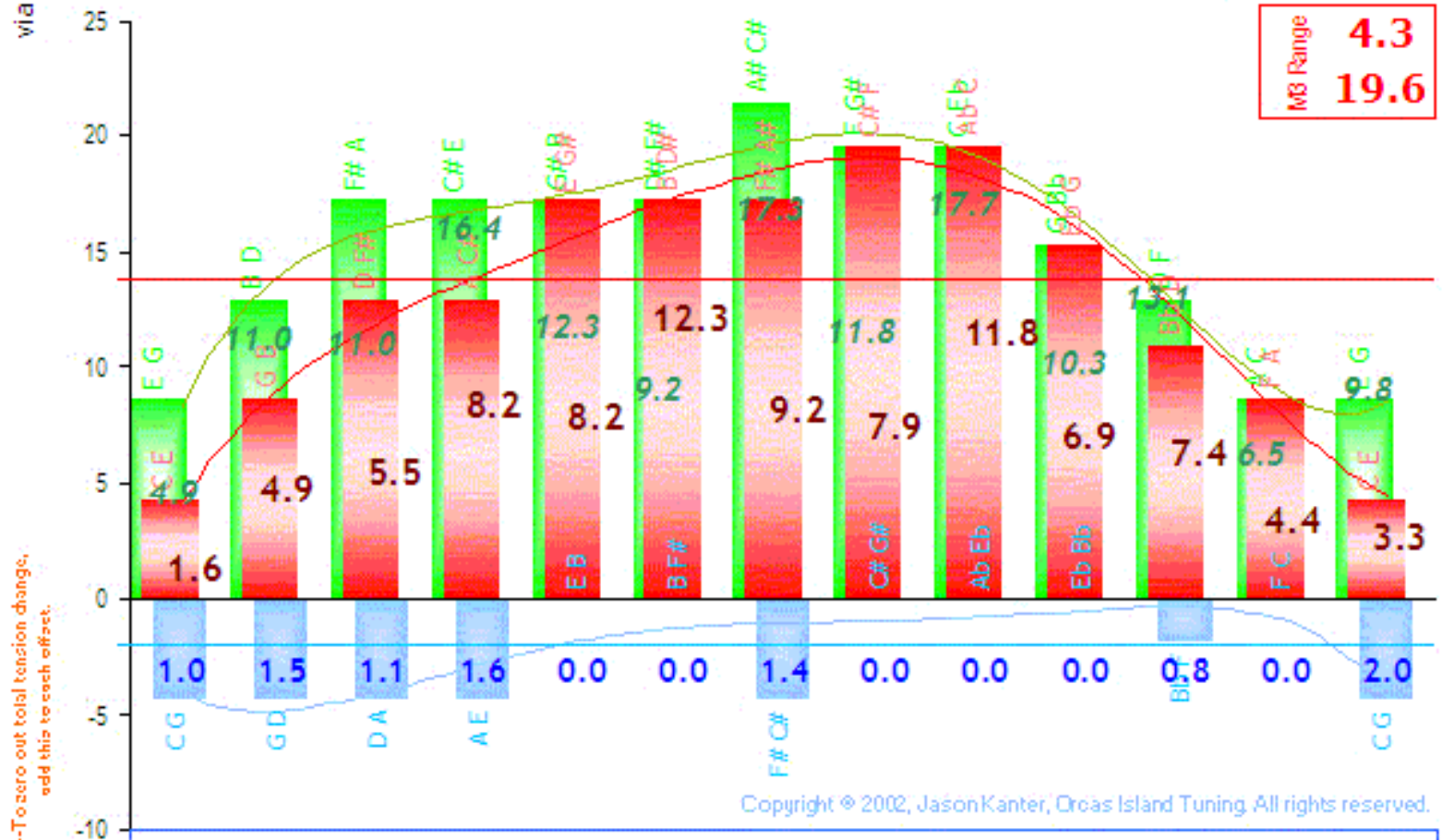
Wendell's Synchronous Victorian 2002

Minor thirds
Major thirds
Fifths (CG)

M3 Range 4.3 19.6

via email

Wendell worked with the concept of beat synchrony (whole-number ratios between the M3/m3 in any triad) to develop this Victorian well.



<--To zero out total tension change, add this to each offset.

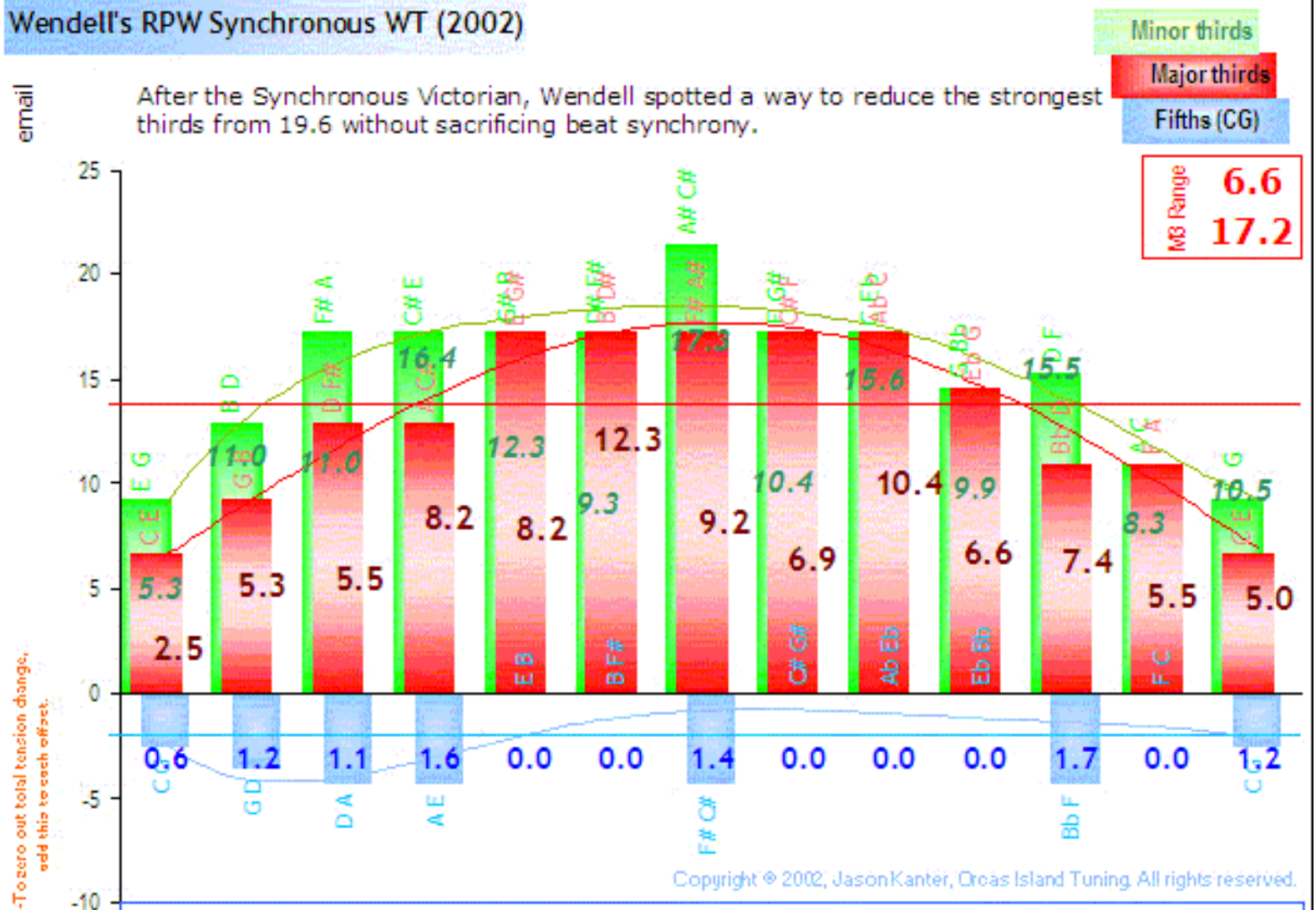
0.00

	+4.82 CEG	+2.48 GBD	+0.13 DF#A	-2.22 AC#E	-4.56 EG#B	-2.61 BD#F#	-0.65 F#A#C#	-3.00 C#FG#	-1.04 AbCEb	+0.91 EbGBb	+2.87 BbDF	+2.87 FAC	+4.82 CEG
m3 ¢	8.60	12.90	17.21	17.21	17.21	17.21	21.51	19.55	19.55	15.25	12.90	8.60	8.60
M3 ¢	4.30	8.60	12.90	12.90	17.21	17.21	17.21	19.55	19.55	15.25	10.95	8.60	4.30
5th ¢	-4.30	-4.30	-4.30	-4.30	0.00	0.00	-4.30	0.00	0.00	0.00	-1.96	0.00	-4.30
M3 bps	1.63	4.89	5.49	8.22	8.21	12.31	9.24	7.86	11.78	6.89	7.41	4.36	3.26
m3 bps	4.89	10.99	10.97	16.42	12.31	9.24	17.29	11.78	17.68	10.33	13.09	6.54	9.78
5th bps	0.98	1.46	1.09	1.64	0.00	0.00	1.38	0.00	0.00	0.00	0.79	0.00	1.95

Wendell's RPW Synchronous WT (2002)

email

After the Synchronous Victorian, Wendell spotted a way to reduce the strongest thirds from 19.6 without sacrificing beat synchrony.

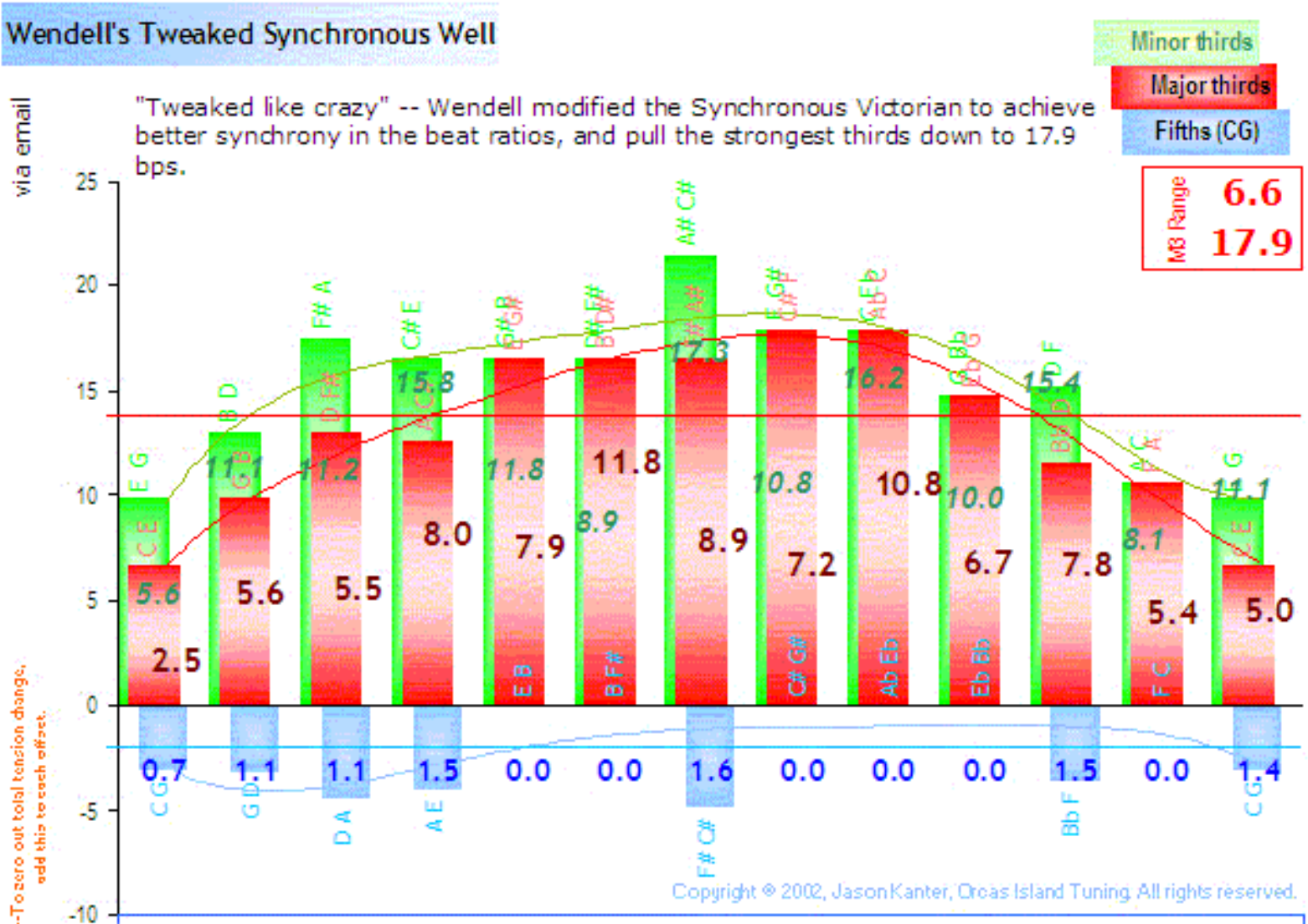


	+4.69 CEG	+4.04 GBD	+2.35 DF#A	0.00 AC#E	-2.35 EG#B	-0.39 BD#F#	+1.56 F#A#C#	-0.78 C#FG#	+1.17 AbCEb	+3.13 EbGBb	+5.08 BbDF	+2.74 FAC	+4.69 CEG
m3 ¢	9.25	12.90	17.20	17.21	17.20	17.21	21.50	17.21	17.20	14.60	15.25	10.95	9.25
M3 ¢	6.65	9.26	12.90	12.91	17.21	17.21	17.21	17.21	17.21	14.60	10.96	10.95	6.65
5th ¢	-2.61	-3.65	-4.31	-4.31	0.00	-0.01	-4.30	-0.01	0.00	-0.01	-4.30	-0.01	-2.61
M3 bps	2.52	5.27	5.50	8.23	8.22	12.33	9.25	6.92	10.38	6.60	7.42	5.55	5.05
m3 bps	5.26	11.00	10.98	16.44	12.33	9.25	17.31	10.38	15.56	9.90	15.48	8.32	10.53
5th bps	0.59	1.24	1.10	1.64	0.00	0.00	1.38	0.00	0.00	0.00	1.74	0.00	1.18

