# Harpsichord & fortepiano

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# Tuning the témpérament ordinaire

by Claudio Di Veroli

### Introduction

Through the heyday of Baroque music this unique and important family of tunings was in widespread use in France and possibly elsewhere also. In modern times however it has not always received the attention it deserves:

- Jorgensen (1977)[1] ignored the matter, rectifying the omission in a more recent work (1991)[2]
- Barbour (1951)[3] and Klop (1974)[4] dealt only – and briefly – with Rameau's account. .
- Lindley (1977)[5] and Padgham (1986)[6] treated only the less frequent variants with no pure $3^{rds}$.
- The first extensive treatment of Baroque French temperaments was published in 1978 [7].
- Some very relevant facts however have been established even more recently (1985) [8].

Today useful descriptions of the *ordinaire* are really thin on the ground. Often modern musicians candidly try and get "a few pure $3^{rds}$ and an overall circular temperament": certainly no substitute for over a century of experimentation by ancient French musicians! Trial-and-error easily produces very rough solutions, with many useful intervals unacceptably out of tune. We intend here to derive historically accurate, acoustically precise and easy-to-tune directions for *témpérament ordinaire.*

### Temperament and meantone

Every musician knows that 12 pure $5^{ths}$ almost, but not quite, close the circle of 12 semitones, the error being called *Pythagorean Comma* (PC). But the worst problem temperament has to tackle is another one: 4 consecutive pure $5^{ths}$ produce only a crude approximation to a pure major $3^{rd}$, the error being called *Syntonic comma* (SC).

An excellent practical solution is *standard (or _ SC) meantone temperament*, in which the $5^{ths}$ are reduced by _ SC each, thus compensating the error: the slightly impure $5^{ths}$ yield **absolutely pure** $3^{rds}$. The unfortunate consequence is that now the circle of 12 fifths does not close by a very large amount: one $5^{th}$ – the "wolf" – absorbs this error, yielding also 4 "wolf" major $3^{rds}$. Thus modulation is quite limited with meantone. However, its reduced palette sports an impressive amount of marvellous pure major $3^{rds}$ and minor $6^{ths}$, plus still more almost-pure minor $3^{rds}$ and major $6^{ths}$ ! Let us just summarise the "state" of $5^{ths}$ and major $3^{rds}$ in standard meantone temperament:

| | | |
|---|---|---|
| 5ths | Good: 11 | Wolves: 1 |
| Maj. 3rds | Pure: 8 | Wolves: 4 |

Clearly the wolf $3^{rds}$ made many modulations unplayable. But meantone was a practical solution and, perhaps, **the best-sounding temperament ever**: this is why it dominated the European musical scene from the beginning of the $17^{th}$ C until mid $18^{th}$ C, i.e. so-called Renaissance and Early Baroque times.

After that period, meantone remained in widespread use only in England. Elsewhere the need for larger modulations persuaded musicians to devise and embrace "more circular" temperaments. Led by the Italians and the Germans, most European countries adopted the "good" or "well" temperaments. But in France there was instead a unique evolution of meantone, enlarging the harmonic palette but keeping meantone's distinctive characteristics (pure or almost-pure thirds) in a few central tonalities. This led in two stages to the *témpérament ordinaire* which would be in general use from the end of $17^{th}$ C for almost a century: the times of Delalande, Marais, F. Couperin, Rameau, Duphly, the Forquerays.

### Early French temperaments

Some of the keyboard works of Louis Couperin (c.1650) are hardly playable in meantone, suggesting that Frenchmen were already going through a first stage of meantone modifications: "wolf-splitting". The deviation is no longer concentrated in **one** wolf $5^{th}$, but instead distributed among three consecutive $5^{ths}$. Why three and not just two? Because two wolf $5^{ths}$ would produce the following result:

| | | | |
|---|---|---|---|
| 5ths | Good: 10 | | Wolves: 2 |
| Maj. 3rds | Pure: 7 | Quite bad: 2 | Wolves: 3 |

i.e. 9 playable $3^{rds}$ instead of 8, but two of them quite bad. Nothing is gained really. But surprisingly, just adding a third $5^{th}$ to the company **does** yield distinct advantages over standard meantone:

| | | | | |
|---|---|---|---|---|
| 5ths | Good: 9 | | Bad: 3 | |
| Maj. 3rds | Pure: 6 | Acceptable: 2 | Bad: 2 | Wolves: 2 |

This is by no means a circular temperament, but now **all** the 5ths are playable! Also, very significantly, if before we had 4 unplayable $3^{rds}$, we now have only 2 of them. The "acceptable" thirds have the same deviation as in equal temperament. The "bad" thirds have the same deviation as in Pythagorean Intonation. Only 2 thirds are useless. With respect to standard meantone, the overall spectrum of modulations has been significantly increased.

