
Tempering Bach's Temperament

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Tempering Bach's temperament

I was interested in Bradley Lehman's exposition of J. S. Bach's temperament, as interpreted from the 'sinuous spiral' drawn as a header to the first volume of the *Well-tempered clavier* in *EM*, xxxiii/1 (Feb 2005), pp.3–23. The temperament he proposes is good indeed, just as good as a number of other temperaments (Neidhardt, *temperament ordinaire*, Vallotti and John Barnes's temperament derived from musical analysis of the '48'). However, I am concerned about the number of assumptions made by Dr Lehman in arriving at his solution.

First, I see no reason to analyse the diagram upside-down (in which case why did Bach not write the vitally important 'C' upside-down as well?). As a harpsichordist who has experimented with many temperaments (one's thinking goes round and round in circles as much as the temperaments themselves), it is plain to me that if one analyses the diagram the right way up the initial 'casual flourish' looks like a 'G'. In which case the 'C' further along the line confirms that each of the 11 loops starting from the left implies:

G–D–A–E–B–F♯–C♯–G♯/A♭–E♭–B♭–F–C

thus giving all the 5ths. This is a completely different solution from that advocated by Dr Lehman, who has read the diagram upside-down.

Now, depending on the relationships between loops, loops with single knots and loops with double knots (that is, whether single knots represent 5ths tempered by $\frac{1}{6}$ or $\frac{1}{12}$ comma, and double knots *vice versa*), this could produce a temperament that is either similar to Lehman's (though not exact) or radically different. Another assumption Lehman makes is that 'The normal amount of tempering is $\frac{1}{6}$ comma': there are other possibilities, as I am sure he well knows. In other words, I am concerned that all the evidence to crack the code of Bach's own keyboard temperament relies on nothing but assumptions, musically based, but with no hard evidence.

Having said that, Lehman's temperament is fine; I have used something very similar for years. But perhaps we should call it 'Lehman's' rather than Bach's, thereby not closing down the opportunities for different interpretations.

DAVID PONSFORD
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This 'Rosetta Stone' can be interpreted in more than one way, and readers may wish to see a separate inquiry to better assess the viability of any given interpretation. I wish to propose an alternative reading which results in a somewhat different circulating temperament than that derived by Bradley Lehman. It mostly follows his original and insightful approach, but pursues some previously unnoticed or unaccounted—for aspects of the diagram. My essay on this fascinating subject, entitled 'J.S. Bach's Well Tempered Clavier Tuning Script: A Proposed 1/18th PC Interpretation', with explanatory diagrams, is available to view or print at: <http://bachtuning.jencka.com/essay.htm>.

DANIEL JENCKA
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The notion that Bach's decorative squiggle on the title-page of *Das wohltemperirte Clavier* is some sort of prescription for a temperament is appealing and, in principle, very plausible. But there seems to be something wrong with Lehman's interpretation of the diagram. He assumes (it is not altogether clear why) that a single loop means a pure 5th, a 'single knot' means a 5th tempered by $\frac{1}{12}$ comma, and a 'double knot' one tempered by $\frac{1}{6}$ comma; the result is a temperament in which B♭–F is $\frac{1}{12}$ comma wide. In his tuning instructions, he says one should tune E♭–B♭–F as pure 5ths, and then lower B♭ 'slightly', i.e. by $\frac{1}{12}$ comma. This last step seems inexplicable to me, since it makes the tuning of various intervals worse than they would be without it, as follows (intervals in cents are rounded to the nearest cent): E♭–B♭ and B♭–F: $\frac{1}{12}$ comma narrow/wide respectively, instead of pure 5ths; G–B♭: narrowed to 300 cents instead of 302 cents; and B♭–D: widened to 398 cents instead of 396 cents. (Admittedly, B♭–D♯ becomes 300 cents instead of 298 and F♯–A♯ becomes 402 instead of 404, but since both intervals are a long way from pure—316 and 386 cents respectively—the gain is insignificant.) I can't believe, therefore, that Bach intended B♭ to be lowered by $\frac{1}{12}$ comma, so according to Lehman's interpretation of the diagram there should have been a plain loop (for a perfect 5th) between D♯ and A♯ instead of a 'single knot'. Hence either Bach made a mistake, or Lehman is wrong—more likely the latter, surely! Depending on what the small loop at the left-hand end means (pure 5th? $\frac{1}{12}$ comma narrow? something else?), there are

