What does the Well-Tempered Clavier sound like in actual well temperament?

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The Well-Tempered Clavier < https://en.wikipedia.org/wiki/The_Well-Tempered_Clavier> is a book of JS Bach compositions for keyboard instruments in each of the twelve major and twelve minor keys. The name refers to Bach's preferred tuning system, which made it possible to play (sort of) in tune in every key. This was a big deal, because in the usual tuning systems of Bach's era, only some of the keys sounded good, while others sounded horrible. The history of tuning in Western music is complicated and abstruse, and I won't go into detail about it in this post, but you can **learn some of how it works here < https://ethanhein.com/wp/2019/why-cant-you-tune-your-guitar/>** . The key facts:

1. Western tuning systems, keys and scales are based on **the natural harmonic series < https://en.wikipedia.org/wiki/Harmonic_series_(music)>** .
2. Harmonics are based on prime numbers.
3. Prime numbers don't divide into each other evenly.

The practical consequence is that **your music can either be in perfect tune, or it can use more than one key, but it can not do both < https://ethanhein.com/wp/2021/just-intonation-and-key-changes/>** . In Hindustani classical tradition, they opted for being in tune, so everything is in a single "key" defined by the omnipresent drone. Western Europeans wanted to be able to change keys, however, and that required some tuning compromises.

The main tuning system in Bach's time was called **meantone temperament < https://en.wikipedia.org/wiki/Meantone_temperament>** . This system sounds great in C major and nearby keys, but the further away you move on the **circle of fifths < https://en.wikipedia.org/wiki/Circle_of_fifths>** , the worse everything sounds. **Kyle Gann < https://en.wikipedia.org/wiki/Kyle_Gann>** helpfully illustrates this with **a recording of all twelve meantone major chords < https://www.kylegann.com/AoL6-Meantone.html>** . The recording starts with C major, which sounds beautiful. G major and D major sound okay too. However, A major and E major are queasy, and B major and F-sharp major sound horrible. If you want to know why this is, Gann explains it well in ***The Arithmetic of Listening < https://www.press.uillinois.edu/books/catalog/42gwm4em9780252042584.html>*** , well worth reading.

Given the limits of meantone, you can see why the Western world collectively abandoned it in favor of our current standard tuning system, **twelve-tone equal temperament < https://en.wikipedia.org/wiki/12_equal_temperament>** (12-TET). Rather than keeping some keys pure while making others unusable, 12-TET distributes the out-of-tuneness evenly across all of the keys. None of the keys sound perfect, but all of them are at least tolerable.

For many years, musicologists assumed that Bach wrote the Well-Tempered Clavier (WTC) as a showcase for 12-TET. However, in the past few decades, evidence has emerged showing that Bach used a different tuning system, one of the other **well temperaments < https://en.wikipedia.org/wiki/Well_temperament>** . Unfortunately, no one knows exactly what temperament system (or systems) this might have been. **Bradley Lehman < http://larips.com/>** has a theory about Bach's tuning system, and it has a slightly unhinged-sounding Da Vinci Code quality. I'm in no position to assess its validity, but it's fun to think about.

Take a look at the cover of Bach's main handwritten copy of the WTC:

Das Wohltemperirte Clavier.

oder

Præludia, und

Fugen durch alle Tone und Semitonia,
So wohl tertiam majorem oder Ut Re Mi anlan-
gend, als auch tertiam minorem od. Re
Mi Fa betreffend. Zum
Nutzen und Gebrauch der Lehrbegierigen
Musicalischen Jugend, als auch derer in diesem Stu-
dio schon habit seyenden besonderem
Zeitvertreib aufgesetzet
und verfertiget von

Johann Sebastian Bach.
p.t. Hochf. Anhalt-
Cöthenischen Capel-
Meister und Di-
rectore derer
Cammer Mu-
sicen.

Anno
1722.

< https://i0.wp.com/ethanhein.com/wp/wp-content/uploads/2020/06/wtc-1722-from-1911-grove.gif?ssl=1>

See the squiggly line across the top? Lehman thinks that it's not a decorative doodle. He thinks that it's a diagram showing the harpsichord tuning peg turns you make to change meantone temperament into Bach's tuning. **Read Lehman's papers < http://larips.com/>** for an explanation of how this works.