Wendell's Tweaked Synchronous Well

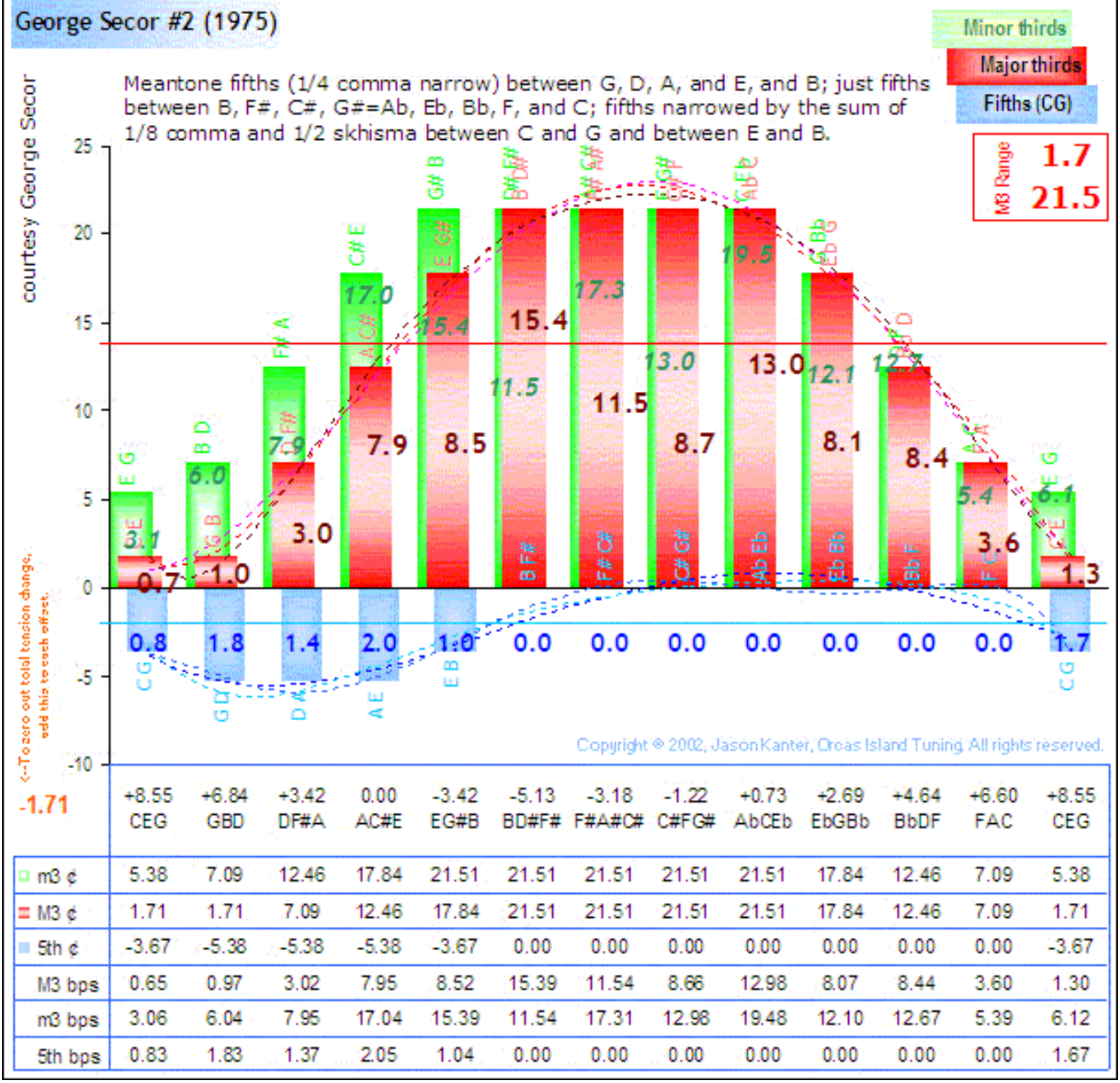
via email

"Tweaked like crazy" -- Wendell modified the Synchronous Victorian to achieve better synchrony in the beat ratios, and pull the strongest thirds down to 17.9 bps.



	+4.99 CEG	+3.81 GBD	+2.54 DF#A	0.00 AC#E	-2.05 EG#B	-0.10 BD#F#	+1.86 F#A#C#	-1.17 C#FG#	+0.78 AbCEb	+2.74 EbGBb	+4.69 BbDF	+3.03 FAC	+4.99 CEG
m3 ¢	9.78	13.00	17.50	16.52	16.52	16.52	21.50	17.89	17.89	14.76	15.15	10.65	9.78
M3 ¢	6.65	9.78	13.01	12.52	16.52	16.53	16.52	17.89	17.90	14.76	11.54	10.66	6.65
5th ¢	-3.14	-3.23	-4.50	-4.01	-0.01	0.00	-4.99	-0.01	0.00	-0.01	-3.62	0.00	-3.14
M3 bps	2.52	5.56	5.54	7.98	7.89	11.84	8.88	7.19	10.79	6.67	7.81	5.40	5.05
m3 bps	5.56	11.08	11.18	15.78	11.84	8.88	17.31	10.79	16.19	10.01	15.38	8.10	11.13
5th bps	0.71	1.10	1.14	1.53	0.00	0.00	1.60	0.00	0.00	0.00	1.46	0.00	1.42

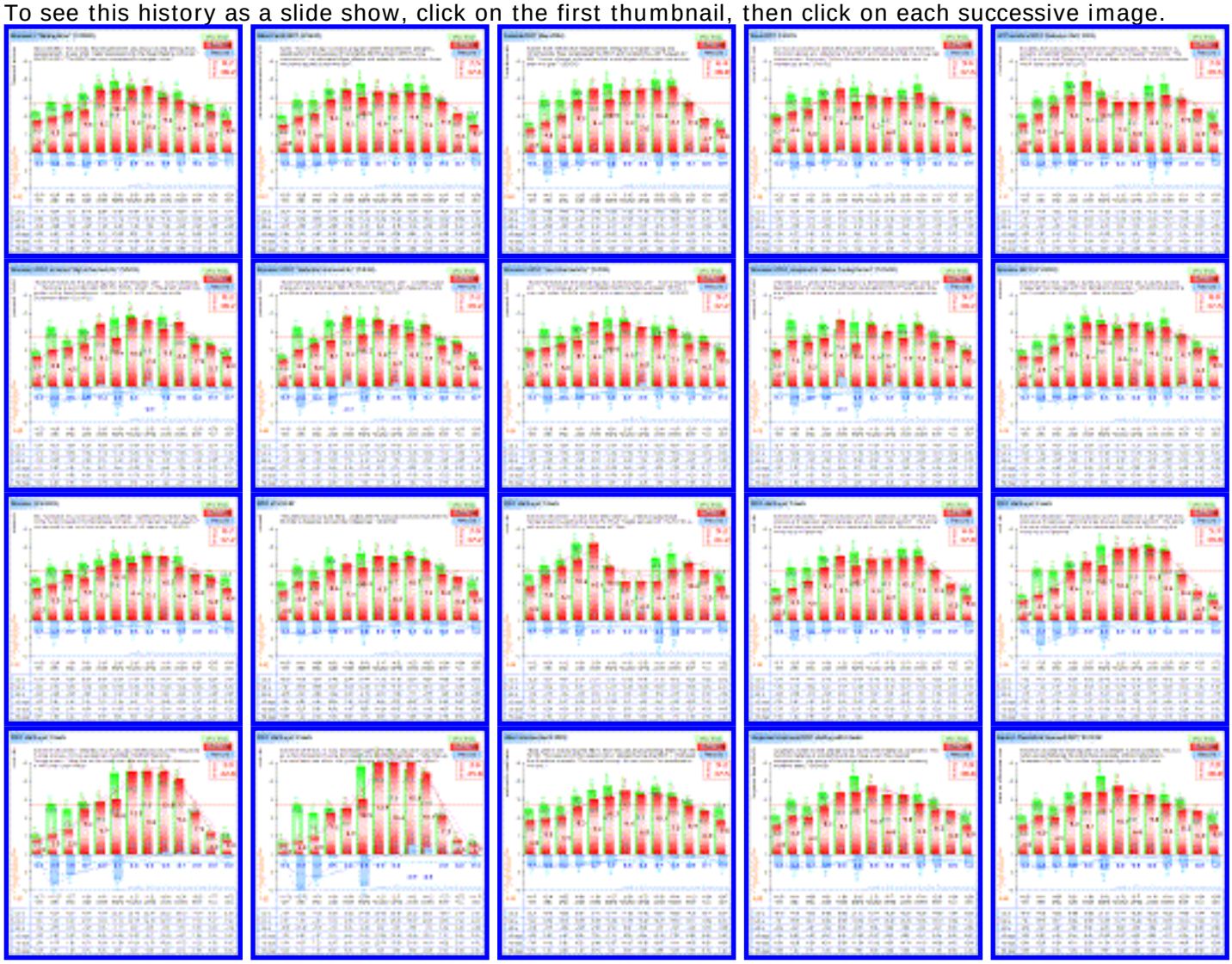
George Secor #2 (1975)



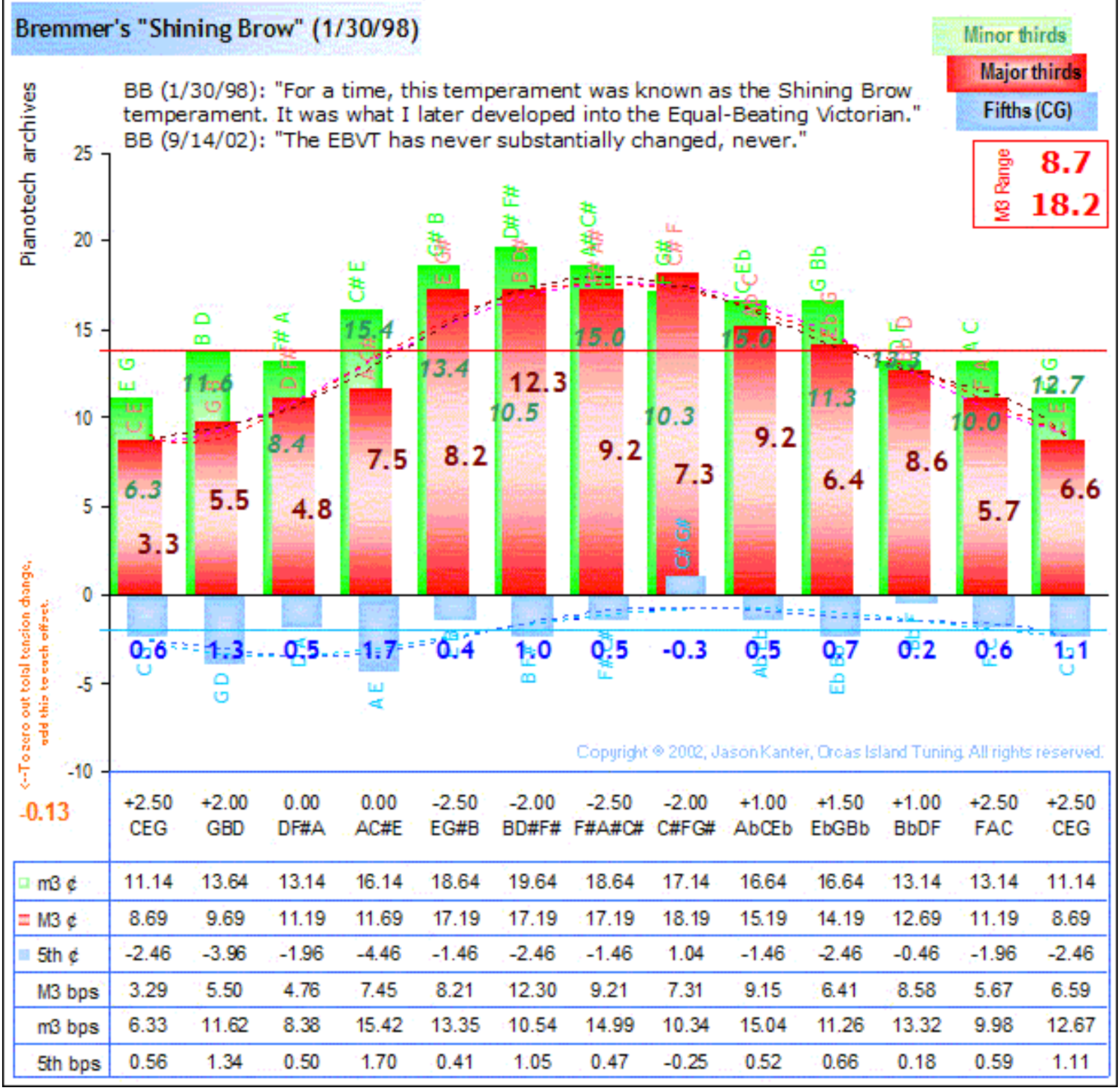
	+8.55 CEG	+6.84 GBD	+3.42 DF#A	0.00 AC#E	-3.42 EG#B	-5.13 BD#F#	-3.18 F#A#C#	-1.22 C#FG#	+0.73 AbCEb	+2.69 EbGBb	+4.64 BbDF	+6.60 FAC	+8.55 CEG
m3 ¢	5.38	7.09	12.46	17.84	21.51	21.51	21.51	21.51	21.51	17.84	12.46	7.09	5.38
M3 ¢	1.71	1.71	7.09	12.46	17.84	21.51	21.51	21.51	21.51	17.84	12.46	7.09	1.71
5th ¢	-3.67	-5.38	-5.38	-5.38	-3.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3.67
M3 bps	0.65	0.97	3.02	7.95	8.52	15.39	11.54	8.66	12.98	8.07	8.44	3.60	1.30
m3 bps	3.06	6.04	7.95	17.04	15.39	11.54	17.31	12.98	19.48	12.10	12.67	5.39	6.12
5th bps	0.83	1.83	1.37	2.05	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67

A Long Road to a Balanced Temperament...

To see this history as a slide show, click on the first thumbnail, then click on each successive image.

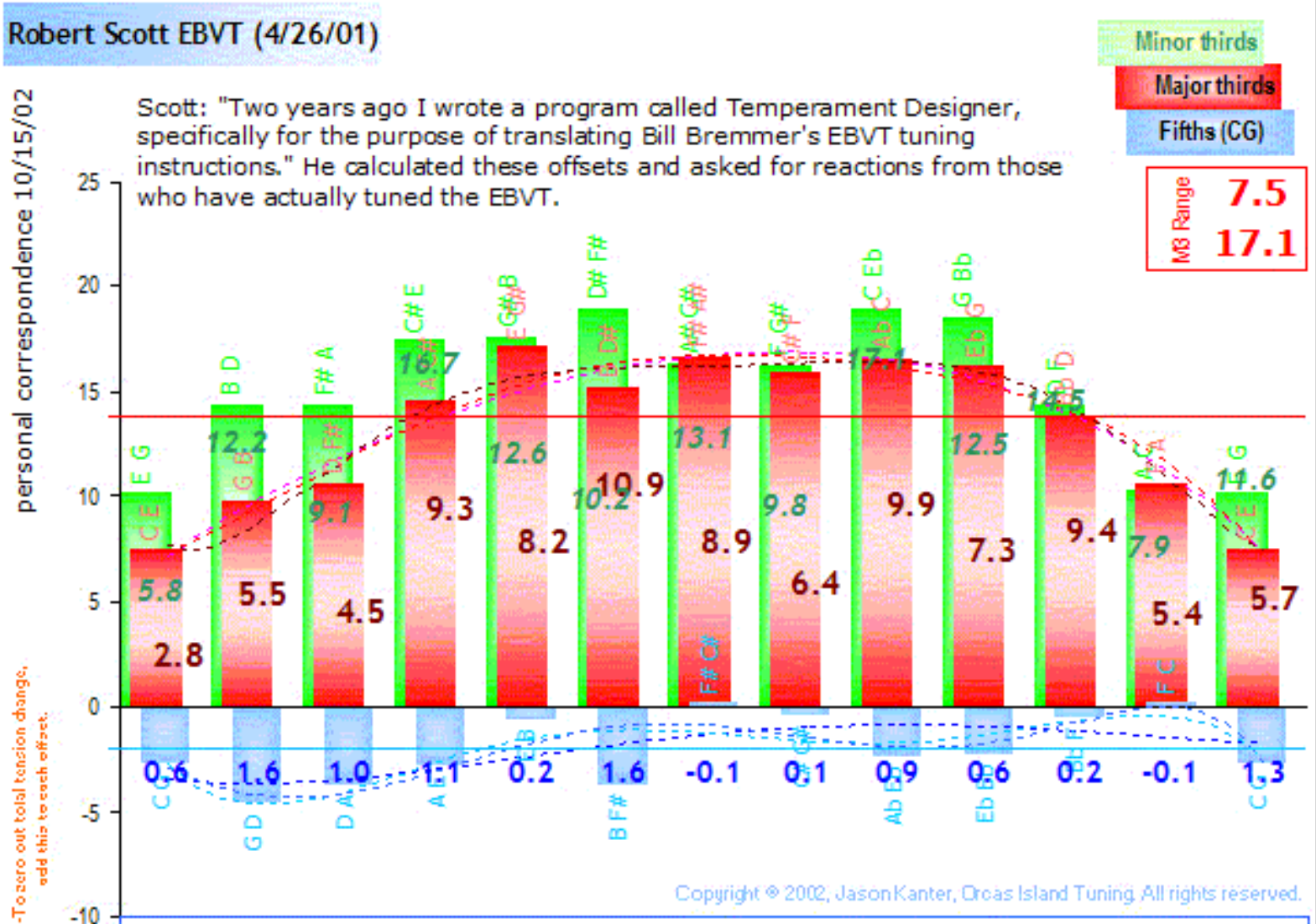


Bremmer's "Shining Brow" (1/30/98)

