



Beyond Temperament: Non-Keyboard Intonation in the 17th and 18th Centuries

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Bruce Haynes

Beyond temperament: non-keyboard intonation in the 17th and 18th centuries

My system is not based on any keyboard temperament; rather, it displays the sounds found on unrestricted instruments like the cello, violin etc, that can play purely in tune . . .

(Georg Philipp Telemann, 'Neues musicalisches System', 1743/4)

'Temperaments' are closed systems designed to help make the intonation of instruments with immovable pitch (like the organ and harpsichord) convincing. But singers and players of stringed and wind instruments have no such limitations—'temperament' is too rigid a concept to apply to them.

Since keyboard temperaments have been studied and discussed for some time,¹ it seems odd that the intonation of singers and orchestral instruments has had very little attention.² It is a subject that is much harder to treat quantitatively, as it depends so much on context. Playing 'in tune' is a relative and very personal affair, and no set of rules or abstractions from practice can possibly encompass its complexities, or substitute for an alert ear and a willing spirit. But certain basic assumptions of a singer or violinist in the 17th and 18th centuries concerning intonation were quite different from ours, and an understanding of them is not only useful in every day ensemble work, but adds an unexplored expressive element to Baroque and Classical performance. Ultimately, using the available historical information, early musicians must work out this question for themselves.³ The appendix to this article therefore presents extensive extracts from original sources on non-keyboard tuning.⁴

Historic expedients to the tuning problem

It is a troublesome physical fact that it is not possible, either in theory or practice, to combine both pure 5ths and pure major 3rds in the same tuning system. A series of four pure 5ths placed above each other (for instance, C–G, G–D, D–A, A–E) will produce a major 3rd (C–E) considerably wider than pure. This is called Pythagorean tuning, a tuning commonly used in the Middle Ages; the 5ths are pure, which means the 3rds are large—larger even than in equal temperament.⁵ A different system, mean-tone temperament, became common by the

middle of the 15th century in response to the need for better 3rds. Mean-tone favours 3rds: in order to get them low enough, the 5ths must suffer by being tuned small.⁶

Because of its one great advantage, practicality, equal temperament had some adherents even in the 18th century and before, but the attitude of one writer of the time was probably typical: it produced, he wrote, a 'harmony extremely coarse and disagreeable'.⁷ Sauveur in 1707 said equal temperament 'is used [only] among the least able instrumentalists, because it is simple and easy'.⁸

By contrast, the most common tuning of the time was described by a number of writers, including Telemann and Quantz, and was engagingly summarized by the singer and musical theorist Pier Francesco Tosi, who wrote in 1723:

Everyone knows that there is a Semitone Major and Minor, because the Difference cannot be known [i.e. played] by an Organ or Harpsichord, if the Keys of the Instrument are not split. A Tone, that gradually passes to another, is divided into nine almost imperceptible Intervals, which are called Comma's, five of which constitute the Semitone Major, and four the Minor. . . . If one were continually to sing only to those above-mentioned Instruments [the organ and harpsichord], this Knowledge might be unnecessary; but since the time that Composers introduced the Custom of crowding the Opera's with a vast Number of Songs accompanied with Bow Instruments, it becomes so necessary, that if a Soprano was to sing D-sharp, like E-flat, a nice Ear will find he is out of Tune, because this last rises. Whoever is not satisfied in this, let him read those Authors who treat of it, and let him consult the best Performers on the Violin.⁹

Among Quantz's many comments on tuning, he explained that

What led me to add another key not previously used on the flute was the difference between major and minor semitones. . . . The major semitone has five commas, the minor only four. For this reason, Eb must be a comma higher than D#.

From our perspective in the late 20th century, we are introduced here to two rather startling concepts:

- 1 the existence of major and minor *semitones* (a D# different from an Eb, for instance);
- 2 the possibility, therefore, that on some notes the harpsi-



1 The musical amateurs (1755). Oil painting by Julius Quinkhard (Amsterdam, Rijksmuseum)

chord or organ might be tuned differently than the other members of an instrumental ensemble.

A system that differentiates between half-steps, according to their harmonic function, suggests refinements unknown to our ears, which have grown accustomed to a mere 12 notes to the octave. But as far as Quantz was concerned in 1752,

Appreciation of [this difference between flats and sharps] is needed by anyone who wants to develop a refined, exact and accurate ear in music.

Modern players usually raise sharps and lower flats to enhance their melodic function as leading, or 'tendency' notes. This practice has its roots at the beginning of the Romantic period with the rise of equal temperament,¹⁰ and is the reverse of the normal practice of 17th- and 18th-century musicians, for whom leading notes were low. Our contemporary preoccupation with melody is apparently recent; a stronger harmonic orientation and more 'vertical' awareness naturally tended to favour the pure major 3rd (which is much smaller than the beating, unresonant equal-tempered one).

The pure 3rd is an interval that is both natural and very satisfying to play, and, indeed, most modern musicians seem to gravitate towards it, especially string players tuning to their open strings. But pure 5ths are even easier and yet more tempting to tune on a stringed instrument. Since the end of the 18th century, therefore, 5ths have usually won out over 3rds in string intonation (compare the Pythagorean system, with its perfect 5ths and high 3rds).¹¹ Rameau (1737), Quantz (1752, chap.17/vii/4) and Sorge (1744, p.53) indicated that some violinists in their day were also inclined to pure 5ths (see appendix for these texts), but they considered this a mistake and associated it with poorer players.¹² They reasoned that a violin tuned to perfect 5ths would be out of tune with the harpsichord or organ, but the deeper implication was that it would also be unsuited to the general intonation system of the period. As John Hind Chesnut wrote (p.271):

Modern intonation practice . . . is not appropriate if our goal is to play Mozart's music as he himself wanted it played. The quasi-Pythagorean 'expressive' or 'functional' intonation of 19th- and 20th-century non-keyboard instruments is particularly foreign to the tradition in which Mozart stood.

Tempering and 'intoning justly'

We are not dealing here with a closed tuning system based on a circle of 5ths like a keyboard temperament. Sources discussing non-keyboard intonation usually only expressed the general principle that flats were a

comma higher than sharps. This says nothing about the naturals; it implies a general system but does not indicate any specific temperament.