various other ways of interpreting Bach's diagram, for example:

a double knot = $\frac{1}{6}$ comma, single knot = $\frac{1}{18}$ comma, LH loop = pure

b double knot = $\frac{1}{6}$ comma, single knot = $\frac{1}{24}$ comma, LH loop = $\frac{1}{24}$ comma

c double knot = $\frac{1}{2}$ comma, single knot = $\frac{1}{4}$ comma, LH loop = $\frac{1}{4}$ comma

None of these differs very much from Lehman's interpretation, except in the placing of B $\flat$; but my point is simply that Bach's diagram on its own is insufficient to define one unique temperament precisely.

RICHARD MAUNDER
Cambridge

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Bradley Lehman's initial approach to determining Bach's temperament is certainly inspired, but he seems to be unaware that the 'C' indicating the starting-point of the temperament is actually an ornamental hook on the 'C' of 'Clavier'. The same hook is seen on the title-page of *WTC II* (not in Bach's hand), where there are no loops. It is also found on the initial 'S' of 'Semitonien' and 'Sebastian'. Bach may have intended the hook to do double duty, but I think that the fact that it has a *bona fide* calligraphic use seriously weakens Lehman's hypothesis. In addition, the ornate spiral and loop pattern near the bottom of the page in *WTC I* suggests that the loops above the title may be purely ornamental after all.

Another problem is that Lehman is clearly unaware that the precise relation between beat rates and tempering was not understood in 1722. Although theorists discussed many different divisions of the comma, my feeling is that it would have been impossible in practice to distinguish one from another. Bedos de Celles's method of 1766 gives beat rates, but, as I have intimated elsewhere (*Revista de musicología*, xxii/2 (1999)), they appear to have been determined empirically. Without a knowledge of beat rates, neither the accuracy nor reproducibility required by Lehman's temperament would have been attainable.

CARL SLOAN
London, Ontario

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Last October I received from Brad Lehman some cordial messages saying that he was a fan of my work on temperaments (but had never been able to find a copy of

Stimmung und Temperatur) and that his discovery of Bach's tuning would soon be announced in *Early music*. Now that his delightfully invigorating article has appeared, I have mixed feelings about it. I appreciate very much its stimulating effect, but disagree with its main conclusion and am planning to explain why in an article to be written for *Early music* in collaboration with Ibo Ortgies.

MARK LINDLEY
Cambridge, MA

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Rather than listing our serious fundamental objections to the two Bradley Lehman Bach articles—which could wait for a later occasion, if required—more importantly, may we briefly suggest an obviously much simpler interpretation of Bach's 'squiggles'?

Let us consider what a tuner of the period, using his ear alone, *basically* needed to know. Namely, how to tune pure octaves and fifths, and how to flatten other fifths equally. In this way, he would be equipped to construct a chain of four $\frac{1}{4}$ -comma fifths making a pure third, either to complete a mean-tone tuning in its entirety, or as a basis for starting an unequal tuning.

So, instead of turning Bach's apparently coded cipher upside down, as Lehman thought necessary, let us begin from the left-hand side, starting the conventional keyboard tuning from C. The majority of all unequal temperaments at this time were based upon the tuning of initial intervals as in mean-tone, leaving the remainder to be tuned unequally. This is much more likely than Lehman's interpretation in which he immediately starts with the extremely complicated $\frac{1}{6}$ th-comma tempering.

We therefore propose the following scheme:

Stage 1: from C, tune three normal mean-tone fifths, C : G : D : A.

Stage 2: from A: tune three pure fifths, A : E : B : F $\sharp$.