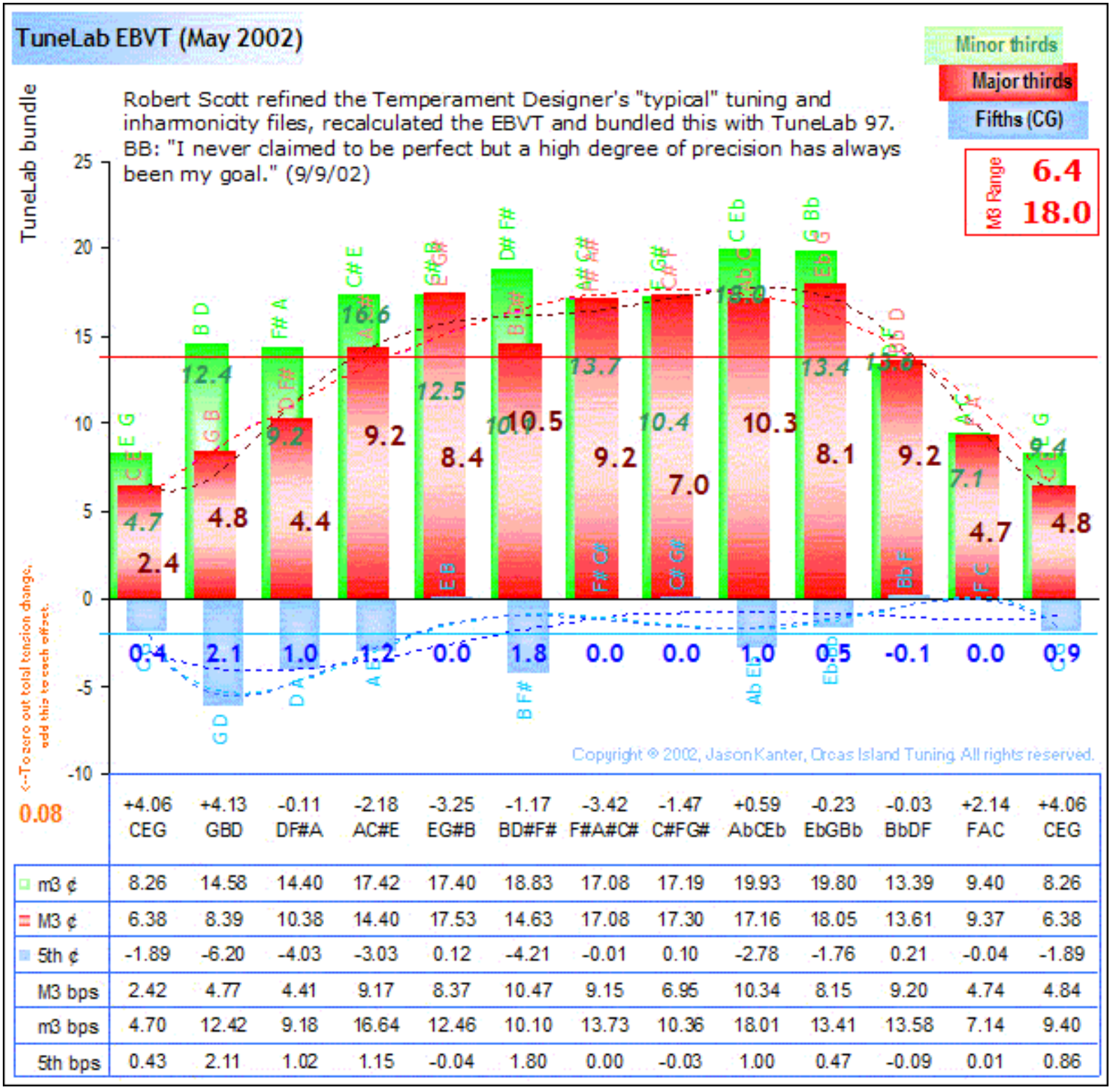


	+2.50 CEG	+2.00 GBD	0.00 DF#A	0.00 AC#E	-2.50 EG#B	-2.00 BD#F#	-2.50 F#A#C#	-2.00 C#FG#	+1.00 AbCEb	+1.50 EbGBb	+1.00 BbDF	+2.50 FAC	+2.50 CEG
m3 ¢	11.14	13.64	13.14	16.14	18.64	19.64	18.64	17.14	16.64	16.64	13.14	13.14	11.14
M3 ¢	8.69	9.69	11.19	11.69	17.19	17.19	17.19	18.19	15.19	14.19	12.69	11.19	8.69
5th ¢	-2.46	-3.96	-1.96	-4.46	-1.46	-2.46	-1.46	1.04	-1.46	-2.46	-0.46	-1.96	-2.46
M3 bps	3.29	5.50	4.76	7.45	8.21	12.30	9.21	7.31	9.15	6.41	8.58	5.67	6.59
m3 bps	6.33	11.62	8.38	15.42	13.35	10.54	14.99	10.34	15.04	11.26	13.32	9.98	12.67
5th bps	0.56	1.34	0.50	1.70	0.41	1.05	0.47	-0.25	0.52	0.66	0.18	0.59	1.11

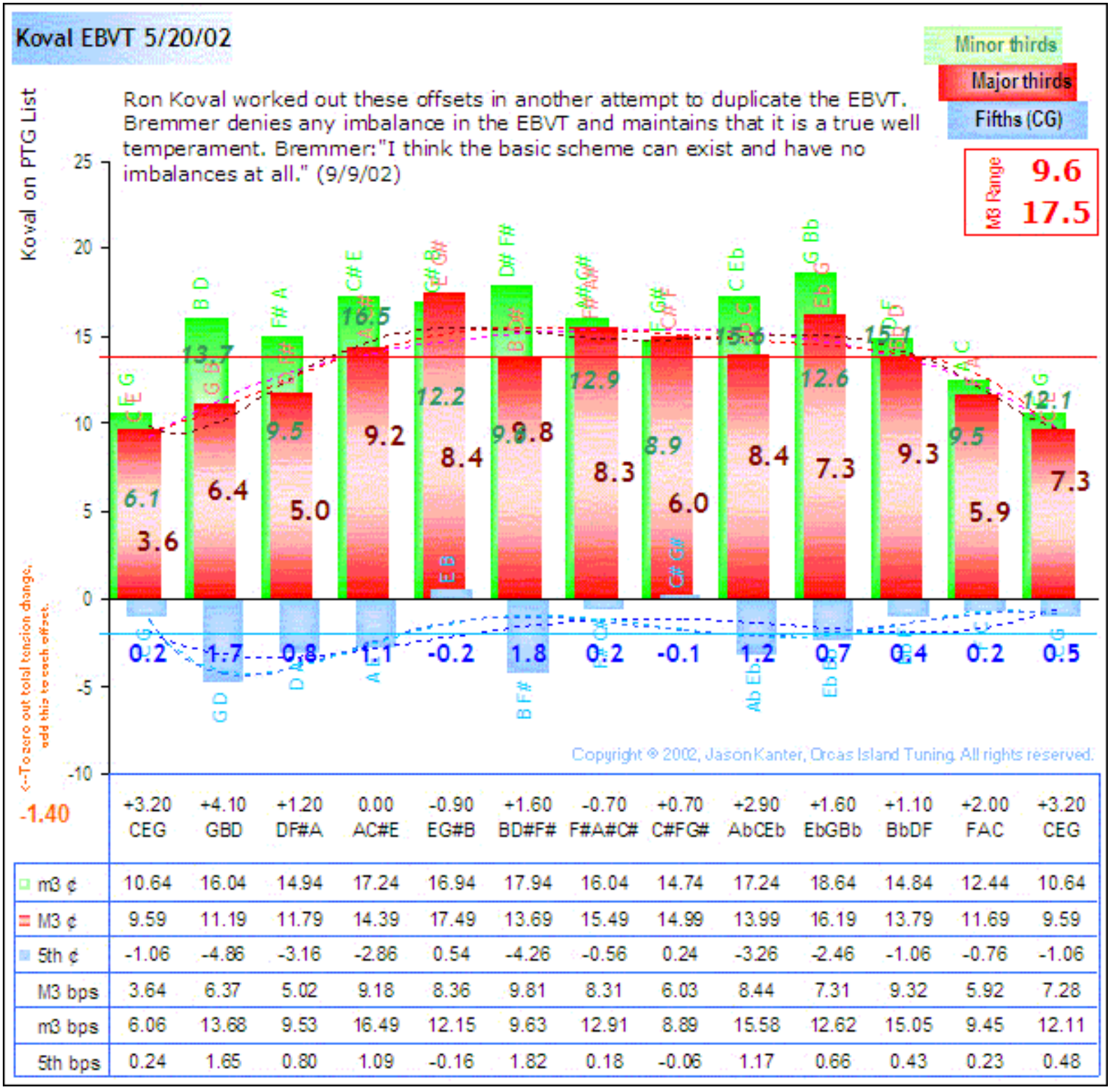
Robert Scott EBVT (4/26/01)



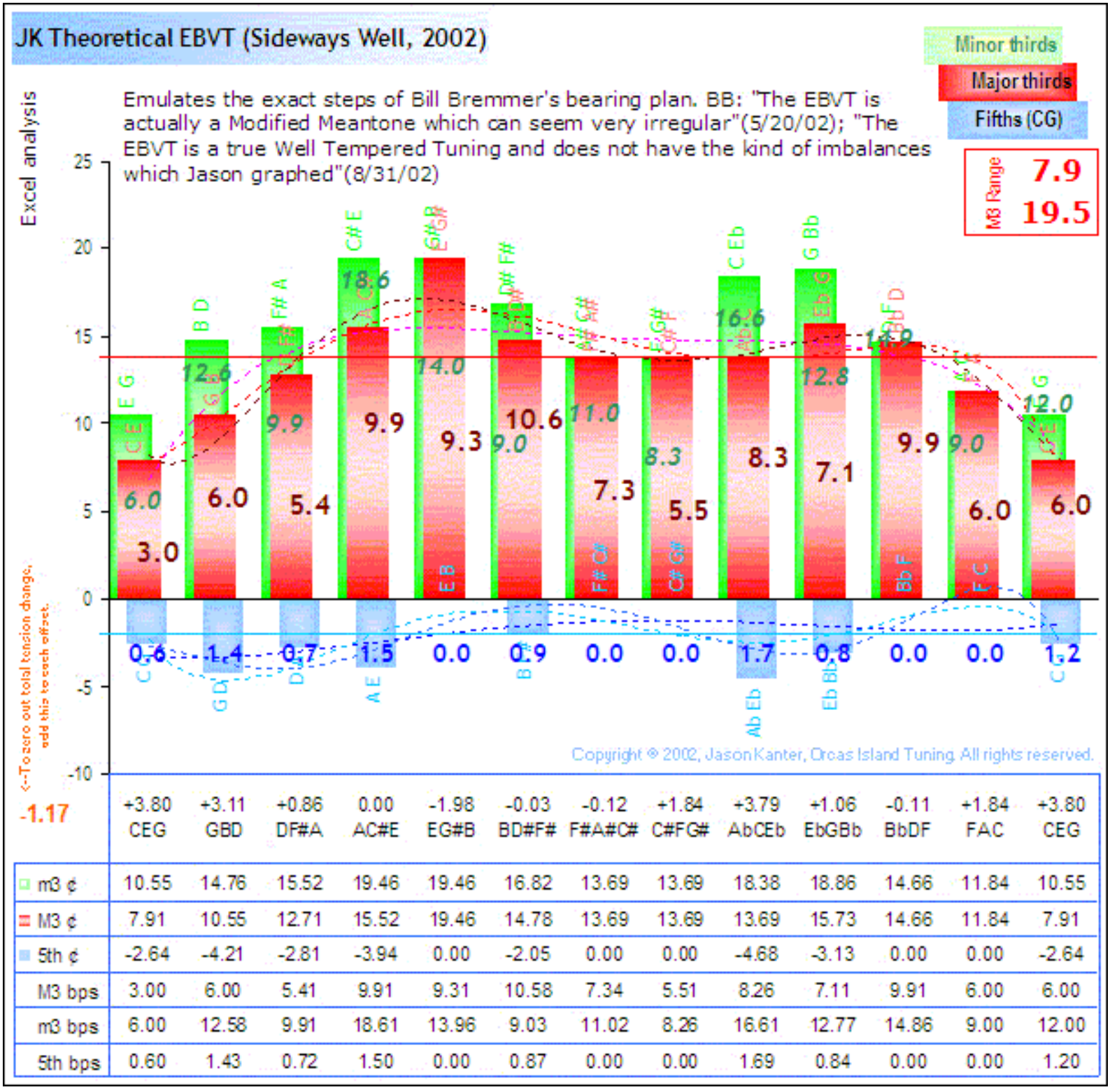
	+3.60 CEG	+2.80 GBD	+0.10 DF#A	-1.70 AC#E	-2.60 EG#B	-1.20 BD#F#	-3.00 F#A#C#	-0.80 C#FG#	+0.80 AbCEb	+0.30 EbGBb	-0.10 BbDF	+1.40 FAC	+3.60 CEG
m3 ¢	10.24	14.34	14.34	17.44	17.64	18.94	16.34	16.24	18.94	18.54	14.34	10.34	10.24
M3 ¢	7.49	9.69	10.59	14.59	17.09	15.19	16.59	15.89	16.49	16.19	13.89	10.59	7.49
5th ¢	-2.76	-4.66	-3.76	-2.86	-0.56	-3.76	0.24	-0.36	-2.46	-2.36	-0.46	0.24	-2.76
M3 bps	2.84	5.51	4.50	9.30	8.16	10.87	8.89	6.39	9.94	7.31	9.38	5.36	5.68
m3 bps	5.82	12.21	9.14	16.66	12.64	10.16	13.14	9.79	17.12	12.55	14.54	7.85	11.65
5th bps	0.63	1.58	0.95	1.09	0.16	1.60	-0.08	0.09	0.88	0.63	0.18	-0.07	1.25



	+4.06 CEG	+4.13 GBD	-0.11 DF#A	-2.18 AC#E	-3.25 EG#B	-1.17 BD#F#	-3.42 F#A#C#	-1.47 C#FG#	+0.59 AbCEb	-0.23 EbGBb	-0.03 BbDF	+2.14 FAC	+4.06 CEG
m3 ¢	8.26	14.58	14.40	17.42	17.40	18.83	17.08	17.19	19.93	19.80	13.39	9.40	8.26
M3 ¢	6.38	8.39	10.38	14.40	17.53	14.63	17.08	17.30	17.16	18.05	13.61	9.37	6.38
5th ¢	-1.89	-6.20	-4.03	-3.03	0.12	-4.21	-0.01	0.10	-2.78	-1.76	0.21	-0.04	-1.89
M3 bps	2.42	4.77	4.41	9.17	8.37	10.47	9.15	6.95	10.34	8.15	9.20	4.74	4.84
m3 bps	4.70	12.42	9.18	16.64	12.46	10.10	13.73	10.36	18.01	13.41	13.58	7.14	9.40
5th bps	0.43	2.11	1.02	1.15	-0.04	1.80	0.00	-0.03	1.00	0.47	-0.09	0.01	0.86