The modern study of this temperament is quite recent. It has been shown that this - or very slight variants thereof which we call *Early French* - is the temperament of young François Couperin's organ, and probably of most organs and harpsichords through the 2nd half of 17th C France [8]. Early French temperament is not only useful in practice but it also yields information useful to solve important issues regarding *témpérament ordinaire.*

### Témpérament ordinaire

The theoretical works of Baroque Frenchmen were centred on "pure intonations", of scarcely any practical relevance. They mostly ignored the evolution that was going on strong at the hands of practical musicians and tuners. By the beginning of the 18th Century, Early French temperament had evolved into a unique modification of meantone, whereby its former regularity (mostly identically-tempered 5ths) had all but vanished yielding instead a peculiar temperament, a **circular one but unique in still keeping a few basic pure thirds.**

However, in modern times *témpérament ordinaire* has proven to be almost as elusive as Etruscan language: we positively know that it existed and was in general use for a long time, but today getting at is true meaning is no easy matter. In order to try and achieve both historical accuracy and a "suitable average version" for modern consumption, we need to confront our mathematics and acoustics with ancient descriptions. And the latter are unfortunately scarce, approximative and not completely reliable.

We will try here to fully revisit the main sources: the well known - but possibly not so well studied - accounts by three great men of their time: Rameau (1726) [9], d'Alembert(1752) [10] and Rousseau (1767) [11].

If we get rid of their treatment of general temperament issues (3rds, 5ths, commas, circles) their descriptions can be reduced as shown below. We have omitted some words or sentences, but the ones shown are of course quoted *verbatim.*

### Rameau's description

*A l'égard de la Partition des Clavecins, on est dans l'habitude d'y affoiblir un tant soit peu les premieres Quintes: & après la quatriéme Quinte accordée, on la compare, pour la preuve, au Son par lequel la Partition a eté commencée, & dont elle doit former la Tierce majeure; desorte que si l'on n'y trouve pas certe Tierce majeure dans la justesse que demande l'oreille, on recommence de nouveau la Partition, en affoiblissant un peu plus les Quintes: car le défaut de justesse q'on sent pour lors dans la Tierce Majeure, vient presque toujours de ce qu'on n'avoit pas assez affoibli les Quintes. ...*

*Une longue experience a fait sentir le point de ce Temperament ... Mi ... pour qu'ils fasse la Tierce majeure juste avec Ut; il n'y a qu'à diminuer chaque Quinte du quart de ce Comma ...*

*... rendre les Quintes un peu plus justes ... dès la Quinte d'Ut# à Sol# ...*

*L'excès des deux dernieres Quintes & des quatre ou cinq dernieres Tierces majeures est tolerable ... parce qu'il se trouve dans des Modulations peu usitées; exceptée que'on les choisisse exprès pour rendre l'expression plus dure, &c. Car il est bon de remarquer que nous recevons des impressions differentes des intervales, à proportion de leur differente alteration: Par example, la Tierce majeure qui nous excite naturellement à la joye, selon ce que nous en éprouvons, nous imprime jusq'à des idées de fureur, lors qu'elle est trop forte ...*

*Les habiles Musiciens sçavent profiter à propos de ces differents effets des Intervales, & font valoir par l'expression qu'ils en tirent, l'alteration qu'on pourroit y condamner.*

*Pour que les Intervales conservent tutte la justesse possible dans les Modulations les plus usitées, il faut commencer la Partition par Si B-mol, & ne rendre pour lors les Quintes un peu plus justes, que depuis Si à Fa#.* [9]

About the Partition (bearings) of the Harpsichords, the use is to reduce by some amount the first Fifths: & after the fourth Fifth tuned, it is compared, as a proof, to the Partition's initial note, & with it it must make a major Third; so that if this major Third is not found as pure as the ear requires, the Partition is restarted, reducing the Fifths a bit more: because the lack of purity that is heard in the major Third, is caused almost always by not having reduced the Fifths enough. ...

A long experience has shown the reason for this Temperament ... [the note] E ... so that it makes a pure major Third with C, it just need to reduce every Fifth by one fourth of that Comma ...

... tune the Fifths more pure ... from the Fifth from C# to G# ...

The excessive size of the last two Fifths & the last four or five major Thirds is tolerable ... because it is found in the less frequent Modulations, except if they are chosen explicitly in order to give a harder expression, &c. Because it is good to point out that we receive different impressions from the intervals, according to their different alteration: For instance, the major Third that brings us naturally to joy, as we feel it, produces sensations approaching the fury, when it is too mistuned ...

Clever Musicians know how to take advantage of these different effects of the Intervals, thus the expression so obtained justifies the alteration that otherwise could be criticised.

In order for the Intervals to remain as pure as possible in the most frequently used Modulations, one should begin the Partition by B flat, & start enlarging the Fifths only from B-to-F#.

### Rameau's consequences

Rameau's instructions can be very precisely reduced to the following simple steps:

1. Start by tuning four consecutive meantone 5ths, yielding a pure Major 3rd.
2. Begin the Tuning at Bb and keep tuning meantone 5ths until E-B included.
3. Enlarge the remaining 5ths as needed.
4. The two largest fifths should be the ones up from C#.

Please note that, for reasons I fail to understand, the renditions of this temperament by both Barbour[3] and Klop[4] differ significantly from this 4-step description. E.g. they both find that the three 5ths B-G# should be tuned pure, the deviation being concentrated in the remaining 5ths. While the resulting temperament is musically acceptable and nicely asymmetrical, it simply does not agree with Rameau's account: nowhere is he suggesting that non-meantone 5ths "on the sharps" should be better than those "on the flats".