Stage 3: from F $\sharp$: tune five equally-flat, very slightly tempered fifths, F $\sharp$: C $\sharp$: G $\sharp$: E $\flat$: B $\flat$: F (i.e. in effect flatten them almost imperceptibly until the remaining fifth F : C is also judged to be of the same size as its immediate predecessors, and so closing the tuning circle).

This produces the following scale of values, to the nearest cent, here shown in both our and Lehman's interpretations:

Scale	Mobbs/Mackenzie	Lehman
C	0	0
C $\sharp$	96	98

Scale	Mobbs/Mackenzie	Lehman
D	193	196
E $\flat$	298	298
E	392	392
F	499	502
F $\sharp$	596	596
G	697	698
G $\sharp$	797	798
A	890	894
B $\flat$	999	998
B	1094	1094
C	1200	1200
Major 3rds	Mobbs/Mackenzie	Lehman
C : E	392	392
G : B	397	396
D : F $\sharp$	402	400
A : C $\sharp$	407	404
E : G $\sharp$	405	406
B : D $\sharp$	404	404
F $\sharp$: A $\sharp$	403	402
C $\sharp$: E $\sharp$	403	404
A $\flat$: C	403	402
E $\flat$: G	399	400
B $\flat$: D	395	398
F : A	390	392
C : E	392	392

Because of these surprisingly similar characteristics as shown above, we trust that Dr. Lehman will appreciate that all his effusive enthusiasm can be transferred equally easily to this much simpler interpretation. We are sure that almost any inevitably tiny tuning discrepancies would, in practice, remain undetectable by even the most professional ear.

Our grateful thanks go to Andreas Sparschuh and Michael Zapf for having first drawn our attention to the possibility of this Bach coded tuning cipher, when we were in communication in February 2002. We also thank David Hitchin for his recent help, particularly in clarifying for us the order of events since 2001 leading up to this, our proposed solution.

KENNETH MOBBS and ALEXANDER MACKENZIE OF ORD
Mobbs Keyboard Collection, Bristol

I have just read the first part of Bradley Lehman's article on 'Bach's temperament' and would like to respond to comments he made regarding my book, *Temperament*.

First, his highlighting of the phrase 'final solution' (which occurs in my introductory chapter in a discussion of various remedies used to address the inability of pure harmonic ratios to co-exist in an instrument of fixed pitches) as 'horribly ironic' is, in my view, sickeningly gratuitous and such an expression should not have been allowed to stand in the article as published in *Early music*.

Mr. Lehman is entitled to propose any analysis he likes of the curls and frills on the title-page of Bach's *WTC*, no matter how farfetched his suppositions. However, he is not entitled to misrepresent my work. It is a serious distortion to say that I claim that modern science has 'triumphed' in giving us equal temperament as the 'final solution'. As Mr. Lehman points out, my book is 'popular', that is, it is literary in style, written for a lay audience. In order to interest non-specialists, it employed a dramatic shape driven by the question: Why is it that a tuning that today enjoys almost universal acceptance was at one time considered a crime against nature? To explore that question, the book traverses the historical record, weaving musical arguments with those taking place in science, art, religion and philosophy, and suggesting many previously unnoted cultural connections, such as that between perspective in painting and temperament in music. When, toward the conclusion of the story, equal temperament does indeed become the tuning of choice (does Mr. Lehman deny this actually happened?), I describe the occasion as the *dénouement* of a centuries-old drama but then immediately show the reader that this was not really the end after all. Indeed, the very last section of the book celebrates the beautiful non-equal tunings of contemporary artists like Michael Harrison, noting the magical resonances in Mr. Harrison's music that simply cannot occur in equally-tempered instruments. The final words of the book are: 'Perhaps Pythagoras was right after all'. Nevertheless, I am a firm advocate of equal temperament when it is used in the repertory for which it is best suited. Since I discuss the matter at some length in the Afterword of the paperback edition, which is cited by Mr. Lehman, his categorization is disingenuous.