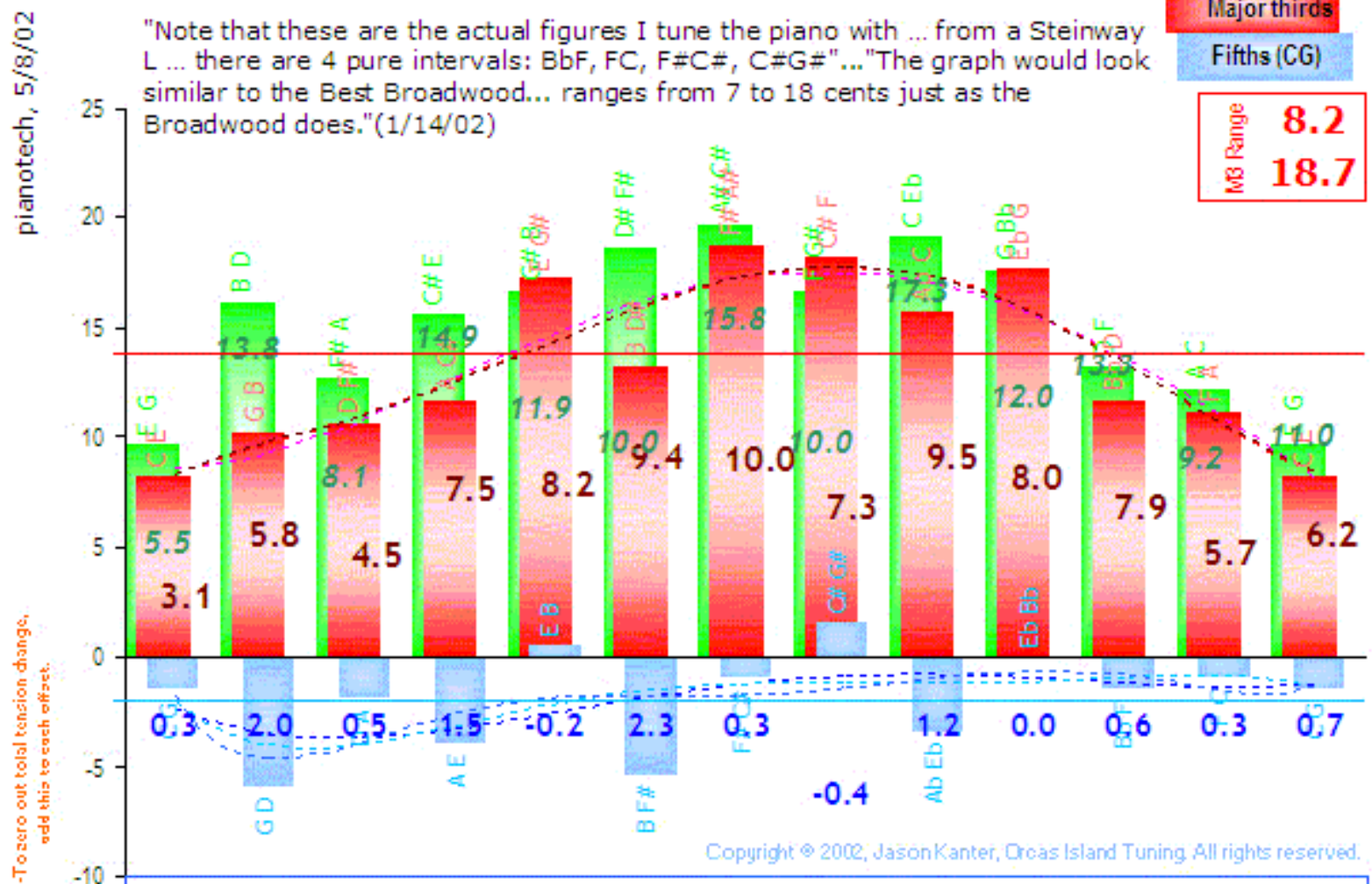


	+3.20 CEG	+4.10 GBD	+1.20 DF#A	0.00 AC#E	-0.90 EG#B	+1.60 BD#F#	-0.70 F#A#C#	+0.70 C#FG#	+2.90 AbCEb	+1.60 EbGBb	+1.10 BbDF	+2.00 FAC	+3.20 CEG
m3 ¢	10.64	16.04	14.94	17.24	16.94	17.94	16.04	14.74	17.24	18.64	14.84	12.44	10.64
M3 ¢	9.59	11.19	11.79	14.39	17.49	13.69	15.49	14.99	13.99	16.19	13.79	11.69	9.59
5th ¢	-1.06	-4.86	-3.16	-2.86	0.54	-4.26	-0.56	0.24	-3.26	-2.46	-1.06	-0.76	-1.06
M3 bps	3.64	6.37	5.02	9.18	8.36	9.81	8.31	6.03	8.44	7.31	9.32	5.92	7.28
m3 bps	6.06	13.68	9.53	16.49	12.15	9.63	12.91	8.89	15.58	12.62	15.05	9.45	12.11
5th bps	0.24	1.65	0.80	1.09	-0.16	1.82	0.18	-0.06	1.17	0.66	0.43	0.23	0.48



	+3.80 CEG	+3.11 GBD	+0.86 DF#A	0.00 AC#E	-1.98 EG#B	-0.03 BD#F#	-0.12 F#A#C#	+1.84 C#FG#	+3.79 AbCEb	+1.06 EbGBb	-0.11 BbDF	+1.84 FAC	+3.80 CEG
m3 ¢	10.55	14.76	15.52	19.46	19.46	16.82	13.69	13.69	18.38	18.86	14.66	11.84	10.55
M3 ¢	7.91	10.55	12.71	15.52	19.46	14.78	13.69	13.69	13.69	15.73	14.66	11.84	7.91
5th ¢	-2.64	-4.21	-2.81	-3.94	0.00	-2.05	0.00	0.00	-4.68	-3.13	0.00	0.00	-2.64
M3 bps	3.00	6.00	5.41	9.91	9.31	10.58	7.34	5.51	8.26	7.11	9.91	6.00	6.00
m3 bps	6.00	12.58	9.91	18.61	13.96	9.03	11.02	8.26	16.61	12.77	14.86	9.00	12.00
5th bps	0.60	1.43	0.72	1.50	0.00	0.87	0.00	0.00	1.69	0.84	0.00	0.00	1.20

Bremmer's EBVT as tuned "High inharmonicity" (5/8/02)



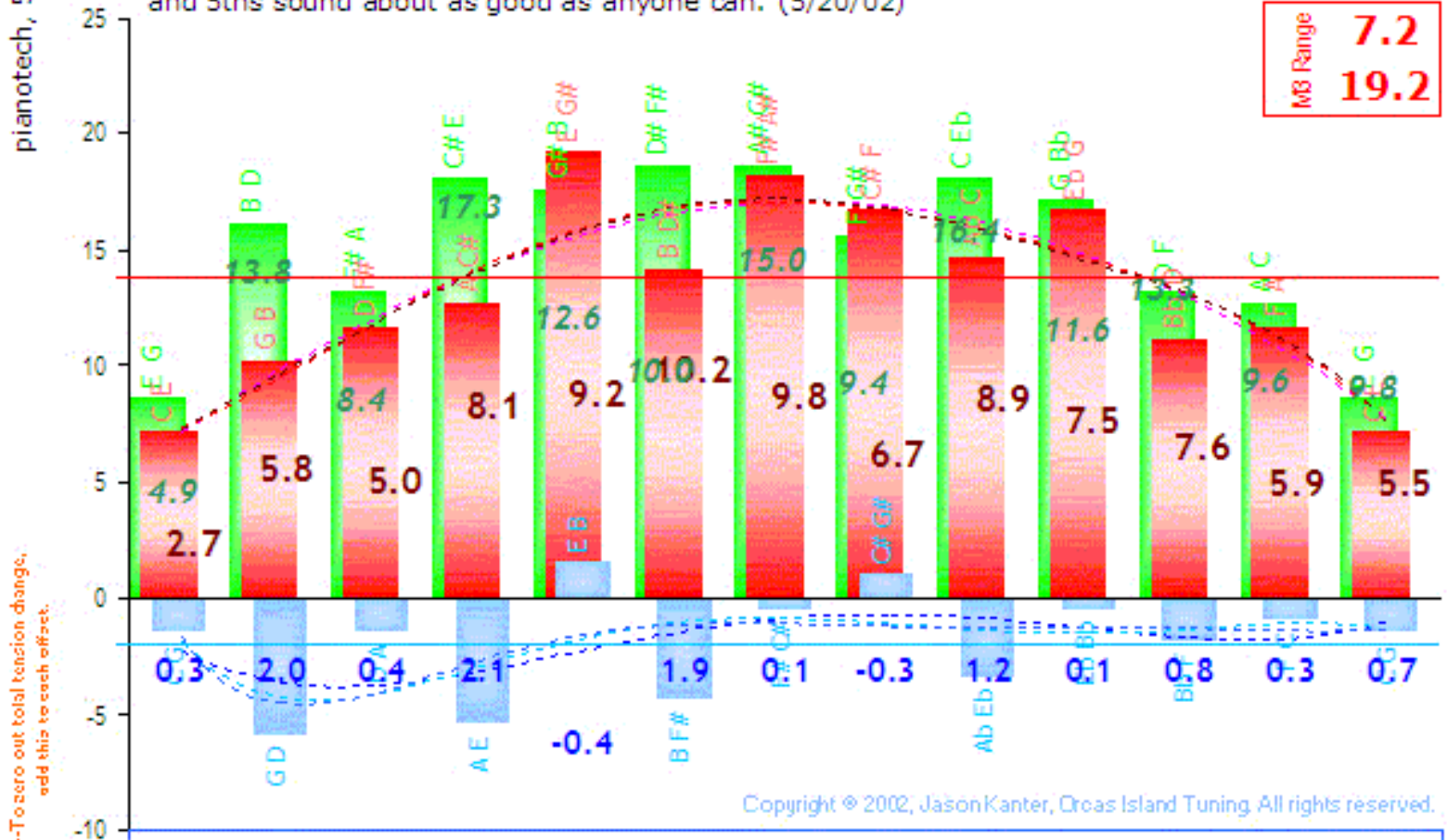
	+3.50 CEG	+4.00 GBD	0.00 DF#A	0.00 AC#E	-2.00 EG#B	+0.50 BD#F#	-3.00 F#A#C#	-2.00 C#FG#	+1.50 AbCEb	0.00 EbGBb	+2.00 BbDF	+2.50 FAC	+3.50 CEG
m3 ¢	9.64	16.14	12.64	15.64	16.64	18.64	19.64	16.64	19.14	17.64	13.14	12.14	9.64
M3 ¢	8.19	10.19	10.69	11.69	17.19	13.19	18.69	18.19	15.69	17.69	11.69	11.19	8.19
5th ¢	-1.46	-5.96	-1.96	-3.96	0.54	-5.46	-0.96	1.54	-3.46	0.04	-1.46	-0.96	-1.46
M3 bps	3.11	5.80	4.55	7.45	8.21	9.44	10.02	7.31	9.46	7.99	7.90	5.67	6.21
m3 bps	5.49	13.75	8.06	14.94	11.93	10.00	15.79	10.04	17.30	11.95	13.32	9.22	10.97
5th bps	0.33	2.02	0.50	1.51	-0.16	2.33	0.31	-0.37	1.24	-0.01	0.59	0.29	0.66

Bremmer's EBVT "Moderate inharmonicity" (5/8/02)

Minor thirds
Major thirds
Fifths (CG)

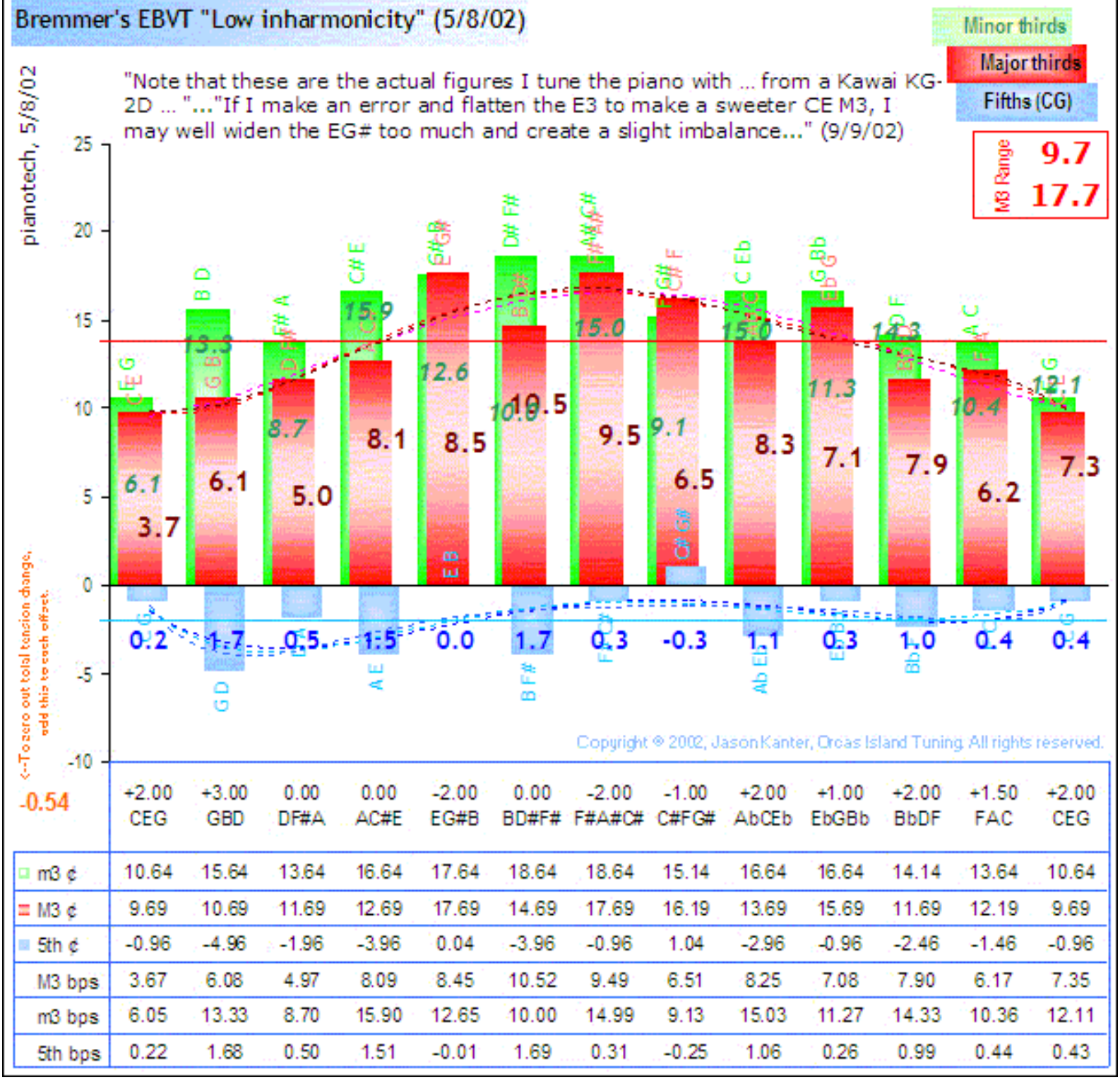
"Note that these are the actual figures I tune the piano with ... a Walter grand ... there are 4 pure intervals: BbF, FC, F#C#, C#G#"..."I can make all my 4ths and 5ths sound about as good as anyone can."(5/20/02)