Quantz wrote:

. . . the other instruments play [the notes] in their correct ratios, whereas on the harpsichord they are merely tempered.

'Merely tempered' is the key phrase here. If we use *both* D \sharp and E \flat , G \sharp and A \flat , etc., we will need more than 12 notes in an octave. These different enharmonics are available for the singer or violinist, who is able to adjust intonation while performing, but keyboard players (unless they have instruments with split keys) are forced to resort to complicated systems of temperament.

'Temperament' in this sense means 'compromise', an expedient that attempts to make the best of the fact that only one note can be played when two are needed.¹³ It is an artifice that gives the illusion that a keyboard instrument is as well in tune as the other instruments when played by musicians with the 'refined, exact and accurate ear' of Quantz's time.

For non-keyboard instruments, in fact, 'temperament' is not even possible. Without a fixed tuning, intonation is influenced by technical situations, subjective perceptions, even differences in dynamics.¹⁴ Players of such instruments are incapable (even if they wanted it) of the level of consistency in intonation implied by a temperament.¹⁵

But although they are not bound by any closed system, it would still be useful to see how original descriptions of their tuning might be roughly fitted into a keyboard system, since they normally perform with harpsichords or organs. A keyboard temperament can also operate as a frame of reference or model, from which singers and players of instruments with flexible intonation can occasionally depart in the context of the moment. Ideally, a 'synergetic' relationship will exist, in which the keyboard is first tempered as closely as possible to the physical and musical needs of the other instruments, who in their turn refer back to it for guidance.

By definition, we can deduce that a tuning that distinguishes between enharmonic pairs, with sharps being a comma lower than flats, does not resemble either equal temperament or the Pythagorean system (in which sharps are higher than flats). If it is a system at all, it must be closer to either just intonation or some form of mean-tone.

Just intonation 'has always had a kind of fatal fascination for musicians because of the purity within the

basic scale of the tonic, subdominant, and dominant chords, and of certain melodic intervals¹⁶ that can be easily tuned to the open strings. Some early violin tutors indicate the use of a kind of just intonation, flexibly applied in a limited way (see appendix Rameau (1726) and Tartini (1754, pp.100-101).¹⁷ But just intonation is a kind of 'holy grail' that is impossible to apply continuously,¹⁸ although ingenious attempts at it have been made.¹⁹ As Barbour put it,²⁰

The bulk of the violinists [in c.1730] were probably still accustomed to the just thirds and greatly flattened fifths of mean-tone temperament.

The line between just and mean-tone need not, of course, be strictly drawn on instruments whose tuning is not fixed.²¹ Some string players begin with open strings tuned to somewhat narrow 5ths and tune intervals purely to the open strings. Wind players, too, tend to adjust long notes purely. Of any consistent system, this tuning most resembles '1/4-comma' mean-tone ('mean-tone' in its strictest sense), in which 3rds are pure (as in just intonation) and 5ths are smaller than pure by a quarter of the syntonic comma.

But the difference between enharmonic pairs in 1/4-comma mean-tone is much greater than that specified by early sources (41 cents as opposed to 22).²² The consistent use of 1/4-comma mean-tone is not, therefore, what they describe. Georg Muffat (1698) even warned violinists to resist the temptation to play leading notes too low (*sic*).

Tosi said that 'a Tone . . . is divided into nine . . . Intervals, which are called Comma's, five of which constitute the Semitone Major, and four the Minor.' (The 'comma' referred to here is just under 22 cents wide).²³ An example of a major semitone would be C-Db, a minor would be C-C#. Since the first is five commas and the second four, the difference between them is one comma.

An octave, as Francesco Geminani wrote in 1751, can be divided 'into 12 Semitones, that is, 7 of the greater and 5 of the lesser'. Since the seven 'greater' or major semitones each contain five commas and the five 'lesser' have four, the octave will consist of a total of 55 commas, or parts. The 55-part octave, as the sources quoted in the appendix show, was a familiar concept in the 17th and 18th centuries.²⁴ It corresponds to a temperament known now as '1/6-comma mean-tone'.²⁵

Written sources

The term 'mean-tone' was not used in the 18th century; in fact, like many commonly accepted assumptions,

musicians were so unconscious of alternatives to a system that included major and minor semitones that it had no name at all.²⁶

Among the more interesting descriptions of non-keyboard tuning are those by Telemann and Quantz. Sorge (1748, p.61) said that Telemann's tuning system 'cannot be applied to a keyboard instrument, but it may be rather convenient for the fiddle and certain wind instruments, and is the easiest for singers'. Chesnut has pointed out that Mozart also apparently distinguished the small and large half steps of a mean-tone temperament similar to 1/6-comma.²⁷ Major and minor semitones were discussed as late as 1813.²⁸

In his 1707 *Méthode* (p.206), Sauveur classes instruments according to their ability to alter their intonation: the voice and violin are in a class in which accurate intonation depends entirely on the ear, while the keyboards are in one where no control is possible during playing. The woodwinds fall in an intermediate class, and are among instruments

. . . on which the pitch is governed by projections, toneholes or touchpieces, but that can be nevertheless corrected by a sensitive ear.²⁹

A number of woodwind fingering charts from the end of the 17th to the end of the 18th century confirm the use of higher pitches for flats and lower for synonymous sharps, although the exact difference is not specified. Recorder charts are the most informative, since the instrument's inflexible blowing technique requires alternative fingerings for correcting intonation. Among the many fingering charts that appeared for the recorder from 1630 to 1795, the earliest often choose only one of the two enharmonic pairs.³⁰ By 1700 complete chromatic charts began to appear that distinguished most pairs, especially the *d#'/eb'*. The most interesting charts were those by Johann Christian Schickhardt (c.1720), which distinguished *g#''/ab''*,³¹ and Thomas Stanesby Jr (c.1732), that distinguished every chromatic note.³²

To a lesser extent, traverso charts also offer useful information; Quantz's additional key indicates that tuning corrections were more limited on the traverso than on the double-reed instruments (to which such keys were never added).³³

Although embouchure adjustments make the oboe's intonation relatively flexible, most oboe charts indicate alternate fingerings for some sharps and flats, from the earliest existing chart (Bismantova, 1688)³⁴ to at least 1816 (Whitely).³⁵ The synonymous pairs that are given the most alternate fingerings are the 'left-hand' notes *G#'/Ab* and *A#'/Bb* (illus.1 and 2). The development of

A Scale of all the Notes both flat and Sharp on the Hoboy

Where you meet with a Cross plac'd on the third line, it shews that you must stop but one of those holes that are cover'd with y^e third finger of your left hand, but let that be the hole which is next your hand. Observe where you see this mark [n] over the heads of the Notes in the Scale which begins at D below and so on all y^e notes in alt you must Press the reed almost close between your lips and blow stronger then you did before and y^e higher you goe still continue blowing somewhat stronger

2 Oboe chart from *The Second Book of Theatre Musick* (London: Walsh, 1699). Durham Cathedral Library, courtesy of the Dean and Chapter of Durham. Note distinctions between G# and Ab.