Rameau's instructions imply **three** pure Major 3rds F-A, C-E, G-B and accordingly six meantone 5ths from F to B. The remaining five 5ths must be gradually enlarged to accommodate the wolf. In practice, this means tuning pure Bb-F and B-F#, very slightly large (1_ Cent each) Eb-Bb and F#-C# and slightly larger (3 Cents each) C#-G# and G#-D#/Eb. The result

1. has all the fifths really good (unlike Early French temperament).
2. slightly favours tonalities with flats rather than sharps
3. is absolutely symmetrical: modulations away from the good intervals fall into the bad ones at the same "speed" either towards the flats(anti-clockwise) or towards the sharps(clockwise).
4. has the following intervals:

| | | | | | |
|---|---|---|---|---|---|
| 5ths | Pure: 2 | Good: 9 ( 6 meantone, 4 large) | | | |
| Maj. 3rds | Pure: 3 | V.Good: 2 | Acceptable: 2 | Bad: 2 | Wolves: 3 |

Thus "Rameau's temperament" is clearly the result of the evolution from Early French, with some 5ths now bridging the transition from meantone 5ths to bad ones. It is interesting that – possibly for theoretical neatness – Rameau's diatonic (i.e. intervals with no sharps or flats involved) 5ths and 3rds are precisely the meantone/pure ones. This looks beautiful on paper, but unfortunately it also slightly favours the flats in modulations, against the musical tendency of the time. As we will see below, this was rectified in the d'Alembert-Rousseau description.

### d'Alembert-Rousseau's account

A few decades later, first d'Alembert(1752)[11] and then Rousseau (1767)[12] publish very similar descriptions, including verbatim similarities and both referring to Rameau as the source. Nevertheless, their accounts do **not** agree with Rameau. Also, Rousseau's account contains everything said by d'Alembert, plus a few significant details. Thus it suffices to follow Rousseau:

*... M. Rameau ... a cru développer le premier la véritable théorie du Tempérament, & a méme prétendu ... établir comme neuve une pratique très ancienne ...*

*... 1°. on commence par l'ut ... & l'on affoiblit les quatre premières Quintes en montant, jusqu'à ce que la quatrième mi fasse la Tierce majeure bien juste avec le premier Son ut; ce qu'on appelle la première preuve. 2°. En continuant d'accorder par Quintes, dès qu'on est arrivé sur les Dièses, on renforce un peu les Quintes, quoique les Tierces en souffrent, & quand on est arrivé au sol Dièse, on s'arrête. Ce sol Dièse doit faire, avec le mi, une Tierce majeure juste ou du moins souffrable; c'est la seconde preuve. 3°. On reprend l'ut & l'on accorde les Quintes au grave; savoir, fa, si Bémol, &c., foibles d'abord; puis les renforçant par Degrés c'est-à-dire, affoiblissant les Sons jusqu'à ce qu'on soit parvenou au re Bémol, lequel, pris comme ut Dièse, doit se truver d'accord & faire Quinte avec le sol Dièse, auquel on s'étoit ci-devant arrêté; c'est la troisième preuve. Les dernières Quintes se trouveront un peu fortes, de même que les Tierces majeures; c'est ce qui rend les Tons majeurs de si Bémol & de mi Bémol sombres & même un peu durs. ...*

*... les Tons naturels jouissent par cette méthode de toute la pureté ... & les Tons transposés, qui forment des modulations moins fréquentes, offrent de grandes ressources au Musicien quand il a besoin d'expressions plus marquées: car il est bon d'observer, dit M. Rameau, que nous recevons ...*

... Mr. Rameau ... believed he developed the first true theory of Temperament, and even pretended .. to establish as new a very ancient practice ...

... 1st. one must start by the C ... going up by making the first four Fifths reduced, until the E makes a pure major Third with the first note C; this is called the first check. 2nd. Going on tuning by Fifths, when one has arrived to the Sharps, the Fifths must be widened up a little, though the Thirds will suffer, and upon arriving to the G# one must stop there. This G# must make, with the E, a pure or at least acceptable major Third: this is the second check. 3rd. Going back to C, one should go down by Fifths, i.e. F, Bb &c small at first, then widening them up gradually until one arrives to the Db which, taken as C#, must make a fifth with the G#, at which one had stopped before: this is the third check. The last Fifths will be found to be somewhat sharp, as well as the major Thirds; this makes the major Tonalities Bb and Eb obscure and somewhat harsh ...

... the natural Tonalities by this method enjoy all the purity ... and the transposed Tonalities, that make less frequent modulations, offer important resources to the Musician when he needs more marked expressions: since it should be observed, said Mr. Rameau, that we receive ...

[Rousseau then quotes verbatim Rameau's sentence on "different impressions" seen above.]

### Rousseau's consequences

In spite of its reference to Rameau, Rousseau's account is far more detailed. Unfortunately it also shows important inconsistencies and errors, typical of a second-hand description. A list of the problems:

There are two good reasons why the 3rd E-G# cannot be pure as Rousseau suggests. First, the 3rd will not be pure if it is achieved by widening the Fifths (with respect to meantone) as per his directions.

The other reason why E-G# cannot be pure: it would imply **five pure major 3rds** , thus eight meantone 5ths. The remaining four 5ths would all be very large, with 5 or 6 really bad major 3rds. Clearly, one must follow the alternative Rousseau also suggests: to have the E-G# "at least acceptable".