M3 Range 7.2 19.2

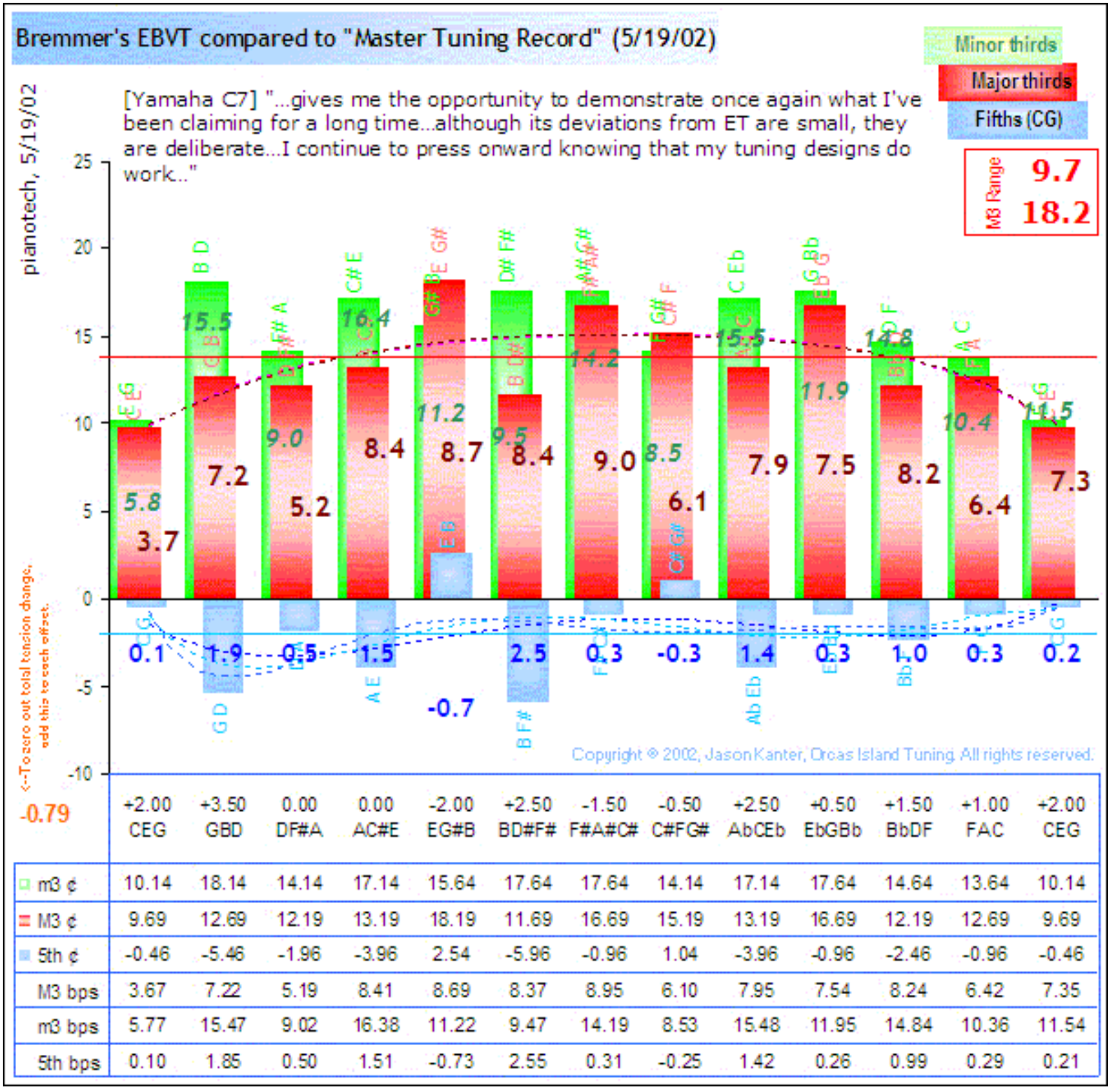


	+3.00 CEG	+3.50 GBD	-0.50 DF#A	0.00 AC#E	-3.50 EG#B	0.00 BD#F#	-2.50 F#A#C#	-1.00 C#FG#	+2.00 AbCEb	+0.50 EbGBb	+2.00 BbDF	+2.00 FAC	+3.00 CEG
m3 ¢	8.64	16.14	13.14	18.14	17.64	18.64	18.64	15.64	18.14	17.14	13.14	12.64	8.64
M3 ¢	7.19	10.19	11.69	12.69	19.19	14.19	18.19	16.69	14.69	16.69	11.19	11.69	7.19
5th ¢	-1.46	-5.96	-1.46	-5.46	1.54	-4.46	-0.46	1.04	-3.46	-0.46	-1.96	-0.96	-1.46
M3 bps	2.73	5.79	4.97	8.09	9.16	10.16	9.75	6.71	8.86	7.54	7.56	5.92	5.45
m3 bps	4.91	13.75	8.38	17.33	12.65	10.00	14.99	9.43	16.39	11.61	13.32	9.60	9.83
5th bps	0.33	2.02	0.37	2.08	-0.44	1.90	0.15	-0.25	1.24	0.12	0.79	0.29	0.66

Bremmer's EBVT "Low inharmonicity" (5/8/02)

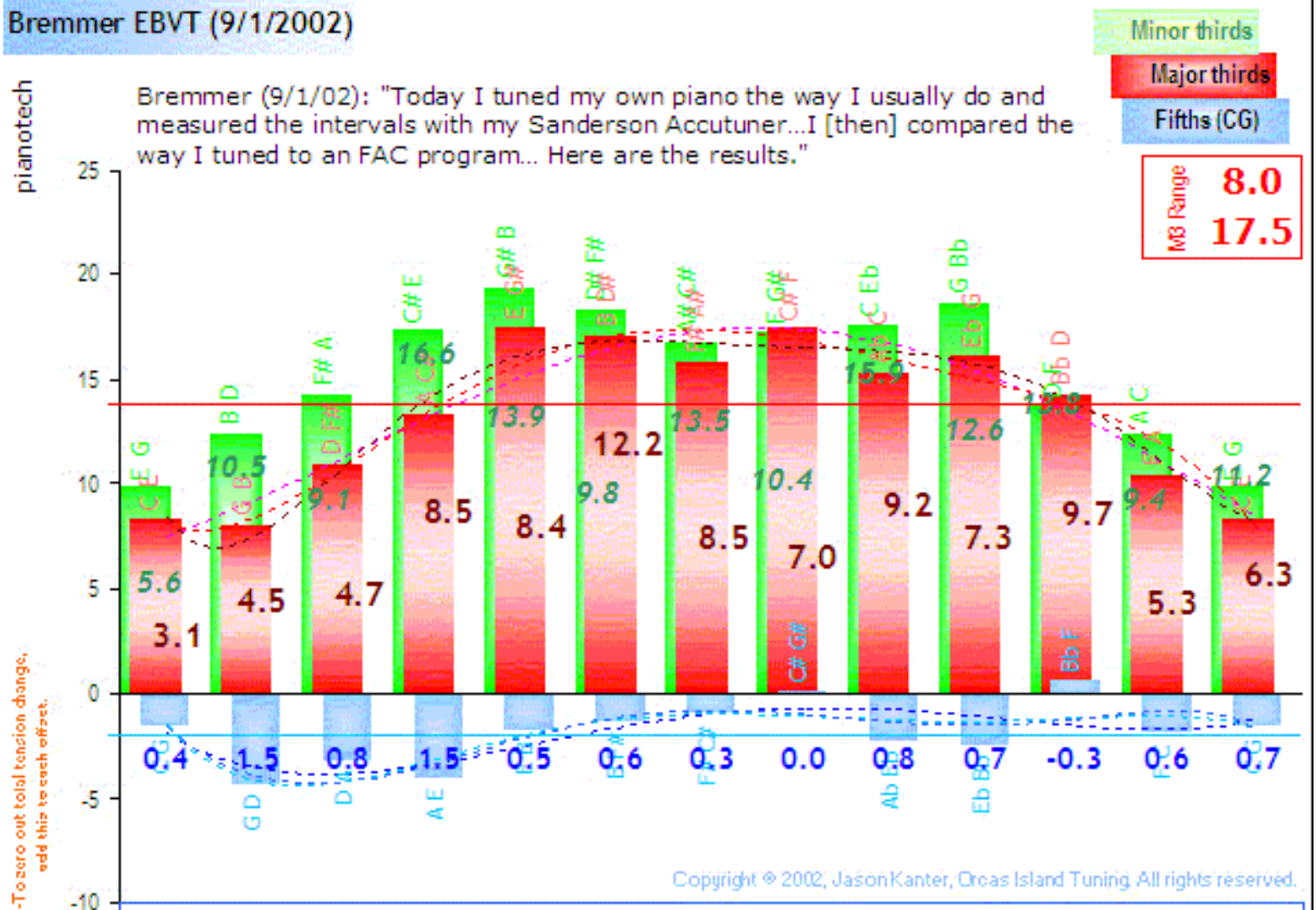


	+2.00 CEG	+3.00 GBD	0.00 DF#A	0.00 AC#E	-2.00 EG#B	0.00 BD#F#	-2.00 F#A#C#	-1.00 C#FG#	+2.00 AbCEb	+1.00 EbGBb	+2.00 BbDF	+1.50 FAC	+2.00 CEG
m3 ¢	10.64	15.64	13.64	16.64	17.64	18.64	18.64	15.14	16.64	16.64	14.14	13.64	10.64
M3 ¢	9.69	10.69	11.69	12.69	17.69	14.69	17.69	16.19	13.69	15.69	11.69	12.19	9.69
5th ¢	-0.96	-4.96	-1.96	-3.96	0.04	-3.96	-0.96	1.04	-2.96	-0.96	-2.46	-1.46	-0.96
M3 bps	3.67	6.08	4.97	8.09	8.45	10.52	9.49	6.51	8.25	7.08	7.90	6.17	7.35
m3 bps	6.05	13.33	8.70	15.90	12.65	10.00	14.99	9.13	15.03	11.27	14.33	10.36	12.11
5th bps	0.22	1.68	0.50	1.51	-0.01	1.69	0.31	-0.25	1.06	0.26	0.99	0.44	0.43



	+2.00 CEG	+3.50 GBD	0.00 DF#A	0.00 AC#E	-2.00 EG#B	+2.50 BD#F#	-1.50 F#A#C#	-0.50 C#FG#	+2.50 AbCEb	+0.50 EbGBb	+1.50 BbDF	+1.00 FAC	+2.00 CEG
m3 ¢	10.14	18.14	14.14	17.14	15.64	17.64	17.64	14.14	17.14	17.64	14.64	13.64	10.14
M3 ¢	9.69	12.69	12.19	13.19	18.19	11.69	16.69	15.19	13.19	16.69	12.19	12.69	9.69
5th ¢	-0.46	-5.46	-1.96	-3.96	2.54	-5.96	-0.96	1.04	-3.96	-0.96	-2.46	-0.96	-0.46
M3 bps	3.67	7.22	5.19	8.41	8.69	8.37	8.95	6.10	7.95	7.54	8.24	6.42	7.35
m3 bps	5.77	15.47	9.02	16.38	11.22	9.47	14.19	8.53	15.48	11.95	14.84	10.36	11.54
5th bps	0.10	1.85	0.50	1.51	-0.73	2.55	0.31	-0.25	1.42	0.26	0.99	0.29	0.21

Bremmer EBVT (9/1/2002)

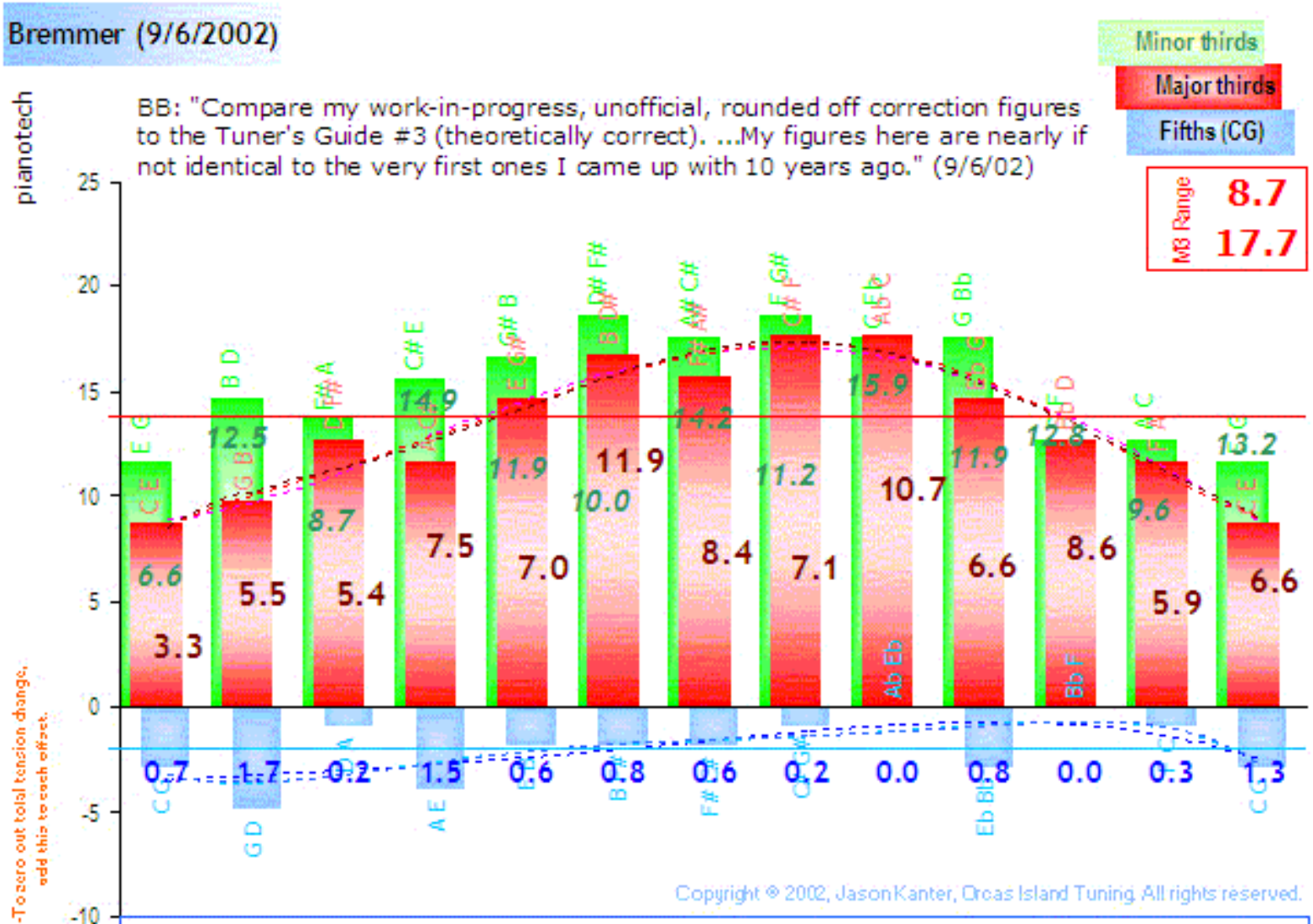


	+3.30 CEG	+3.70 GBD	+1.30 DF#A	0.00 AC#E	-2.10 EG#B	-2.00 BD#F#	-1.40 F#A#C#	-0.40 C#FG#	+1.70 AbCEb	+1.30 EbGBb	+0.70 BbDF	+3.30 FAC	+3.30 CEG
m3 ¢	9.84	12.34	14.24	17.34	19.34	18.34	16.74	17.24	17.64	18.64	13.64	12.34	9.84
M3 ¢	8.29	7.99	10.99	13.29	17.49	16.99	15.79	17.39	15.29	16.09	14.29	10.39	8.29
5th ¢	-1.56	-4.36	-3.26	-4.06	-1.86	-1.36	-0.96	0.14	-2.36	-2.56	0.64	-1.96	-1.56
M3 bps	3.14	4.54	4.68	8.47	8.36	12.16	8.47	6.99	9.22	7.27	9.66	5.26	6.29
m3 bps	5.60	10.51	9.09	16.57	13.86	9.84	13.46	10.40	15.94	12.62	13.84	9.38	11.20
5th bps	0.35	1.48	0.83	1.54	0.53	0.58	0.31	-0.03	0.85	0.69	-0.26	0.59	0.71

Bremmer (9/6/2002)

pianotech

BB: "Compare my work-in-progress, unofficial, rounded off correction figures to the Tuner's Guide #3 (theoretically correct). ...My figures here are nearly if not identical to the very first ones I came up with 10 years ago." (9/6/02)