3 Pages 54-5 from Georg Andreas Sorge's *Gespräch zwischen einem musico theoretico und einem studioso musices* (Lobenstein, 1748)

● 54 ●

SYSTEMA

C	2000.	00
bbD	1975.	30
x̄C	1901.	40
bD	1877.	92
D	1785.	50
bbE	1763.	45
x̄D	1697.	55
bE	1676.	59
E	1593.	98
bF	1574.	30
x̄E	1515.	49
F	1496.	78
bbG	1478.	30
x̄F	1423.	04
bG	1405.	48

● 55 ●

TELEMANNICUM.

x̄F	1352.	93
G	1336.	23
bbA	1319.	73
x̄G	1270.	41
bA	1254.	73
A	1192.	91
bbH	1178.	18
x̄A	1134.	15
bH	1120.	15
bbC	1106.	32
H	1064.	96
b̄C	1051.	82
x̄H	1012.	50
C	1000.	00

x̄F

● 4

● 56

double holes on the oboe and recorder has an obvious application for 'intoning' enharmonic pairs. On both instruments they affect the most ambiguous pair, G \sharp -Ab.³⁶

Bassoon fingering charts also distinguished enharmonic pairs.³⁷ Towards the end of the century, however, keys began to be added whose purpose may have partially been to obscure these distinctions.³⁸

Regular versus irregular temperaments

As Telemann wrote of his tuning system (1743/4), 'It establishes a continuous proportional equality between intervals . . .' This implies something similar to a standard 'regular' mean-tone temperament, defined by Barbour as one 'in which all the fifths save one are the same size'.³⁹

An interesting attribute of 'regular' mean-tones is the ease with which standard transpositions can be made, since intervals are identical in strategic keys. This would explain how German composers like Bach and Telemann were able to function in mean-tone while using Chor-Ton and Cammer-Ton simultaneously.⁴⁰ 'Transposing' instruments were a part of life for German musicians at this time. Parts for transposing instruments were notated in different keys from the majority of the parts, because they were 'pitched' differently (being tuned to Chor-ton/Cammer-Ton). The 'd'amore' instruments and the violino piccolo also had transposed parts.⁴¹

It is obvious that, however notes are notated or fingered, they should be at the same frequency for all the instruments of an ensemble. But the differences in key among transposing instruments were always either a major 2nd or a minor 3rd. Since in a regular mean-tone, parallel scales a major 2nd or minor 3rd apart would normally be inflected identically,⁴² their notes would have corresponded closely.⁴³ Mean-tone tuning will therefore work with transposing instruments, as long as the keyboard instruments in such music are tuned in regular (rather than irregular) temperaments.⁴⁴

A model based on a regular temperament is relatively simple and easy to remember.⁴⁵ Let us take $\frac{1}{6}$ -comma mean-tone as an example. Since most musicians nowadays use a Korg or similar tuning machine, the following table shows where its notes are placed in relation to equal temperament.⁴⁶

As flattened notes become more distant from C, they become gradually higher, whereas sharpened notes become lower. The note Bb, for instance, is 9 cents higher than in equal temperament, Eb 10 cents, Ab 12 cents etc. Going in the other direction, F \sharp is 6 cents low, C \sharp 8 cents, G \sharp 10 cents, D \sharp 11 cents etc.⁴⁷

	C	+5 cents	
C \sharp -8			Db +14
	D	+1	
D \sharp -11			Eb +10
	E	-2	
	F	+7	
F \sharp -6			Gb +16
	G	+3	
G \sharp -10			Ab +12
	A	0	
A \sharp -13			Bb +9
	B	-4	
	C	+5	

Although a regular temperament might have been useful for the keyboard instruments, it is unlikely that other instrumentalists and singers adhered strictly to it, since the 3rds and 5ths would never have been completely pure. Irregular mean-tone systems, which favour selected keys at the expense of others, were no doubt also used together with non-keyboard instruments.⁴⁸ There are clear expressive advantages to these tunings, in which modulations are more colourful.

But no system, regular or irregular, could possibly have been applied rigidly on the flexibly pitched instruments. The regular 55-part octave was no more than a convenient theoretical framework, and it can be used to advantage by present-day musicians with either a similarly tuned keyboard instrument or one tuned in an irregular temperament such as the well-known 'Werckmeister III' or 'Tempérament ordinaire'.

Reconciling the keyboard to the other instruments

Discussing intonation, Hubert LeBlanc (p.55) commented that:

The divine artistry of Mr Blavet consists in adjusting [the tuning of his] flute by his manner of blowing. But students of the harpsichord praise the instrument for its intonation, not perceiving that it is in fact never truly in tune.

It is natural to refer to the keyboard instrument when intonation questions arise in an ensemble, since it is the only instrument with a fixed pitch. But fixed pitch has the defect of its virtue: when the music changes and demands tuning modifications, the keyboard cannot adapt as the other instruments can. It is a case of the immovable object and the irresistible force. There is little sense, for instance, in tuning the G \sharp of a flute to a harpsichord with an Ab.

A number of sources (among them Sauveur, Tosi, Quantz, Telemann, Tartini, Sorge and Mozart) accepted

the fact that keyboards used different systems of tuning from other instruments.⁴⁹ There are suggestions as to how the problem was solved. Huygens, Rameau (1726) and Sorge (1744, p.53; 1758) all assumed that the melody instruments should conform to the keyboard. On the other hand, Rameau (1737), Rousseau (1743) and de Béthizy considered it self-evident that (except for unison notes and final tonics) singers purposely ignored the temperament of the accompanying instruments. Quantz (1752, chap.17/vi/20) proposed a more diplomatic solution in which the fixed-pitch instrument also adapted to the other instruments.