STUART ISACOFF
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Editor's note:

I have received further correspondence concerning the work of the mathematicians Michael Zapf in Frankfurt and Andreas Sparschuh in Darmstadt, much of which can be

found on various sites on the Web. One of these detailed responses, by J. Charles Francis ('The esoteric keyboard temperaments of J. S. Bach'), can be read at <http://www.eunomios.org>. Keith Briggs has also been in touch to say that he had written a letter to *Early music review* on the subject in May 2003, based on material in circulation on the Web, which he believed to have been based on Zapf's work. Bradley Lehman does indeed acknowledge their work, though admittedly in material that appeared on the *Early music* website; for his own account of his and their respective discoveries, see <http://www-personal.umich.edu/~bpl/larips/faq2.html> and <http://www-personal.umich.edu/~bpl/larips/discovery.html>. There Lehman points out that he and they have derived different temperaments from the same Bach drawing. The Zapf-Sparschuh interpretation '... did not use Bach's letter C (where he placed it second from the right) as a meaningful part of the drawing; they assigned C elsewhere. Also, they read the drawing in the opposite direction, and used a premise that the loops have something to do with seconds and half-seconds of time in the beat rates. In practice their method yields a temperament that has ten different sizes of 5ths, and has their required beat rates (multiples of half a second) at only one particular diapason (starting pitch).'

Nowadays the proliferation of material on the Web—where much discussion of this subject has been taking place between Lehman and others both before and after the publication of the first part of the article in the February 2005 issue—makes almost any 'discovery' in old-fashioned print an *idée reçue* among those who have already read or participated in the on-line debate. However, it is important that such matters are debated openly and that they are communicated to as many people as possible, including those who do not have the time, energy or inclination to surf the Web.

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Copyright issues

I can only assume that the comments in the editorial in *EM*, xxxii/4 (Nov. 2004), p.495, were made without access to the full facts of the litigation with Hyperion Records Ltd. Since then, of course, the three judges of the Appeal Court have upheld the High Court judgment. There are some salient facts about this matter that seem not always to have been clear, especially as most commentators elsewhere have taken Hyperion's press releases at face value and not bothered to check whether these represented the whole story.

1 I spent a total of two and a half years trying to get Hyperion to talk, repeatedly offering to negotiate a single sum in lieu of royalties, without any response. In an interview with the *Los Angeles Times* last March, Mr Perry admitted that this was so (we were not able to disclose these offers earlier for legal reasons), but he let the matter go to court because he wanted to find out whether he was 'right or wrong' in his stance about copyright. Then he went further and appealed the judgment. Thus the legal bill he has incurred is entirely self-inflicted. He has also inflicted a long period of stress on me—as have Jeffrey Skidmore and the chairman of Ex Cathedra whose conduct contributed to this dispute in the first place, and who were criticised by the judge for 'playing both sides off in order to secure the recording'. I prepared these editions without any written contract believing that previous practice would obtain (I had prepared editions for an earlier recording of Lalande motets by Ex Cathedra for the ASV label, and have been receiving royalties on that CD), and not until a few days before the Hyperion recording sessions did Skidmore inform me of the stance Hyperion were taking.

2 In connection with the disputed CD, I was never paid for my editing work, despite Hyperion's assertions they paid an editing fee. The only payment ever made was for the hire of the actual music copies (charged at about 40% of the commercial rate charged for Lalande motets material by, say, Novello or Faber) as, in addition to having prepared the editions, I also self-published them (computer-engraved to the highest standard, printed and bound—almost 300 copies in all). (See below for the MPA and the legal view of the distinction between hire fees and royalties.) If I had worked at an hourly rate equal to the minimum wage (which studio producer, composer, or anyone else in the CD industry would do so?), the editing fee alone would exceed £6,000. If a more appropriate rate was calculated... but apparently, editors should do it all for the honour and glory, according to Hyperion.

3 It was also open to Hyperion to seek out lawyers to act on a conditional fee basis. The CFA arrangement mainly exists to enable individuals like myself (a retired teacher living on a pension; my editing and hiring just breaks even, and I don't pay myself anything) to stand up to powerful, multimillion-pound companies with large advertising (and propaganda) budgets.

4 I have spent more than 30 years making available for the first time more than 40 major works, which have been performed by more than 60 organisations worldwide and some of which have been recorded on several other major