But if we "accept an acceptable" E-G#, we no longer know **how many** major 3rds should be tuned pure after the initial C-E: just one more (G-B), two (D-F#) or three(A-C#)? More on this below.

Tuning down the Flats by gradually widening the 5ths until C#/Db poses **two problems**. One is that the tuner overrides an already tuned-and-checked note: G#/Ab.

The other problem is that a good (perhaps meantone) 5th F#-C# would be followed by C#-G# as the worst 5th of all. This imbalances the temperament in many ways. It favours the flats, while we know that French musical literature or the 18th Century shows a *penchant* for the sharps.

The obvious solution to the "two problems" is to take the words "Db which, taken as C#" as an error: he is tuning 5ths down, thus the last note before reaching the already-tuned G# is "Eb which, taken as D#". However, this "error" also appears in d'Alembert, with a most curious variant: he does not mention C#, but instead he asserts that descending a fifth from Db (same as C# in a circular temperament) one reaches G#: this is a fourth, not a fifth!

The coinciding inconsistencies strongly suggest that **either** Rousseau based his account on d'Alembert (adding some additional information) **or** both accounts were based on a previous unknown author X . Whatever happened, X was **either** writing down a verbal account by a practical tuner **or** modifying Rameau's method. In the process, X misunderstood or miscalculated some parts of the scheme, the error finally appearing – with variants – in both d'Alembert and Rousseau.

### Solution and comparisons

The crucial step is now to decide how many 3rds are to be tuned pure. It is quite easy to show that **four pure 3rds** are too many: it makes it very difficult to produce anything like a circular temperament. Furthermore, there is no clear requirement for so many pure 3rds in any of the sources. Since we are clearly being asked **more than one pure 3rd**, we are left with two alternatives:

Rousseau-2. TWO pure 3rds. With some modern mathematics and trial and error, the solution is a decidedly asymmetrical temperament we already described in a previous work (1978)[7]. The intervals become very gradually dissonant as one modulates towards the sharps, and distinctively faster so if one modulates towards the flats.

| | | | | | |
|---|---|---|---|---|---|
| 5ths | Pure: 2 | Good: 10 ( 5 meantone, 2 small, 3 large) | | | |
| Maj. 3rds | Pure: 2 | V.Good: 3 | Acceptable: 2 | Bad: 2 | Wolves: 3 |

Rousseau-3. THREE pure 3rds. This alternative – of which more details below – has two very minor drawbacks: a slightly less asymmetrical and also very-slightly less gradual tuning. But it also shows significant advantages: a) it keeps more of the old-&-nice meantone sound, b) it is more similar to Rameau's temperament and c) is easier to tune than both.

| | | | | | |
|---|---|---|---|---|---|
| 5ths | Pure: 3 | Good: 9 ( 6 meantone, 3 large) | | | |
| Maj. 3rds | Pure: 3 | V.Good: 2 | Acceptable: 2 | Bad: 2 | Wolves: 3 |

Six pure intervals are a lot, implying an easier, faster and more precise tuning. I can assure the reader that it is virtually impossible to tell Rousseau-2 from Rousseau-3 in performance: a graph below shows their similarity. Thus obviously Rousseau-3 is to be favoured, being both most useful in practice and possibly the most likely historical reconstruction. It can also be seen as a quite direct modification of Rameau whereby a) the whole temperament is shifted one position towards the sharps and b) the "chromatic fifth" sizes are very slightly modified resulting in an asymmetrical circle, also favouring the sharps.

As a conclusion, and in spite of Rameau's musical authority, d'Alembert-Rousseau's description yields a tuning decidedly more in agreement with the qualities we expect from temperament in 18th C Baroque France.