In larger settings such as orchestras, a keyboard instrument is considerably less audible than the treble melody instruments. In the case of the harpsichord, the sound dies away quickly, while pure intervals are sustained by the other treble and bass instruments. De Béthizy and Quantz (1752, chap.16/7) suggest that singers and other players would thus do better to adjust to the violins and oboes rather than the harpsichord (compare also Tosi above).⁵⁰ The problem is more acute for the other bass instruments, since they usually play in unison with a harpsichord or organ.⁵¹ There are a number of possible solutions.

The idea of a harpsichord or organ with split keys was mentioned by Tosi and Quantz; something similar was apparently used by Handel.⁵² With both D \sharp /E \flat and G \sharp /A \flat , the keyboard would have good major triads as far as B and A \flat major, making it possible to venture into tonalities with as many as four sharps or flats and still keep the thirds relatively pure.⁵³ For continuo playing, therefore, split keys clearly have a use.⁵⁴

Barbour (1951, p.191) suggests that, when key changes were limited, it was a historic practice to retune unsplit keyboard accidentals during a programme. It takes about as long to change a D \sharp to an E \flat on a harpsichord as to tune a section of violins.⁵⁵

Another solution is to use two harpsichords, one tuned (for instance) to sharps and the other to flats. Alternatively, one two-manual harpsichord can be used in this way.⁵⁶

Where frequent choices between enharmonics are necessary (i.e. when a wide range of keys cannot be avoided), another approach is suggested by several sources. Quantz's 'good temperament which allows either [synonymous flat/sharp] to be endurable' and Telemann's enharmonic pairs that are 'blended together' on keyboard instruments (1767) imply either the use of an irregular mean-tone or the splitting of the difference between the two or three trouble-making accidentals

within the framework of a regular mean-tone system.⁵⁷ The latter compromise (which is necessarily rather colourless in character) might look on a Korg tuner like this:

C	+5 cents
C \sharp	-8
D	+1
D \sharp /E \flat	0
E	-2
F	+7
F \sharp	-6
G	+3
G \sharp /A \flat	+1
A	0
B \flat	+9
B	-4
C	+5

This scale is based on $\frac{1}{8}$ -comma mean-tone; C \sharp , F \sharp and B \flat plus all the diatonic notes are left in their normal places (see previous table), and the difference between the two ambiguous flat/sharps is split.

Some practical considerations

Quantz gave some advice on practising intonation (1752, chap.17/vii/8). He advised (as did Leopold Mozart) the use of a monochord to players of melodic instruments.⁵⁸

The best manner of escape from [poor intonation] is the monochord, on which one can clearly learn the intervals. Every singer and instrumentalist should become familiar with its use. They would thereby learn to recognize minor semitones much earlier as well as the fact that notes marked with a flat must be a comma higher than those with a sharp in front of them. Without these insights one is obliged to depend entirely on the ear, which can however deceive one at times. Knowledge of the monochord is required especially of players of the violin and other stringed instruments, on which one cannot use the placement of the fingers as an exact guide, as one can on wind instruments.

In our time, we can add that we have all grown up in a prevailing atmosphere of approximate equal temperament, making the help of a reference beyond our ears even more necessary. There is a 'black box' on the market that functions much like a monochord; it is designed to play in any temperament the user wishes.⁵⁹

A player using mean-tone as a model is theoretically expected to have alternate flats and sharps available for every note, but in practice some accidentals are rarely used, since 18th-century music usually stays within the bounds of keys with four flats and sharps. One seldom

has to play the notes E \sharp , F \flat , G \flat , B \sharp , C \flat etc. There are, then, three sets of enharmonic pairs that are usually ambiguous and need attention: Ab/G \sharp , Eb/D \sharp , and Db/C \sharp .⁶⁰ The other notes (C, D, E, F, F \sharp , G, A, B \flat , B) are normally always in the same place.

The less adaptable to different tonalities a temperament needs to be, the purer and richer it can be. Just intonation, the theoretical ideal, is practical in only one key; equal temperament works in all of them. When planning concert programmes, therefore, the choice of tonalities relates directly to the choice of keyboard temperament, and vice versa.

Conclusion

It should be clear by now why the concept of major and minor semitones is fundamental to 18th-century tuning practice, why it can cause problems between the keyboard and the other instruments, and how it logically leads to intonation models that resemble various temperaments known nowadays as 'mean-tone'. A closed system is artificial when applied to strings, winds and voices, but it can help players and singers understand how to work with the 'immovable object', a keyboard instrument with its fixed pitch, as well as provide them with a frame of reference with which to build a more expressive and 'harmonious' structure of intervals.⁶¹

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¹Aside from his articles on temperament in *New Grove*, Mark Lindley has written an excellent historical survey of temperament and tuning in 'Stimmung und Temperatur', *Geschichte der Musiktheorie, vi: Hören, Messen und Rechnen in der Frühen Neuzeit* (Berlin, 1987).

²Patrizio Barbieri's excellent article 'Violin intonation: a historical survey', *Early Music*, xix/1 (1991), pp.69–88, is a welcome exception. The present article will, I hope, complement it.

³Fretted stringed instruments, whose intonation is a more specialized subject, are not treated in this study (see, however, LeBlanc (1740) in the appendix). Cf. M. Lindley, *Lutes, Viols and Temperaments* (Cambridge, 1984).

⁴Other useful sources are cited and discussed in Barbieri.

⁵See J. M. Barbour, *Tuning and Temperament, a Historical Survey* (East Lansing, Michigan, 1951), pp.1, 89.

⁶In classic $\frac{1}{4}$ -comma mean-tone, 11 5ths are tuned one-quarter of a syntonic comma smaller than pure. This produces eight pure major 3rds. The placement of the twelfth 5th, known as the 'wolf', determines which tonalities are usable.