	+3.00 CEG	+2.00 GBD	-1.00 DF#A	0.00 AC#E	-2.00 EG#B	-2.00 BD#F#	-2.00 F#A#C#	-2.00 C#FG#	-1.00 AbCEb	+1.00 EbGBb	0.00 BbDF	+2.00 FAC	+3.00 CEG
m3 ¢	11.64	14.64	13.64	15.64	16.64	18.64	17.64	18.64	17.64	17.64	12.64	12.64	11.64
M3 ¢	8.69	9.69	12.69	11.69	14.69	16.69	15.69	17.69	17.69	14.69	12.69	11.69	8.69
5th ¢	-2.96	-4.96	-0.96	-3.96	-1.96	-1.96	-1.96	-0.96	0.04	-2.96	0.04	-0.96	-2.96
M3 bps	3.30	5.50	5.40	7.45	7.01	11.94	8.41	7.11	10.66	6.63	8.57	5.92	6.59
m3 bps	6.62	12.46	8.70	14.94	11.91	10.00	14.18	11.23	15.94	11.94	12.81	9.60	13.24
5th bps	0.67	1.68	0.24	1.51	0.56	0.84	0.63	0.23	-0.02	0.80	-0.02	0.29	1.34

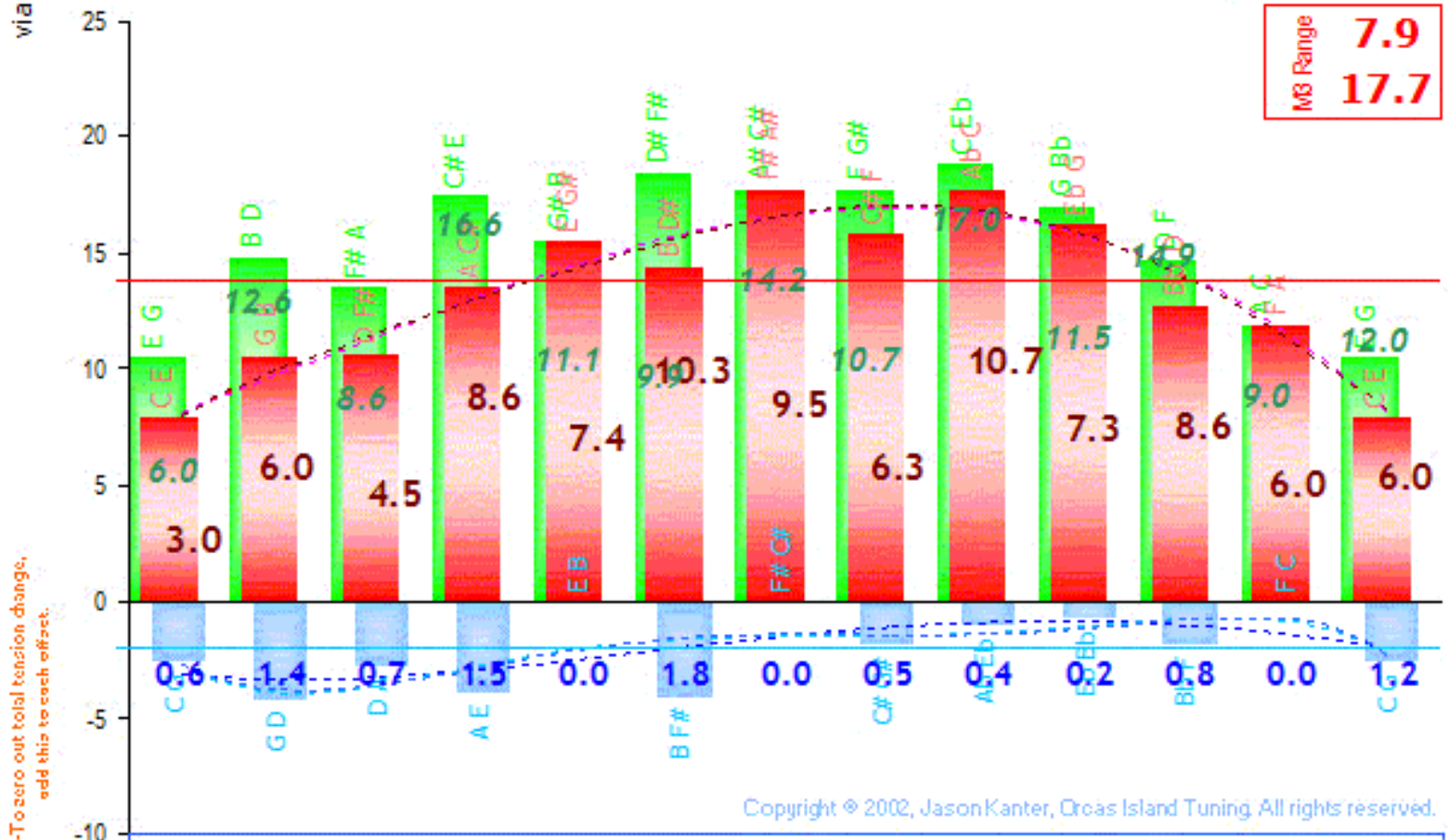
EBVT of 9/23/02

Minor thirds
Major thirds
Fifths (CG)

via email

"This kills two of my pure 5ths... widens the F# 3rd & Ab 3rd & narrows the E & Bb 3rds to hopefully correct the imbalances." (9/23/02)

M3 Range 7.9 17.7



<--To zero out total tension change, add this to each offset.

-0.62

	+3.80 CEG	+3.11 GBD	+0.86 DF#A	0.00 AC#E	-1.98 EG#B	-0.03 BD#F#	-2.17 F#A#C#	-0.22 C#FG#	-0.22 AbCEb	+0.63 EbGBb	+1.84 BbDF	+1.84 FAC	+3.80 CEG
m3 ¢	10.55	14.75	13.47	17.40	15.45	18.44	17.70	17.70	18.81	16.91	14.66	11.84	10.55
M3 ¢	7.91	10.55	10.66	13.47	15.45	14.35	17.70	15.75	17.71	16.17	12.71	11.85	7.91
5th ¢	-2.65	-4.21	-2.82	-3.94	-0.01	-4.10	-0.01	-1.96	-1.11	-0.75	-1.96	0.00	-2.65
M3 bps	3.00	6.00	4.54	8.59	7.38	10.27	9.49	6.33	10.67	7.30	8.59	6.00	6.00
m3 bps	6.00	12.57	8.59	16.63	11.07	9.89	14.24	10.67	17.00	11.45	14.87	9.00	12.00
5th bps	0.60	1.43	0.72	1.50	0.00	1.75	0.00	0.47	0.40	0.20	0.79	0.00	1.20

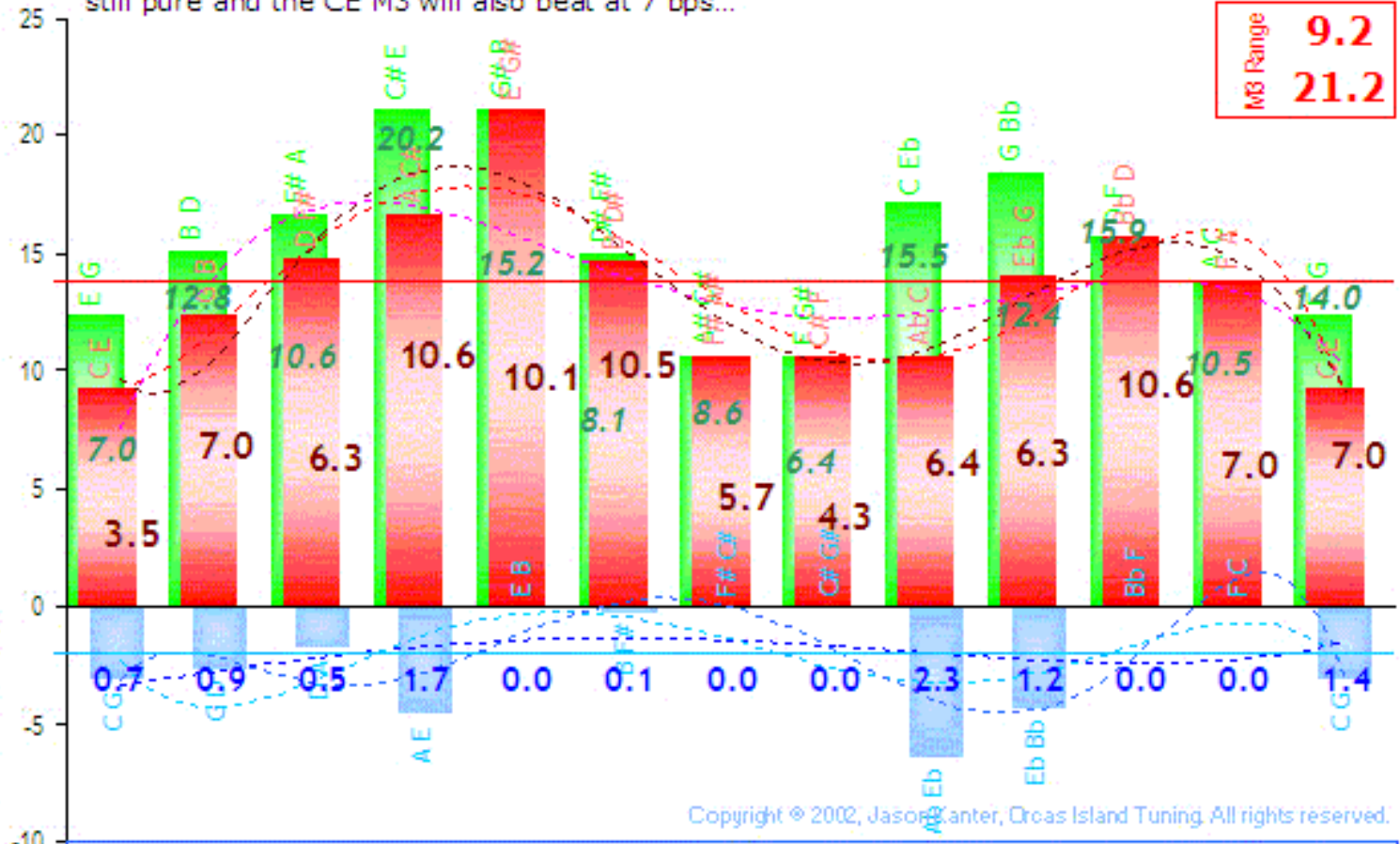
EBVT starting at 7 beats

Minor thirds
Major thirds
Fifths (CG)

excel calc

Bremmer (8/18/02): "I have even been able to ... create a Quasi-Equal Temperament by setting the initial FA M3 at 7 beats per second. The FC 5th is still pure and the CE M3 will also beat at 7 bps..."

M3 Range 9.2 21.2



	+1.82 CEG	+0.68 GBD	-0.12 DF#A	-0.00 AC#E	-2.64 EG#B	-0.69 BD#F#	+0.93 F#A#C#	+2.89 C#FG#	+4.84 AbCEb	+0.30 EbGBb	-2.09 BbDF	-0.14 FAC	+1.82 CEG
m3 ¢	12.32	15.07	16.57	21.17	21.17	15.01	10.66	10.66	17.16	18.42	15.66	13.83	12.32
M3 ¢	9.23	12.32	14.73	16.57	21.17	14.67	10.66	10.66	10.66	14.07	15.66	13.83	9.23
5th ¢	-3.09	-2.75	-1.84	-4.60	0.00	-0.34	0.00	0.00	-6.50	-4.35	0.00	0.00	-3.09
M3 bps	3.50	7.00	6.27	10.58	10.12	10.50	5.72	4.29	6.43	6.35	10.58	7.00	7.00
m3 bps	7.00	12.84	10.58	20.24	15.18	8.06	8.58	6.43	15.50	12.45	15.87	10.50	14.00
5th bps	0.70	0.93	0.47	1.75	0.00	0.14	0.00	0.00	2.34	1.17	0.00	0.00	1.40

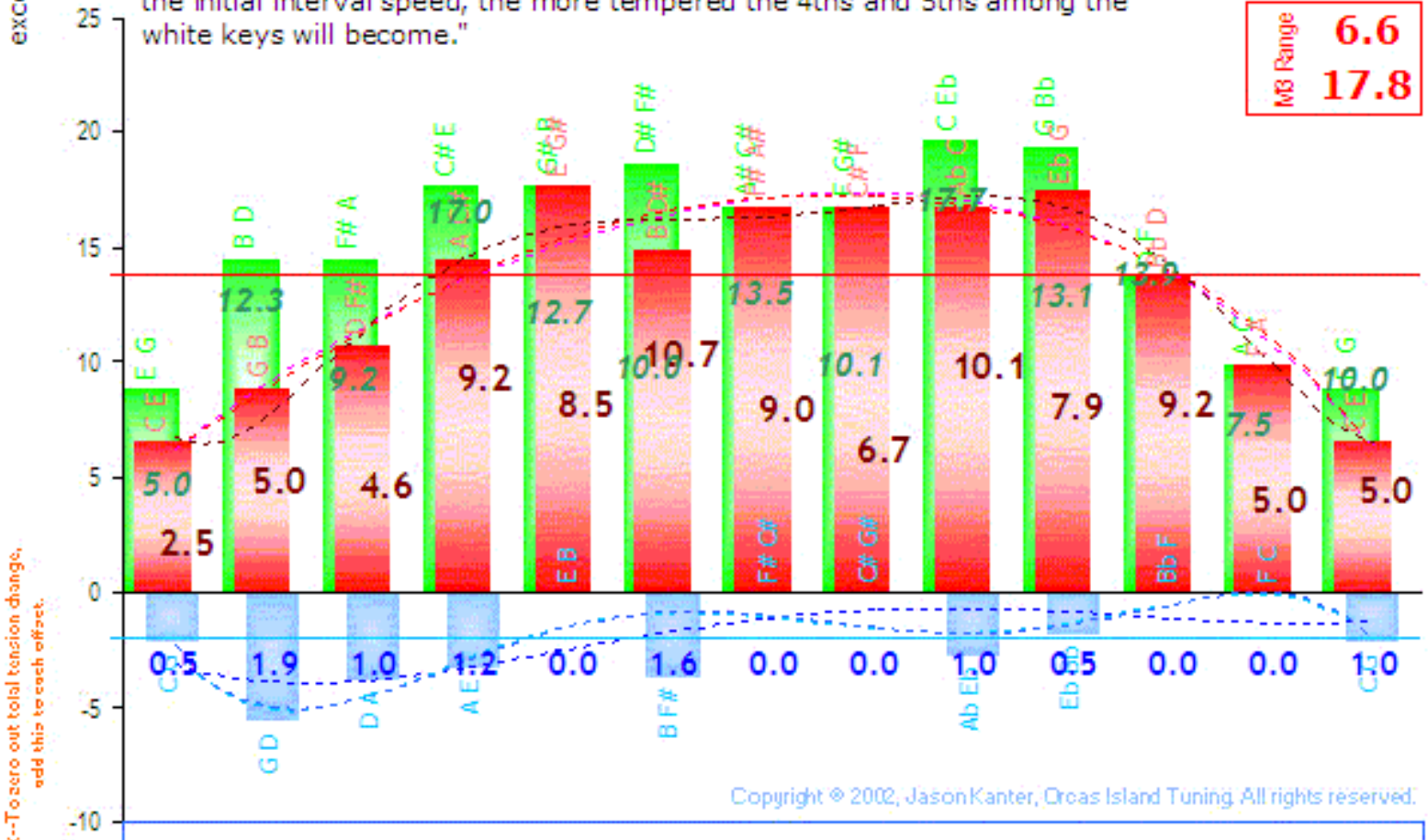
EBVT starting at 5 beats

Minor thirds
Major thirds
Fifths (CG)

excel calc

Bremmer (8/18/02): "There is always room for variations. I can set that first interval at 5 beats per second and as slow as 4 beats per second ... the slower the initial interval speed, the more tempered the 4ths and 5ths among the white keys will become."