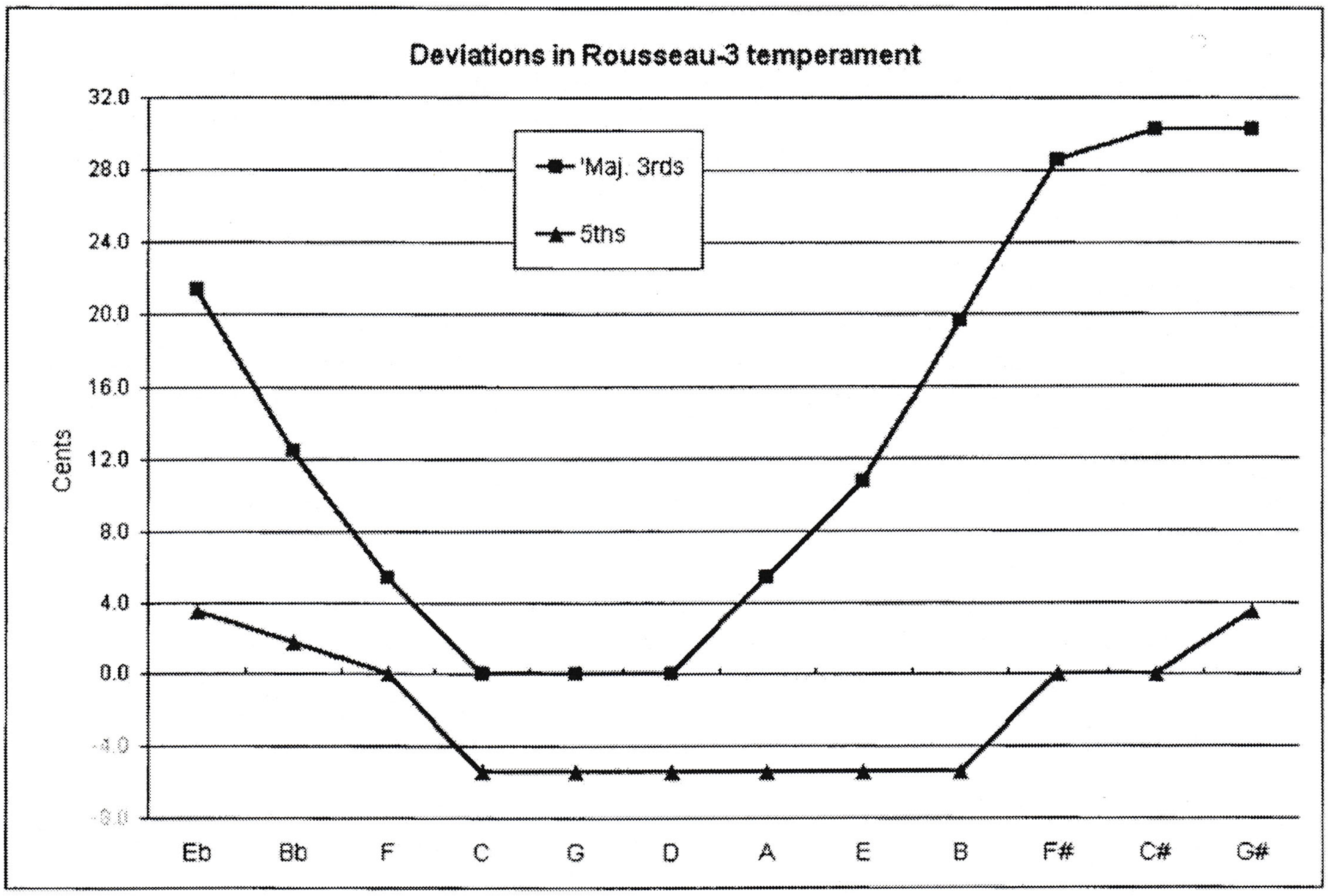
## Sorry, no variants

I have spared the reader the details – mostly not even documented – of decades of my experiments with French temperaments, first in computer FORTRAN programs, then in harpsichords (public performances included), then in computer spreadsheets and more recently also in the personal computer with a MIDI-sampled organ[12]. Lacking those details, anybody is entitled to be suspicious about the solution given above. The test question is: once agreed to have three pure major 3rds , is our Rousseau-3 the only solution in agreement with Rousseau's description?
Yes it is. To get Rousseau-3 as described, one should very obviously:
tune 5 meantone fifths up from C to B
tune two further pure fifths up from B to C#
tune a further pure fifth down from C to F
tune slightly larger than pure the remaining three fifths from G# to F
Of course, we could tune only two pure 5ths instead of three, but that yields virtually no difference in the thirds: it just adds to the tuning difficulty. The only possible variants left are limited to different ways to distribute a deviation of just 8.8 Cents among the three slightly-large fifths. Now this is obviously a very subtle and largely irrelevant matter. One could just allocate 3 Cents each, though I find it convenient to slightly favour Bb-F, thus slightly improving the useful Bb major triad.