Whether Bach used Lehman's proposed tuning or not, he definitely used some well temperament, and it wasn't 12-TET. In well temperaments, every key is usable, but the keys do *not* all sound the same. Instead, each key has a distinct harmonic personality, with some a bit sunnier and smoother, and others darker and edgier. The point of the WTC was not, "Hey, you can play music in all the keys now because they are all interchangeable." The point was, "Hey, you can play in all the keys now, and they all sound a little different, so here's some music that takes advantage of those differences for a range of emotional effects."

So how does Lehman's proposed Bach tuning sound? Peter Watchorn used it for his recording of the WTC. The sunniness of the C major prelude is matched by its more consonant tuning, while the tragic quality of the E-flat minor prelude is matched by edgier tuning.

This sounds good, but the differences from 12-TET don’t leap out at me. It’s more helpful to be able to compare an unequal temperament with 12-TET side by side. A piano tuner named **Carl Radford < https://www.radfordpiano.com/>** made some helpful videos doing A/B comparisons of WTC pieces in 12-TET versus in **Thomas Young Well Temperament < https://en.wikipedia.org/wiki/Young_temperament>** , which is similar to Bach’s well temperament. The differences are more obvious.

I used Oddsound’s MTS-ESP tuning plugin to run a MIDI version of some of the WTC preludes through eight different tuning systems, including Lehman’s proposed tuning and various historical temperaments:

This has all been good geeky fun, but really, if you're not a harpsichordist doing historically-informed performances of Bach, should you care? I think the answer is yes. I mean, you shouldn't necessarily care about the details. But you should be aware that 12-TET is not the only tuning system in the world, that its dominance was not inevitable, that alternatives exist, and that it's worth questioning customs and standards we normally take for granted.

Tuning systems are part of the unseen infrastructure of music, the background against which you make all your creative choices. As with all the "**invisible systems < https://www.theatlantic.com/technology/archive/2017/05/gratitude-for-invisible-systems/526344/>** " of modern society, it's rare that we examine the tuning infrastructure itself, much less question it. As measured by its widespread adoption around the world, 12-TET is an incredibly successful standard, but maybe it's *too* successful. Together with Western music notation and the MIDI standard, 12-TET threatens to stamp out alternatives and regional traditions. Universal standards are convenient, but they can also be crushingly hegemonic.

When someone does venture outside of 12-TET, it can sound extremely strange. Depending on your tastes and enculturation, you might find that strangeness intriguing. However, you are more likely to find it alienating, anxiety-producing, or even nauseating. For example, try **The Well-Tuned Piano <**

https://en.wikipedia.org/wiki/The_Well-Tuned_Piano> by **La Monte Young < https://en.wikipedia.org/wiki/La_Monte_Young>** .

You don’t have to go to avant-garde composers to hear unconventional tuning. You can hear it in all kinds of pop and vernacular music too. In “Jumpin’ Jack Flash” by the Rolling Stones, the guitars are spectacularly out of tune with each other.

For more mystical tuning, check out this track from the 1981 dub classic, ***Scientist Rids the World of the Evil Curse of the Vampires*** < ***https://en.wikipedia.org/wiki/Scientist_Rids_the_World_of_the_Evil_Curse_of_the_Vampires***> .

The bassist on the original session, **Errol Holt** < **https://en.wikipedia.org/wiki/Errol_Holt**> , is playing so far out of tune that I can't believe it wasn't intentional on some level. His low E string is an entire quarter tone flat. **Bingy Bunny's** < **https://en.wikipedia.org/wiki/Eric_%22Bingy_Bunny%22_Lamont**> guitar is also way out of tune. The music doesn't sound bad to me, though. The tuning adds to the woozy, dreamy feeling, enhanced by the strange juxtaposition of horror-movie dialog and the cheery reggae groove.

Detuned synths and samples are everywhere in current hip-hop, electronic dance music, and film and TV music. To pick one example of uncountably many:

I should also point out that **the vocal melodies in hip-hop < https://www.ethanhein.com/wp/2016/visualizing-hip-hop-melodies/>** are usually outside of conventional tuning too.

12-TET is a cultural convention, not a fundamental truth of nature. It feels profound and inevitable if you've grown up with it, and challenges to it are shocking at first. But it only takes a few hours of close listening to get used to other tuning systems, and to start to hear the limitations and deficiencies of 12-TET. There are larger political and cultural resonances here. What other arbitrary conventions do we accept without question? **Hegemonic whiteness < https://ethanhein.com/wp/2020/the-racial-politics-of-music-education/>** ? Gender norms? American exceptionalism? It's worth asking.

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