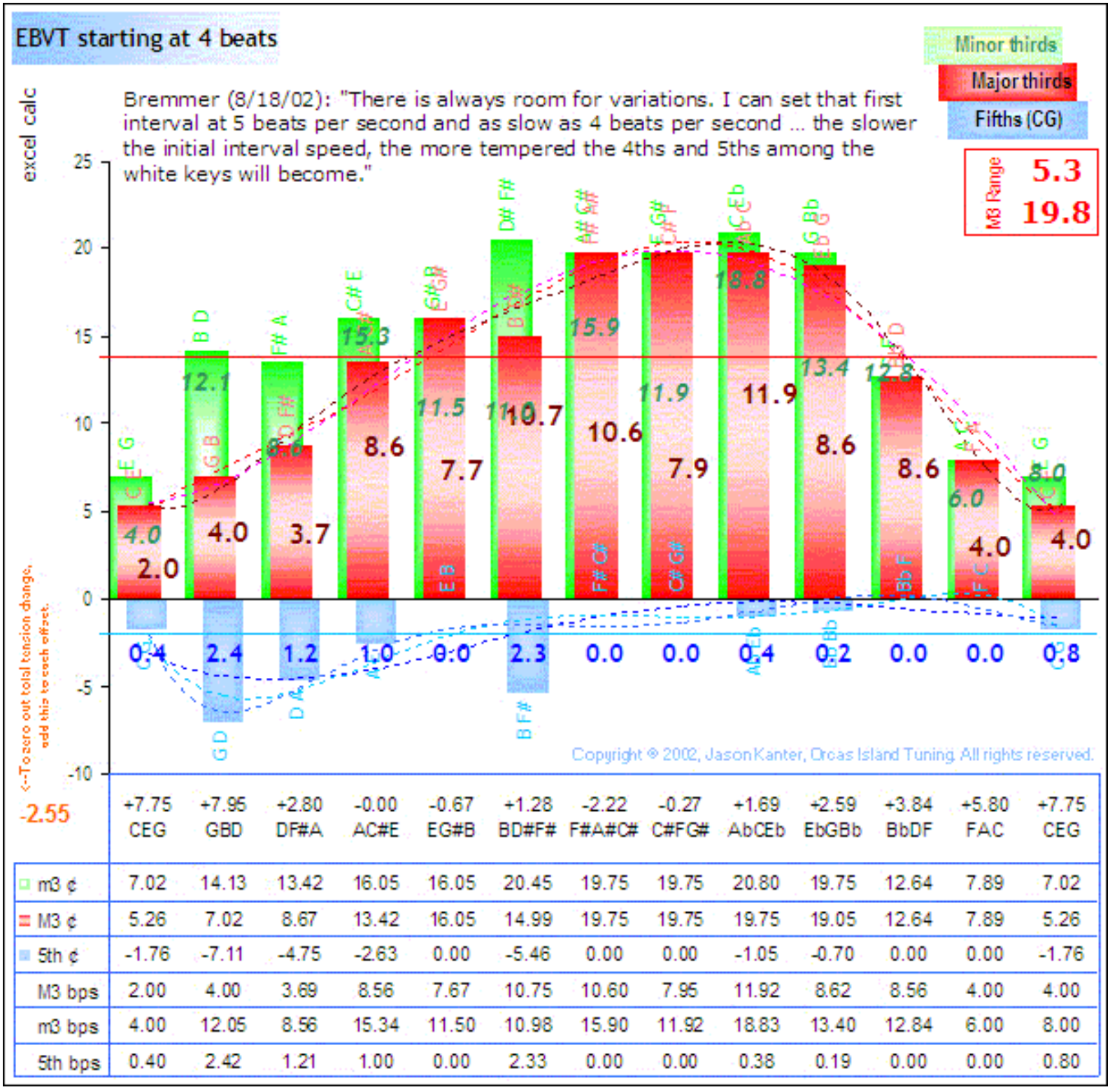
M3 Range 6.6 17.8



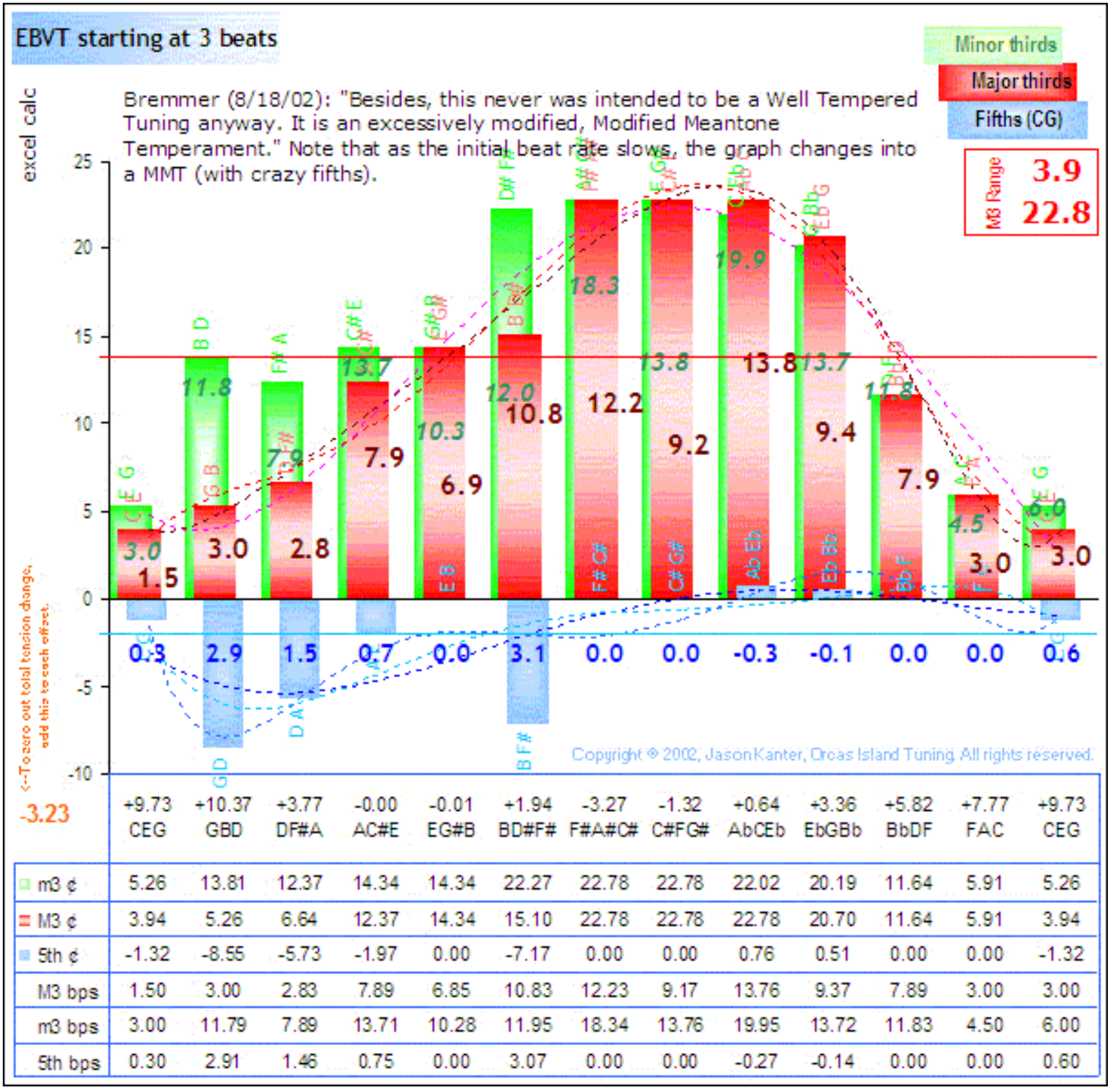
<--To zero out total tension change, add this to each offset.

-1.86

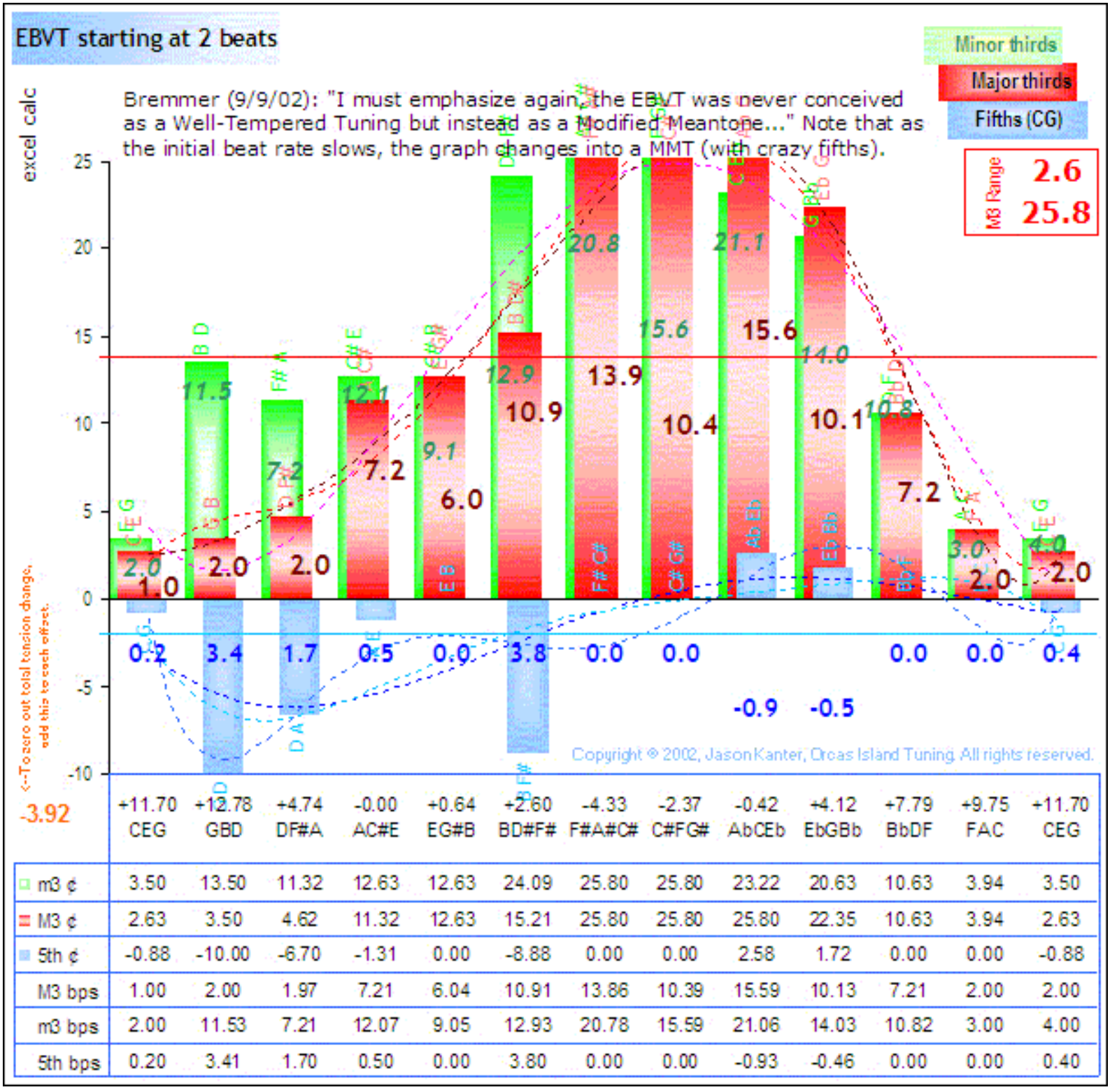
	+5.78 CEG	+5.53 GBD	+1.83 DF#A	-0.00 AC#E	-1.33 EG#B	+0.63 BD#F#	-1.17 F#A#C#	+0.78 C#FG#	+2.74 AbCEb	+1.83 EbGBb	+1.87 BbDF	+3.82 FAC	+5.78 CEG
m3 ¢	8.78	14.44	14.47	17.75	17.75	18.64	16.72	16.72	19.59	19.31	13.65	9.86	8.78
M3 ¢	6.58	8.78	10.69	14.47	17.75	14.88	16.72	16.72	16.72	17.39	13.65	9.86	6.58
5th ¢	-2.20	-5.66	-3.78	-3.28	0.00	-3.75	0.00	0.00	-2.87	-1.91	0.00	0.00	-2.20
M3 bps	2.50	5.00	4.55	9.23	8.49	10.67	8.97	6.73	10.09	7.86	9.23	5.00	5.00
m3 bps	5.00	12.31	9.23	16.97	12.73	10.01	13.46	10.09	17.72	13.08	13.85	7.50	10.00
5th bps	0.50	1.92	0.96	1.25	0.00	1.60	0.00	0.00	1.03	0.52	0.00	0.00	1.00



	+7.75 CEG	+7.95 GBD	+2.80 DF#A	-0.00 AC#E	-0.67 EG#B	+1.28 BD#F#	-2.22 F#A#C#	-0.27 C#FG#	+1.69 AbCEb	+2.59 EbGBb	+3.84 BbDF	+5.80 FAC	+7.75 CEG
m3 ¢	7.02	14.13	13.42	16.05	16.05	20.45	19.75	19.75	20.80	19.75	12.64	7.89	7.02
M3 ¢	5.26	7.02	8.67	13.42	16.05	14.99	19.75	19.75	19.75	19.05	12.64	7.89	5.26
5th ¢	-1.76	-7.11	-4.75	-2.63	0.00	-5.46	0.00	0.00	-1.05	-0.70	0.00	0.00	-1.76
M3 bps	2.00	4.00	3.69	8.56	7.67	10.75	10.60	7.95	11.92	8.62	8.56	4.00	4.00
m3 bps	4.00	12.05	8.56	15.34	11.50	10.98	15.90	11.92	18.83	13.40	12.84	6.00	8.00
5th bps	0.40	2.42	1.21	1.00	0.00	2.33	0.00	0.00	0.38	0.19	0.00	0.00	0.80