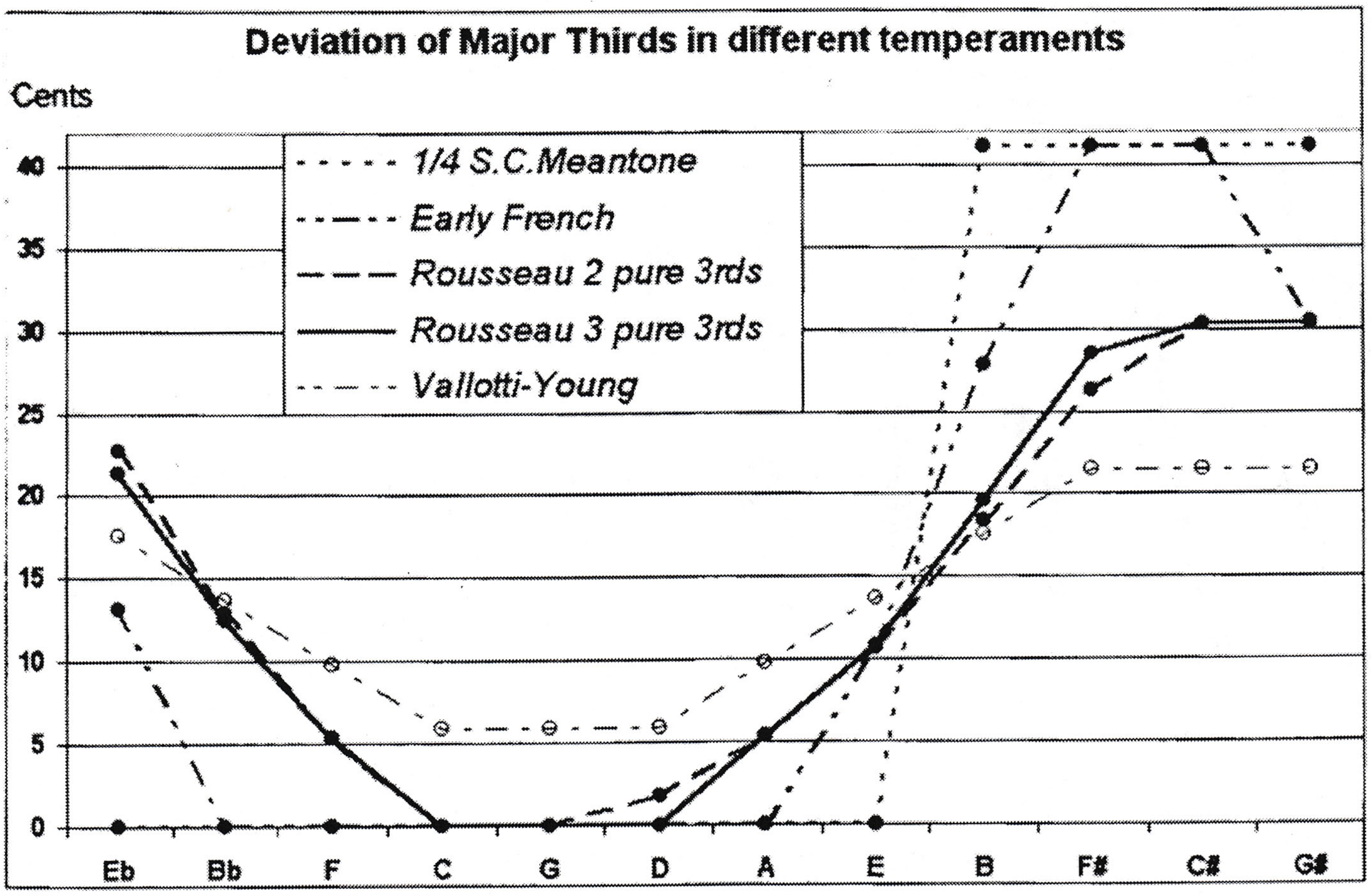
## Cents and comparisons

The deviations in Cents are as follows (Base=lowest note of the interval) [13]

| Base | Eb | Bb | F | C | G | D | A | E | B | F# | C# | G# |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5th | +3.5 | +1.8 | 0 | -5.4 | -5.4 | -5.4 | -5.4 | -5.4 | -5.4 | 0 | 0 | +3.5 |
| M.3rd | 21.4 | 12.5 | 5.4 | 0 | 0 | 0 | 5.4 | 10.8 | 19.6 | 28.5 | 30.3 | 30.3 |




The following is a comparison of the Circle of Thirds in all the _ S.C. temperaments described in this article. A typical "good" temperament – Vallotti-Young – is also thrown in for good measure.




**Beat table and tuning schemes**

The beats for A=415 Hz are as follows [14]:

| Base | Hz | iii | III | IV | V | VI |
|---|---|---|---|---|---|---|
| A | 103.75 | -1.9★ | 1.6★ | 1.3• | -1.0• | 1.6★ |
| Bb | 110.21 | -10.8 | 4.0★ | -0.9• | 0.3• | 5.7 |
| B | 116.00 | -2.2• | 6.6★ | 1.4• | -1.1• | 5.4 |
| c | 124.11 | -11.4 | 0.0★ | 0.0★ | -1.2★ | 1.9★ |
| c# | 130.09 | -4.8 | 11.5 | 0.0★ | 0.0★ | 10.8 |
| d | 138.76 | -5.2 | 0.0★ | 1.7★ | -1.3★ | 2.2★ |
| eb | 146.65 | -12.6 | 9.1★ | -1.2★ | 0.9★ | 11.4 |
| e | 155.14 | -2.9★ | 4.8★ | 1.9★ | -1.4★ | 4.8 |
| f | 165.49 | -17.2 | 2.6★ | -0.7★ | 0.0• | 5.2 |
| f# | 173.45 | -3.2• | 14.4 | 2.2★ | 0.0• | 12.6 |
| g | 185.59 | -11.4 | 0.0★ | 2.3• | -1.7• | 2.9• |
| g# | 195.14 | -11.9 | 17.2 | 0.0★ | 1.0• | 16.4 |

Notation: use of the interval in the tuning scheme below:
★ used / checked • indirectly checked

Note that we have included the rarely-mentioned major VI, which is a very consonant interval due to its simple ratio 5:3. By comparison, minor 3rds are far less consonant, thus less useful in practical tuning.

The mathematics needed to compute the above data was just being discovered in the 18th Century and was therefore beyond the reach of even the most advanced Baroque theoreticians. Today we use our mathematics to avoid lengthy experimentation, but must always bear in mind that French Baroque musicians concocted their tuning schemes by "ear, trial and error", not by calculation.[15]

Based on the beat table above as a starting point, we have devised the following practical tuning scheme for the *témpérament ordinaire*. We have selected for careful control only rates within the optimal range, i.e. from 1 to 3 per second. If you are not an experienced tuner and wish to achieve a professional-standard result, you should first master standard (_ S.C.) meantone temperament and only then attempt this evolved and more difficult tuning.