⁷R. Smith 'Harmonics' (2nd ed. 1759), pp.166–7, quoted in A. J. Ellis, 'On the History of Musical Pitch', in A. J. Ellis and A. Mendel, *Studies in the History of Musical Pitch* (Amsterdam, 1968), p.55. Smith was a respected astronomer. See Lindley, 'Stimmung und Temperatur', p.297.

⁸... a son usage chés les Joueurs d'Instrumens les moins habiles à cause de sa simplicité & de sa facilité.' Joseph Saveur, *Méthode générale* (1707). The famous conversion of Rameau to a kind of equal temperament, recorded in his *Génération harmonique* (1737) was an interesting exception. See Lindley, 'Stimmung und Temperatur', pp.244–47.

⁹The translation used here is by the oboist J. E. Galliard, who published an English version of Tosi's book in 1743 entitled *Observations on the Florid Song*. Tosi's book was still current enough in 1757 that it was translated by J. F. Agricola in *Anleitung zur Singkunst*. The words in brackets are mine.

¹⁰See D. Boyden, *The History of Violin Playing* (Oxford, 1965), pp.186, 370–71; Lindley, 'Stimmung und Temperatur', p.296. See also Cavallo (1788) in appendix.

¹¹T. Podnos, *Intonation for Strings, Winds, and Singers* (Metuchen, NJ, 1981), p.9; D. D. Boyden, 'Preleur, Geminiani, and Just Intonation', *JAMS*, iv (1951), p.219; J. M. Barbour, 'Violin Intonation in the 18th Century', *JAMS*, v (1952), p.233; J. H. Chesnut, 'Mozart's Teaching of Intonation', *JAMS*, xxx (1977), pp.255, n.9, 256; and Barbier; pp.82–5.

¹²See also Werckmeister (1691) in appendix. Barbieri (pp.70, 74) noted other indications of both pure-5th tuning and tempered open strings.

¹³Cf. Leopold Mozart (1756) in appendix.

¹⁴A violinist plays on an open string about 5 cents higher when playing *forte* than when playing *piano*. (This is the conclusion reached by the author and a Baroque violinist, in experiments using an electronic tuner.)

¹⁵This inconsistency is the hobgoblin of a theoretician of 'little mind' like Sorge (cf. Sorge (1744), p.53 in appendix).

¹⁶Boyden, 'Preleur, Geminiani and Just Intonation', p.202

¹⁷See Boyden, 'Preleur, Geminiani and Just Intonation', and Robert Bremner's Preface to J. G. C. Schetky's *Six Quartetts*, op.6, quoted in full in N. Zaslav, 'The Compleat Orchestral Musician', *EM* (1979), pp.46–57. Bremner (a student of Geminiani) gives violin intonation exercises based on pure intervals. See also M. Lindley, 'Der Tartini-Schüler Michele Stratico', *Kongressbericht Bayreuth, Gioseffo Zarlino, 1588, Sopplimenti musicali* (Venice, 1981), chaps.33–7, and Lindley, 'Stimmung und Temperatur', p.293. LeBlanc (1740), p.133ff. may also be discussing just intonation, to judge from his comments on the difficulty of modulations: 'harpischords are tuned with both major and minor semitones, which are nevertheless not exempt from problems when there is a change of key. This practice has been renounced despite its occasional benefits.'

¹⁸This is a well-known problem in choral practice, where intonation tends to be quite pure, leading the final tonic to a point remote from where it began. Sauveur also discusses this problem in his *Méthode* (1707), pp.206–7. A more complete discussion of the ramifications of playing in just intonation on a violin is presented in C. Moran, 'Temperament and Violin Intonation in Baroque Music' (unpublished paper, University of Montreal, 1986).

¹⁹See Barbieri, pp.69–72.

²⁰Barbour, 'Violin Intonation', p.234. Barbour's article was written in response to Boyden's, and gives several convincing arguments for this statement (pp.232–4).

²¹Many musical theorists also drew this line vaguely. See Lindley, 'Stimmung und Temperatur', p.293. As Barbieri put it (p.72), 'mean-tone can be considered a tempered just intonation . . .'

²²See Boyden, 'Preleur, Geminiani and Just Intonation', p.215.

²³This is very close to the 'syntonic comma', which is 21.5062896 cents, and is incidentally the difference between the over-large major 3rd in Pythagorean tuning and a pure 3rd. See Lindley, *New Grove*, iv, p.591 and Sorge (1758) in the appendix.

²⁴See Sauveur (1707) and Fontenelle (1711). Lindley, 'Stimmung und Temperatur', p.191 registers an inexact discussion of the 55-part octave by Fernandez as early as 1626; see also p.211 on N. Mercator (1672).

²⁵ $\frac{1}{6}$ -comma mean-tone is produced by tuning 11 of the 12 5ths on a keyboard smaller than pure by $\frac{1}{6}$ of a comma (whence the name). In this temperament, a major semitone = 109.09 cents and a minor semitone = 87.273 (see Lindley, *New Grove*, ix, p.278). The difference between them is therefore 21.817 cents, or about as close to a syntonic comma as it is possible to achieve in a keyboard tuning system. We can deduce then, that if a consistent system is implied in the use of major

and minor semitones, $\frac{1}{6}$ -comma mean-tone is the temperament that it most resembles.

²⁶Some writers, beginning in the early 17th century, conceived it in terms of the 55-part octave.

²⁷See W. A. Mozart (1785–7) in appendix. In *Popoli di Tessagli*, K316, bar 42, the voice has a B \flat and an A \sharp in the same bar; both the oboe and violin have A \sharp , though the piece is in C minor. The distinction between the two notes was obviously significant to Mozart.

²⁸See Busby (1813) in appendix. Sources that describe $\frac{1}{6}$ -comma mean-tone, but which are not included in the appendix, include: Johann Mattheson, *Der vollkommene Capellmeister* (Hamburg, 1739), p.55; Johann Adolf Scheibe, *Eine Abhandlung von den musicalischen Intervallen und Geschlechtern* (Hamburg, 1739); Daniel Gottlob Türk, *Kurze Anweisung zum General-bassspielen* (Leipzig and Halle, 1791).

²⁹This is reminiscent of Freillon-Poncein (1700) in the appendix.