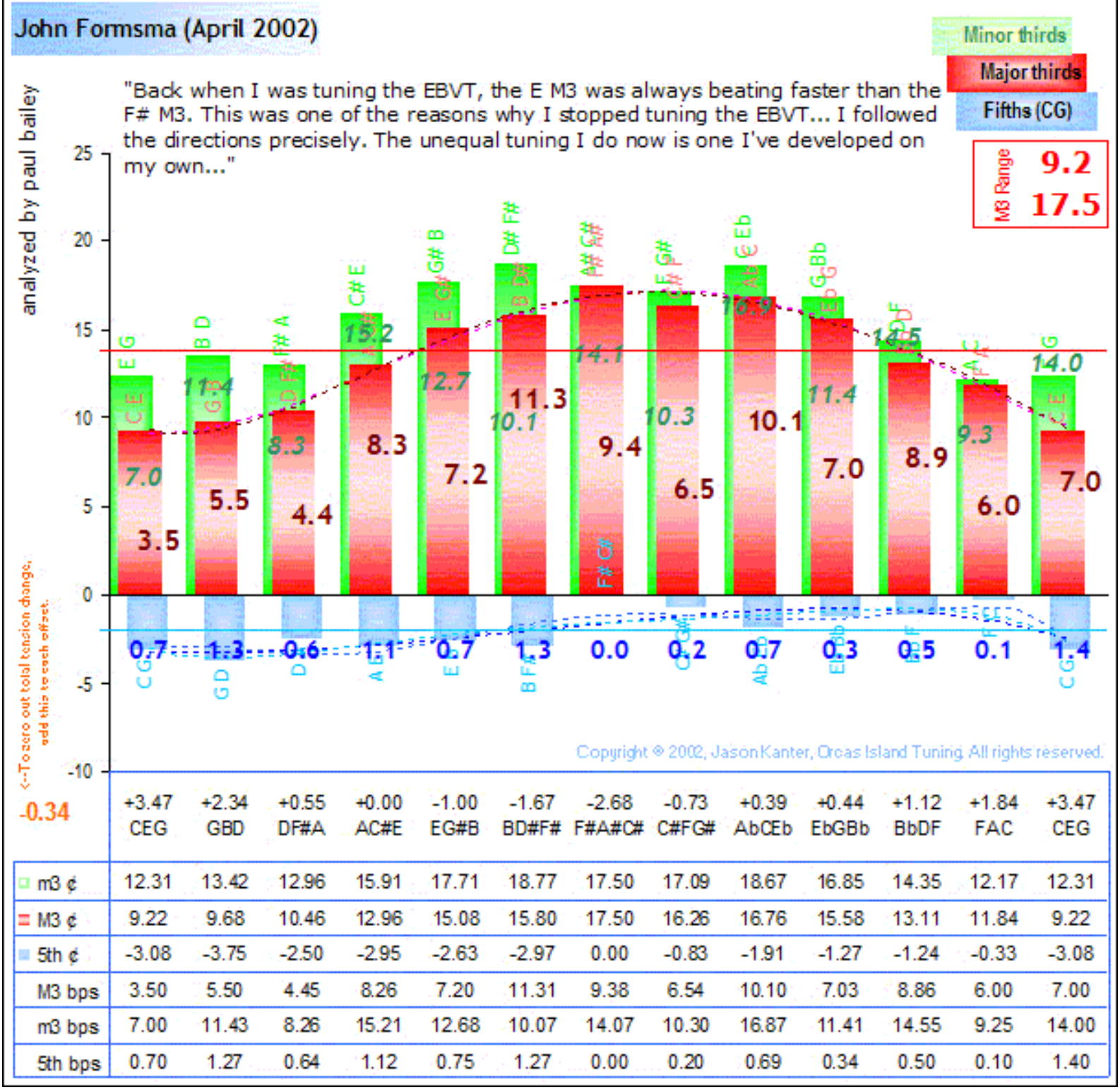


	+9.73 CEG	+10.37 GBD	+3.77 DF#A	-0.00 AC#E	-0.01 EG#B	+1.94 BD#F#	-3.27 F#A#C#	-1.32 C#FG#	+0.64 AbCEb	+3.36 EbGBb	+5.82 BbDF	+7.77 FAC	+9.73 CEG
m3 ¢	5.26	13.81	12.37	14.34	14.34	22.27	22.78	22.78	22.02	20.19	11.64	5.91	5.26
M3 ¢	3.94	5.26	6.64	12.37	14.34	15.10	22.78	22.78	22.78	20.70	11.64	5.91	3.94
5th ¢	-1.32	-8.55	-5.73	-1.97	0.00	-7.17	0.00	0.00	0.76	0.51	0.00	0.00	-1.32
M3 bps	1.50	3.00	2.83	7.89	6.85	10.83	12.23	9.17	13.76	9.37	7.89	3.00	3.00
m3 bps	3.00	11.79	7.89	13.71	10.28	11.95	18.34	13.76	19.95	13.72	11.83	4.50	6.00
5th bps	0.30	2.91	1.46	0.75	0.00	3.07	0.00	0.00	-0.27	-0.14	0.00	0.00	0.60



	+11.70 CEG	+12.78 GBD	+4.74 DF#A	-0.00 AC#E	+0.64 EG#B	+2.60 BD#F#	-4.33 F#A#C#	-2.37 C#FG#	-0.42 AbCEb	+4.12 EbGBb	+7.79 BbDF	+9.75 FAC	+11.70 CEG
m3 ¢	3.50	13.50	11.32	12.63	12.63	24.09	25.80	25.80	23.22	20.63	10.63	3.94	3.50
M3 ¢	2.63	3.50	4.62	11.32	12.63	15.21	25.80	25.80	25.80	22.35	10.63	3.94	2.63
5th ¢	-0.88	-10.00	-6.70	-1.31	0.00	-8.88	0.00	0.00	2.58	1.72	0.00	0.00	-0.88
M3 bps	1.00	2.00	1.97	7.21	6.04	10.91	13.86	10.39	15.59	10.13	7.21	2.00	2.00
m3 bps	2.00	11.53	7.21	12.07	9.05	12.93	20.78	15.59	21.06	14.03	10.82	3.00	4.00
5th bps	0.20	3.41	1.70	0.50	0.00	3.80	0.00	0.00	-0.93	-0.46	0.00	0.00	0.40

John Formsma (April 2002)



	+3.47 CEG	+2.34 GBD	+0.55 DF#A	+0.00 AC#E	-1.00 EG#B	-1.67 BD#F#	-2.68 F#A#C#	-0.73 C#FG#	+0.39 AbCEb	+0.44 EbGBb	+1.12 BbDF	+1.84 FAC	+3.47 CEG
m3 ¢	12.31	13.42	12.96	15.91	17.71	18.77	17.50	17.09	18.67	16.85	14.35	12.17	12.31
M3 ¢	9.22	9.68	10.46	12.96	15.08	15.80	17.50	16.26	16.76	15.58	13.11	11.84	9.22
5th ¢	-3.08	-3.75	-2.50	-2.95	-2.63	-2.97	0.00	-0.83	-1.91	-1.27	-1.24	-0.33	-3.08
M3 bps	3.50	5.50	4.45	8.26	7.20	11.31	9.38	6.54	10.10	7.03	8.86	6.00	7.00
m3 bps	7.00	11.43	8.26	15.21	12.68	10.07	14.07	10.30	16.87	11.41	14.55	9.25	14.00
5th bps	0.70	1.27	0.64	1.12	0.75	1.27	0.00	0.20	0.69	0.34	0.50	0.10	1.40

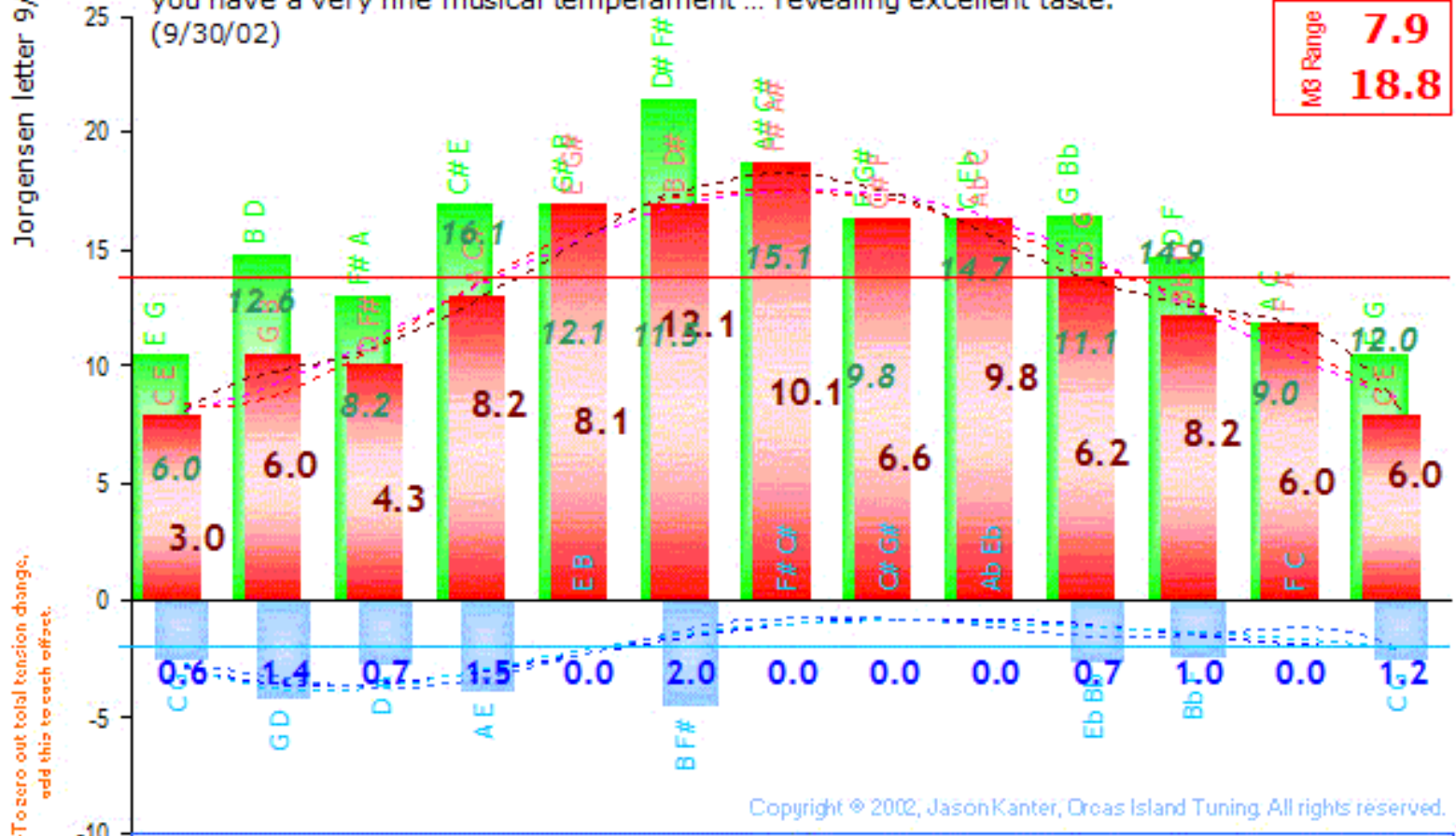
Jorgensen's Improved EBVT

Minor thirds
Major thirds
Fifths (CG)

M3 Range 7.9 18.8

Jorgensen letter 9/30/02

Jorgensen confirmed two suggestions from BB to correct the imbalance: sharpen Bb and D# slightly. Jorgensen: "the harmonic balance is wonderful and you have a very fine musical temperament ... revealing excellent taste." (9/30/02)



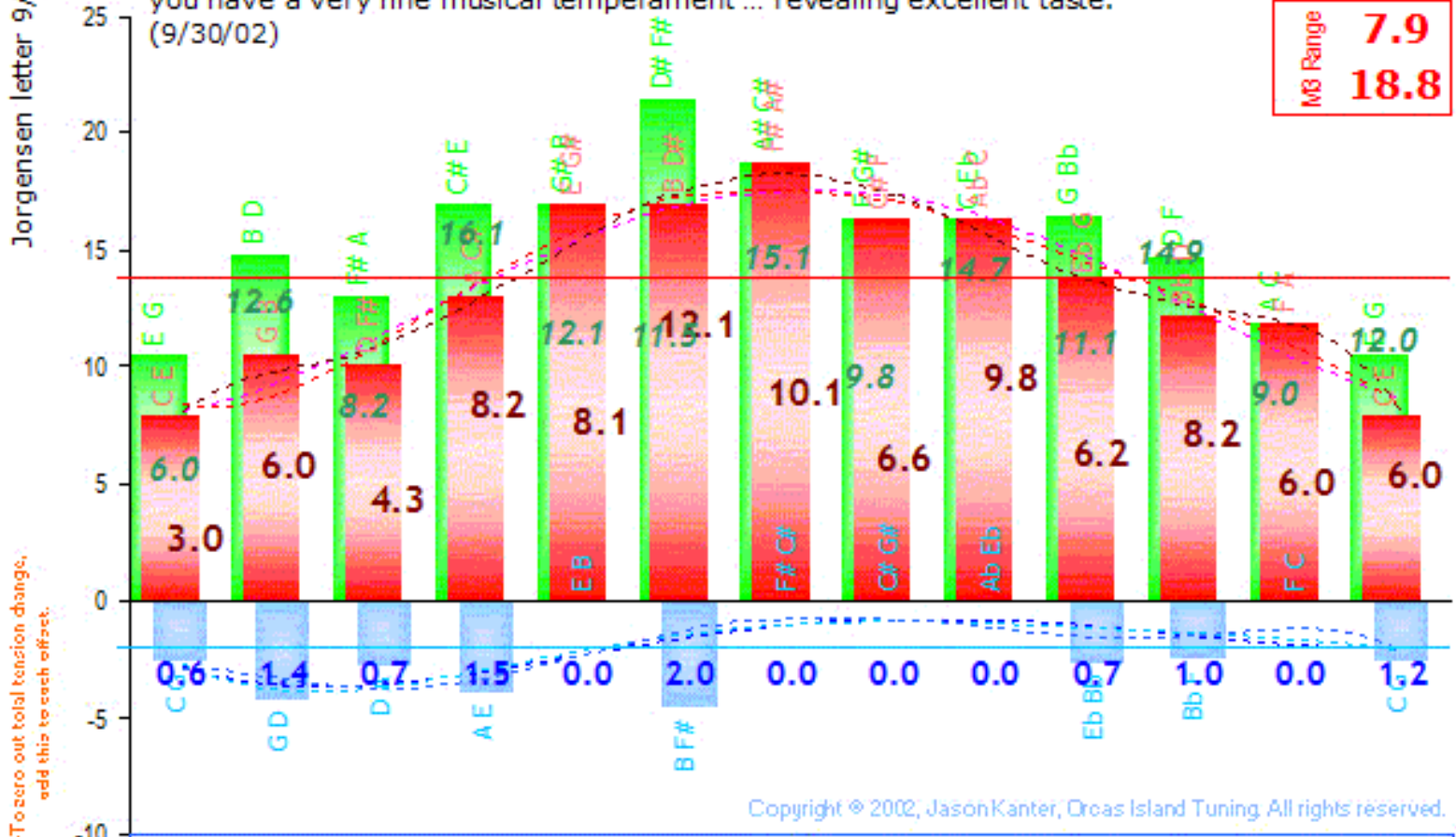
	+3.80 CEG	+3.11 GBD	+0.86 DF#A	0.00 AC#E	-1.98 EG#B	-0.03 BD#F#	-2.72 F#A#C#	-0.77 C#FG#	+1.19 AbCEb	+3.14 EbGBb	+2.36 BbDF	+1.84 FAC	+3.80 CEG
m3 ¢	10.55	14.76	12.92	16.86	16.86	21.51	18.77	16.29	16.29	16.39	14.66	11.84	10.55
M3 ¢	7.91	10.55	10.11	12.92	16.86	16.86	18.77	16.29	16.29	13.65	12.18	11.84	7.91
5th ¢	-2.64	-4.21	-2.81	-3.94	0.00	-4.65	0.00	0.00	0.00	-2.74	-2.47	0.00	-2.64
M3 bps	3.00	6.00	4.30	8.24	8.05	12.08	10.07	6.55	9.83	6.17	8.24	6.00	6.00
m3 bps	6.00	12.58	8.24	16.11	12.08	11.54	15.10	9.83	14.74	11.10	14.86	9.00	12.00
5th bps	0.60	1.43	0.71	1.50	0.00	1.99	0.00	0.00	0.00	0.74	1.00	0.00	1.20

Jorgensen's Improved EBVT

Minor thirds
Major thirds
Fifths (CG)

M3 Range 7.9 18.8

Jorgensen confirmed two suggestions from BB to correct the imbalance: sharpen Bb and D# slightly. Jorgensen: "the harmonic balance is wonderful and you have a very fine musical temperament ... revealing excellent taste." (9/30/02)



	+3.80 CEG	+3.11 GBD	+0.86 DF#A	0.00 AC#E	-1.98 EG#B	-0.03 BD#F#	-2.72 F#A#C#	-0.77 C#FG#	+1.19 AbCEb	+3.14 EbGBb	+2.36 BbDF	+1.84 FAC	+3.80 CEG
m3 ¢	10.55	14.76	12.92	16.86	16.86	21.51	18.77	16.29	16.29	16.39	14.66	11.84	10.55
M3 ¢	7.91	10.55	10.11	12.92	16.86	16.86	18.77	16.29	16.29	13.65	12.18	11.84	7.91
5th ¢	-2.64	-4.21	-2.81	-3.94	0.00	-4.65	0.00	0.00	0.00	-2.74	-2.47	0.00	-2.64
M3 bps	3.00	6.00	4.30	8.24	8.05	12.08	10.07	6.55	9.83	6.17	8.24	6.00	6.00
m3 bps	6.00	12.58	8.24	16.11	12.08	11.54	15.10	9.83	14.74	11.10	14.86	9.00	12.00
5th bps	0.60	1.43	0.71	1.50	0.00	1.99	0.00	0.00	0.00	0.74	1.00	0.00	1.20