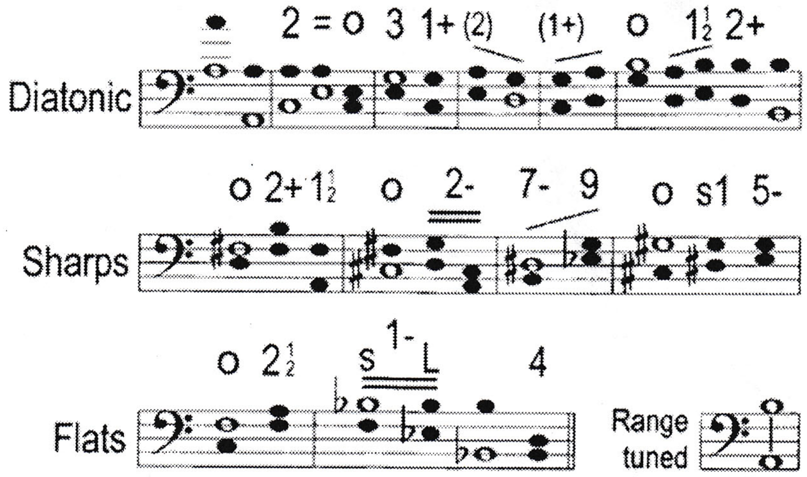
In this tuning, as for most – but not all – Baroque temperaments:

- Major 3rds and 6ths are all either pure or larger
- Minor 3rds are all smaller than pure
- Unless otherwise stated, 4ths are all large and 5ths are all small.
- Octaves are all pure

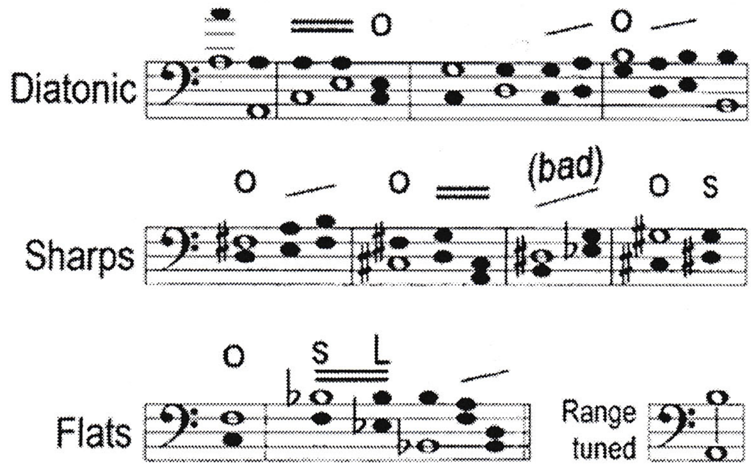
The following symbols are used in the scheme:

| | | | |
|---|---|---|---|
| black note | note already tuned | = | same beats as previous interval |
| white note | note to be tuned | o | pure interval |
| / | increasing beat rate | \ | decreasing beat rate |
| + | slightly more, approx. _ | - | slightly less, approx. _ |
| s | smaller than pure | L | larger than pure |

The numbers show beat rates per second for a pitch of A=415 Hz. Since a pitch variation of a semitone yields a 6% change in beat rates, the ones given are good for all pitches from A=390 up to A=450, say.
For accidentals the modern convention is followed: sharps and flats apply to all the following notes within the "bar", but not to the following bars.




Some musicians prefer "purist" schemes, i.e. to tune the temperament (surely with some trial-and-error and less precision) not using beat rates at all. This is akin to try and make a modern harpsichord without the use of **any** electrical tool throughout the process. It is possible indeed, and it can also be a once-only interesting experiment. Does it guarantee a better historical accuracy? I doubt so. The researcher will surely learn one thing or two, but the practical musician will only get more work and less useful results. Anyway, here it is:




### Some final suggestions

After tuning and playing the *témpérament ordinaire*, most people are enthusiastic. If you are not, please read the following suggestions:

Re-read this article and its directions. This is **not** easy matter for modern musicians.

Try and use a keyboard instrument you are familiar with and you can play upon frequently.

If you performed the tuning yourself, bear in mind that keyboard tuning – in any temperament – is a difficult ability that takes a good hearing and years of practice to acquire.

Some of Bach's works will sound nice, most will **not**: the *ordinaire* is inadequate for many non-French works.

Today we are surrounded by a variety of temperaments: Baroque Frenchmen only heard the *ordinaire*. Accordingly, you should keep the instrument you use daily tuned in the *ordinaire* for months on a row, possibly devoting most of your musical time to French Baroque works. Soon you will be delighted, and you will find yourself frequently coming back to the *ordinaire* in the future.

Though not really within the scope of this article and magazine, *témpérament ordinaire* poses no ensemble problems. Minute embouchure adjustments and a minimum of fingering variants are enough for wind instruments to produce any Baroque temperament, and it is perfectly possible to fret any viol or lute in the *ordinaire*. As for unfretted strings, it is then just a matter of practice. The *ordinaire* has been thoroughly and successfully used by ensembles in public recitals.

**Footnotes**

1. Owen Jorgensen. *Tuning the Historical Temperaments by Ear*. The Northern Michigan University Press, Marquette, Michigan 1977. [The *témpérament ordinaire* is ignored].
2. Owen Jorgensen. *Tuning*. Michigan State University Press, East Lansing, Michigan 1991. [He devotes to the *ordinaire* only two of about two hundred descriptions]
3. J. Murray Barbour. *Tuning and Temperament: A Historical Survey*. East Lansing, Michigan 1951. Reprinted by Da Capo Press, New York 1972. [Only Rameau's account is briefly treated, p. 137]
4. G. C. Klop. *Harpsichord Tuning*. Garderen, Holland 1974. [Rameau temperament]

5 Mark Lindley. "Instructions for the clavier diversely tempered' in *Early Music*, Vol. 5 No. 1. Oxford University Press, London 1977.