³⁰See E. Eijken, 'Een onderzoek naar getempereerd spel op houtblas-instrumenten in de 17e en 18e eeuw, in het bijzonder op de blokfluit' ['An investigation of tempered intonation on woodwinds of the 17th and 18th centuries, particularly on the recorder'] (unpublished term paper, Royal Conservatory, The Hague, 1982), p.19.

³¹Johann Christian Schickhard, *Principes de la flûte* (Amsterdam, c. 1720). Schickhard also published 'L'Alphabet de la musique', a collection of sonatas for violin, traverso or recorder in 24 keys (1735).

³²Thomas Stanesby Jr, *A New System of the Flute à Bec or Common English Flute* (London, c.1732).

³³Barbieri (p.82) notes, however, that Charles Delusse in *L'Art de la Flute traversiere* (c.1761) was apparently giving fingerings that produced sharps higher than flats (he cites Pierre Sechet). At the time, this was exceptional.

³⁴Bartolomeo Bismantova, 'Regole . . . del Oboè' [Ms version of *Compendio musicale*] (Ferrara, 1688). See E. Tarr, *Tibia*, 2/87 (1987).

³⁵See B. Haynes, 'Oboe Fingering Charts, 1695–1816', *GJ* (1978), pp.68–93.

³⁶Both Quantz and Sorge indicated that woodwind players tuned their scales from the tonic note of the key in which they were playing rather than from an absolute pitch as given by a keyboard instrument. See Sorge (1758), p.9, par.14; Quantz (1752), chap.16/4. Fred Morgan recently made a beautiful recorder for me with a doubled third hole, making it possible to distinguish \flat more accurately from \sharp .

³⁷See P. J. White, 'Early Bassoon Fingering Charts', *GJ* (1990), p.98.

³⁸See White, 'Early Bassoon Fingering Charts', p.96 on Ozi (1787).

³⁹Barbour, *Tuning and Temperament*, p.xi. Many keyboard temperaments use more complex systems. In a regular mean-tone, any six keys related to each other by 5ths (B \flat F C G D A, for instance), will contain appropriately tuned accidentals and identical scale intervals. In order to use other keys, accidentals have to be retuned. Chesnut believed Quantz was describing an irregular system for his harpsichord ('Mozart's Teaching of Intonation', p.260, citing Quantz (1752), chap.17/vi/20), but in fact the discrepancy to which Quantz referred was between the harpsichord and other bass instruments. Thus it is quite possible that the 'bonne Temperature' that Quantz suggested for the harpsichord (chap.17/vii/9) was a regular one.

⁴⁰See B. Haynes, 'Questions of Tonality in Bach's Cantatas: the Woodwind Perspective', *Journal of the American Musical Instrument Society* (1986), pp.40–67.

⁴¹Instruments built in consorts are normally tuned at the more compatible intervals of a 4th or 5th. Since in mean-tone conjunct 5ths are tuned similarly, a consort of instruments tuned in 5ths (F–C–F–C, G–D–G–D or even G–D–A) would be well in tune even when instruments were separately tuned starting on different notes. The 'd'amore' instruments, on the other hand (such as the voice-flute, oboe d'amore, flute d'amore and usually viola d'amore), are pitched a minor 3rd below their more standard counterparts. Looked at without consideration for how these instruments were used, certain notes that are low (from the individual player's point of view) might need to be high in the context of the rest of the group. Fingering F \sharp (IV \sharp) on a flute or

oboe d'amore, for instance (normally a low note), could as easily be a sounding Eb as a D \sharp ; fingered A \sharp (V \sharp) on a voice-flute (also very low, especially in the second octave, and a C \sharp on the normal F-treble) could be sounding B \flat . Should these instruments be tuned differently from standard ones? There are numerous examples indicating that 'd'amore' instruments were often used principally for their ability to play in sharp keys. The basic key (i.e. six-fingered note) of an oboe d'amore or flute d'amore is sounding B major; that of a voice-flute is E. See Haynes, (1986), p.54. If such instruments were normally associated with sharp keys, it is unlikely that they would often have played a sounding Eb; the note would have normally been a D \sharp and thus the fingered F \sharp (like the D \sharp , inflected low) would have worked perfectly well.

⁴²Using $\frac{1}{6}$ -comma mean-tone in a range of six normal keys for the Cammer-Ton instruments (Eb B \flat F C G D for instance), an organ at Chor-Ton a major 2nd higher would have been tuned with all the accidentals as flats to produce identical parallel intervals for the keys Db Ab Eb B \flat F C. If Chor-Ton was a minor 3rd higher than Cammer-Ton, the same parallel intervals would have been obtained by tuning the organ to the keys C G D A E B, produced by tuning all the accidentals as sharps.

⁴³There would have been a slight difference in pitch. For the interval of a major 2nd, the difference would have been 4 cents (At $d'=410$, 4 cents is about 1 Hz, which is negligible). The interval of a minor 3rd produces a pitch difference of about 5.5 cents, or about 1.5 Hz.

⁴⁴Although Neidhart (1732) and Sorge (1744, p.24) seem to be speculating on the use of irregular temperaments in these situations, Sorge (1748) strongly advocates what he calls a 'gleichschwebende Temperatur', in which 11, not 12, 5ths are equal (pp.14, 34). A modern instance of 'transposition' is the use of portable organs designed to play alternately at $d'=440$ and $d'=415$ with movable keyboards. A semitone difference is much less practical in a regular mean-tone, such as $\frac{1}{6}$ -comma, since an organ tuned to play the keys Eb B \flat F C G D at $d'=440$ would only be capable of playing the keys E B F \sharp C \sharp G \sharp D \sharp in tune at $d'=415$. If the keys Eb B \flat F C G D were available at $d'=415$, switching to $d'=440$ would produce D A E B F \sharp D \sharp .

⁴⁵The 3rd and the 7th, for instance, are always 7 and 9 cents below their placement in equal temperament.

⁴⁶Scales in the 18th century were traditionally tuned from C, not A (see Asselin, p.34, Chesnut, 'Mozart's Teaching of Intonation', p.268, and Boyden, *History of Violin Playing*, p.204). For string players, however, it is easier to tune to an open string. The table therefore gives A as 0.

⁴⁷Note that synonymous sharps/flats are always approximately a syntonic comma apart (i.e. between 21 and 22 cents—the actual figure contains decimal points that have been rounded off on one side or the other).

⁴⁸On this subject, see Heinichen (1728) and Rameau (1737) in appendix.

⁴⁹We should be less surprised by [such a situation] when we remember that from the nineteenth century to the present day, keyboard and non-keyboard instruments have characteristically been tuned according to different systems of intonation, the keyboard instruments being in equal temperament and the non-keyboard instruments usually in some form of quasi-Pythagorean tuning.' Chesnut, 'Mozart's Teaching of Intonation', p.257.

⁵⁰Organs are more audible because their notes do not decay quickly.

⁵¹On this question see Quantz (1752), chap.17/vi/20.

⁵²See Ellis ([1750]) in appendix. The keys that were split were D \sharp and G \sharp . Since it is in the regular temperaments that a choice is necessary between enharmonic equivalents, the use of split keys implies also the use of a regular temperament.

⁵³The practical limits would be E to Eb in major keys and E to F in minor keys.

⁵⁴Some history of the use of split keys can be found in Lindley, 'Stimmung und Temperatur', p.186; F. Hubbard, *Three Centuries of Harpsichord Making* (Cambridge, Mass, 1965), pp.35–6, 168; and Klop, p.12. As

might be expected, the two notes that seem to have been commonly split were D \sharp and G \sharp .

⁵⁶Barbour, *Tuning and Temperament*, p.191. But cf. LeBlanc (1740), who said ([On a harpsichord,] one cannot correct [tuning] during a concert . . . (p.55) and 'harpsichord or organ, which are tuned for a concert once and for all (and sometimes for a half year)' (p.133).

⁵⁷In this situation, ten of the 12 notes would normally be identical, and only D \sharp /Eb and G \sharp /Ab would be different. Sympathetic vibrations on the instrument would not, therefore, be significantly affected.

⁵⁷Rousseau suggested the same idea by dividing the wolf over the last three 5ths (thereby striking a mean between D \sharp /Eb and G \sharp /Ab) in the *Encyclopédie, ou Dictionnaire raisonné des sciences, arts et métiers*, ed. D. Diderot and J. Le Rond d'Alembert (1756). Barca's temperament also allows for irregular placement of chromatic notes and might therefore be similar to this one.

⁵⁸The oboist Michel Piguet of Basle, who has used a system similar to $\frac{1}{6}$ -comma mean-tone (with Rousseau's modification) for many years, has written a useful commentary on teaching historical intonation in 'Beispiele zur Intonationslehre im Unterricht', *Alte Musik; Praxis und*

Reflexion, Sonderband der Reihe 'Basler Jahrbuch für Historische Musikpraxis', (1983), pp.346-52.

⁵⁹The tuner is available from Widener Engineering, 203 Westbrook Drive, Austin TX 78746, USA. (Model 110—cheaper than a Korg, I believe—is recommended.)

⁶⁰On a woodwind instrument, only two enharmonic pairs need to be ambiguously tuned so the player has a choice: D \sharp /Eb and G \sharp /Ab. All four of these notes are regularly demanded when playing in standard Baroque keys. (Db is rarer, so tuning decisively to C \sharp is usually desirable.) On a flute, G \sharp /Ab can be adjusted with embouchure or alternate fingerings, but the fingering 123-456-7 (D \sharp /Eb) give a very decisive pitch because most of the tone holes are closed, there is relatively little leeway for adjusting breath pressure, and there is no alternate fingering. Hence the necessity of the added key.

⁶¹G. C. Klop observed (in a lecture on harpsichord temperaments at Bruges in 1975) that tuning was usually discussed in 18th-century treatises under the heading of *composition*, since it was regarded as an expressive device.

4 Michel Corrette, 'Gamme du hautbois', p.51 in *Méthode raisonnée pour apprendre aisément à jouer de la Flûtte Traversiere . . . Nouvelle édition . . . augmentée de la Gamme du Haut-bois . . .* [? 1776]. Paris, Bibliothèque Nationale (rés.337). Corrette shows f \sharp 's 'à l'Italienne' and 'à la française'

GAMME DU HAUTOIS

à l'Italienne à la française

En Montant

En Descendant

Les chiffres 1.2.3.4.5.6.7.8. marquent le nombre des trous du Hautbois et les O blancs ou noirs ou demi noirs O quand les Trous doivent être ouvert ou fermez, ou bien demi ouverts et demi fermez.

APPENDIX: SOURCES

[?1690s; manuscript]. Christiaan Huygens, *Oeuvres complètes* (The Hague, 1888-1950), xx, pp.73-4

Mais la voix ajuste tout cela, au moins quand on chante sans être accompagné de quelqu'un de ces instrumens à tons fixes. But a singer adjusts all [these varieties of temperament], at least when singing without the accompaniment of an instrument with fixed pitch.

1691 Andreas Werckmeister, *Musicalische Temperatur* (Frankfurt-on-Main and Leipzig), p.3

Wenn alle Quinten rein gestimmt würden/wolte schon eine unreine Folge der Consonantie entstehen.¹ If the 5ths are tuned purely [on a violin], the result will be impure intonation.

1698 Georg Muffat, *Florilegium secundum* (Passau), 'Premieres Observations: I. Contactus. Du Toucher Juste'

J'ay remarqué que les défauts de ceux qui Jouënt faux proviennent la plus part, de ce que des deux touches qui ensembles composent le semiton (par exemple le mi, & le fa; a & b; ♯ & c; ou ♯f & g; ♯c & d; ♯g & a & c.) Jamais il ne prennent le mi, ou la dièse ♯ assez haut; ny le fa ou le b mol assez bas. I have noticed that the most common mistake of those who play out of tune involves the two notes that make up a semitone (as for example E-F, A-B♭, B-C, F♯-G, C♯-D, G♯-A etc). The E, or the sharpened note (♯) is not played high enough, nor the F, or the flattened note, low enough.