6 Charles A. Padgham. *The Well-Tempered Organ*. Positif Press, Oxford 1986.

7 Claudio Di Veroli. *Unequal Temperaments and their Role in the Performance of Early Music*. Farro, Buenos Aires 1978. [Chapter 8: Irregular French temperaments]

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10 Jean-le-Rond d'Alembert. *Éléments de Musique théorique et pratique suivant les principes de M. Rameau*. Paris 1752. Modern fac-simile reprint by Ressources, Genève 1980.

11 Jean Jacques Rousseau. *Dictionnaire de Musique*. Genève/Paris 1767 (printed privilege dated Paris 1765, where it was available from 1767 on, many reprints). [Entry *Tempérament*.]

12 A standard PC-plus-MIDI-keyboard-and-software can be used to produce sampled instruments, but only in Equal Temperament, right? Wrong! E.g. using most Sound Blaster cards and Vienna software, one will define an "Instrument" as a organ or harpsichord stop, and a "Preset" as a stop combination, and both will automatically be in equal temperament. But for a instrument with few stops, for each stop one can define, instead of just one "Instrument", 12 of them, one for each semitone, and then produce the required complicated Preset definitions. It may take hours of mouse clicks for a single stop, it may take more work than real harpsichord retuning, but it can be done, it works and sounds beautifully, and it allows for all sorts of on-the-spot temperament comparisons.

13. The formulae used – in computer spreadsheet notation – are as follows:

| | | |
|---|---|---|
| Cents conversion coefficient (CCC) | = 12 * 100 / log(2) | = 3986.3137 |
| Syntonic Comma interval(SCI) | = (3/2)^4 / (2^2 * 5/4) | = 1.0125 |
| Syntonic Comma in Cents (SCC) | = CCC * log(SCI) | = 21.5063 |
| Pythagorean Comma interval (PCI) | = 3^12 / 2^19 | = 1.013643 |
| Pythagorean Comma in Cents (PCC) | = CCC * log(PCI) | = 23.4600 |
| Meantone(1/4 SC) 5th dev.Cents(MFC) | = - SCC / 4 | = -5.3766 |
| Large 5ths deviation G# to Bb (LFD) | = - 0.4 * (6*MFC + PCC) | = 3.5198 |
| 5th deviation Bb-F | = LFD / 2 | = 1.7599 |

14. The formulae used to compute the frequencies in Hz are as follows:

| | | |
|---|---|---|
| Tuning fork A frequency in Hz(TUA) | | = 415.0000 |
| Pure 5th size in Cents (FIC) | = CCC * log(3/2) | = 701.9550 |
| Pure 4th size in Cents (FOC) | = CCC * log(4/3) | = 498.0450 |
| Meantone(1/4 SC) 5th ratio (MFI) | = (3/2) / SCI^(1/4) | = 1.495349 |
| Meantone(1/4 SC) 4th ratio (MFO) | = (4/3) * SCI^(1/4) | = 1.337481 |
| Large 5th ratio (LFR) | = 10^[(FIC+LFD)/CCC] | = 1.503053 |
| Slightly-large 5th ratio (SFR) | = 10^[(FIC+LFD/2)/CCC] | = 1.501526 |
| A | = TUA / 4 | = 103.7500 |
| d | = A * MFO | = 138.7636 |
| e | = A * MFI | = 155.1424 |
| g | = d * MFO | = 185.5936 |
| B | = e / MFO | = 115.9960 |
| c | = e * 4 / 5 | = 124.1139 |
| f# | = d * 5 / 4 | = 173.4545 |
| f | = c * 4 / 3 | = 165.4853 |
| c# | = f# * 3 / 4 | = 130.0909 |
| g# | = c# * 3 / 2 | = 195.1363 |
| Bb | = f / SFR | = 110.2114 |
| eb | = Bb * 2 / LFR | = 146.6501 |

On a pocket calculator, decimals may differ. The numbers shown were computed with a PC spreadsheet, using 14 significant digits.

Beat rate formulae are as follows, beautiful in their Pythagorean simplicity and sequence, with numerical examples shown for A as base note:

| | | |
|---|---|---|
| iii | = 5*c - 6*A | = -1.9 |
| III | = 4*c# - 5*A | = 1.6 |
| IV | = 3*d - 4*A | = 1.3 |
| V | = 2*e - 3*A | = -1.0 |
| VI | = 3*f# - 5*A | = 1.6 |

15. Jorgensen bases all his writings on his "equal-beating" theory, whereby ancient tuning practice was based on looking for intervals with similar beat rates. The idea is clever and plausible, but it has been criticised on more than one count. For one thing, there is not a hint of such practice in any ancient document. For another, it is easy to show that minimal variants of a temperament (of the sort that nobody notices but easily arise during everyday tuning) can imbalance beats so that equal-beating intervals are no longer such and yet the temperament is still quite adequately tuned.

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