1700 Jean-Pierre Freillon-Poncein, *La Véritable Manière d'apprendre à jouer en perfection du haut-bois, de la flûte et du flageolet* (Paris), p.9

Je ne parle point icy de la difference qu'il y a des demy tons majeurs ou mineurs, parce que aux Instrumens où l'oreille conduit les sons, on peut les faire tous égaux; ainsi la transposition sur toute sorte de demy ton se peut executer avec autant de justesse que sur le naturel. I will not speak here of the difference that exists between major and minor semitones, since on instruments that control their tuning by ear, they can all be played alike [i.e. with the same fingerings]. Thus, a scale transposed to any semitone can be played as well in tune as one without flats or sharps.

1707 Joseph Sauveur, *Méthode générale pour former les systèmes tempérés de musique, et du choix de celui qu'on doit suivre: Histoire de l'Académie royale des sciences*, p.215; reproduced in facsimile in R. Rasch, *Joseph Sauveur: Collected Writings on Musical Acoustics (Paris 1700-13)* (Utrecht, 1984)

Le système temperé de 55 comma . . . est celui dont les Musiciens ordinaires se servent . . . The 55-part octave . . . is the one used by musicians in general [as distinguished from keyboard musicians in particular] . . .

1711 Bernard le Bovier, sieur de Fontenelle, *Sur les sistèmes tempérés de musique: Histoire de l'Académie royale des sciences*, p.80; reproduced in facsimile in R. Rasch, *Joseph Sauveur: Collected Writings on Musical Acoustics (Paris 1700-13)* (Utrecht, 1984)

On a vû dans l'Hist. de 1709 que M. Sauveur qui a proposé un système temperé de Musique, par lequel il divise l'Octave en 43 parties égales, croyoit n'avoir que deux autres systèmes raisonnables à combattre, l'un de M. Huguens qui divise l'Octave en 31, & l'autre du gros des Musiciens qui la divisent en 55. In the 1709 issue of the *Histoire* we saw that M. Sauveur proposed a tempered musical system that divides the octave in 43 equal parts, and that only two other systems offered any reasonable competition: one by M. Huguens [Huygens] that divides the octave in 31, and the other used by the majority of musicians, that divides it into 55 . . .

1723 Pier Francesco Tosi, *Opinioni de' cantori antichi e moderni*, chap.1, par.15

[See quotation in article above.]

p.111:

[Singers need not follow the above tuning system] excepté qu'elles ne soient accompagnées par des Instruments, au Temperament [*sic*] desquels elles se conforment, tant à l'aide de leur flexibilité qu'à l'aide de la sensibilité de l'oreille.²

[Singers need not follow the above tuning system] except when they are accompanied by instruments, to whose temperament they conform by virtue of their flexibility and the sensitivity of their ear.

p.110:

Les habilles Musiciens savent profiter à propos de ces differens effets des Intervalles, & font valoir par l'expression qu'ils en tirent, l'alteration qu'on pourroit y condamner.³

Good musicians know how to use the different effects of the intervals, and prove their value by the expression and variety they are able to draw from them.

1728

Johann David Heinichen, *Der General-Bass in der Composition* (Dresden), pp.83-5

. . . bey heutigen guten Temperaturen, (von alten Orgel =Wercken reden wir nicht) die mit # und b. doppelt und 3fach bezeichneten Tone, vornehmlich im Theatralischen Stylo als die schönsten, und expressivesten vorkommen, daher ich zu Erfindung eines indeschmaskten pur-diatonischen Clavieres nicht einmahl rathen wolte wenn es Practibel wäre: allein dass man specialiter diesem oder jenem Tone den Affect der Liebe, der Traurigkeit, der Freude, &c. zu eignen will, das gehet nicht gut.

. . . in today's good temperaments (I am not referring to old organs) the keys with two or three flats or sharps in their signatures emerge, especially in the theatrical style, as the most beautiful and expressive. For this reason I would not even support the invention of the long-sought clavier in just intonation were it to become practicable. But that the affect of Love, Melancholy, Joy, etc, belongs to specific keys, I cannot accept.

1730

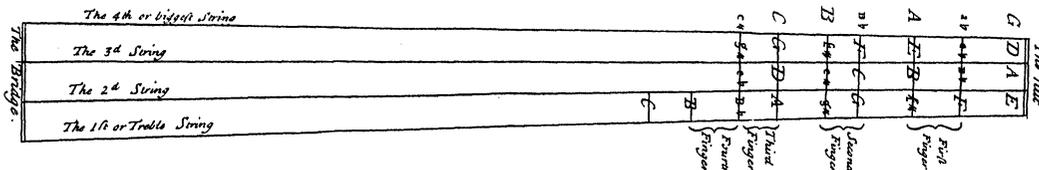
Peter Prelleur, *The Modern Musick-Master* (London), section on the violin, p.4

Note also that as G-sharp & A-flat, or A-sharp & B-flat, or also D-sharp & E-flat, etc, are not the same Notes you must not

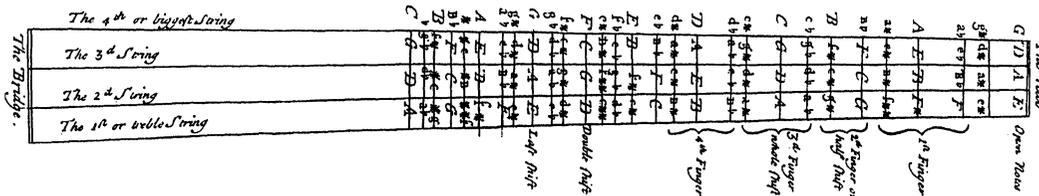
stop them with the same Finger. [See illus.5. Note that flat notes are higher than the corresponding sharp notes.]

5 Fingering chart from Peter Prelleur, *The Modern Musick-Maker*, Part V, 'Art of Playing on the Violin' (London, 1731)

Let the length of your Strings between the Nut and the Bridge be the same as in this Example, which you may easily do by removing the Bridge a little forward or backward as Occasion requires; then with a pair of Compasses mark out these lines either Ind. or with bit of Paper pasted on the neck of your Violin at the same Distance as they are in this Example; Thus you'll easily discern every Note, and with a little practice learn how to stop in Tune to a very great Nicety.



When you are pretty well acquainted with the manner of stopping according to the former Scheme, you may proceed to this, which directs you to stop in all the fifths, for Example if first fifth which is called the half fifth is upon the 5th line; the whole fifth is upon the 3rd line; the double fifth is upon the 1st line; the last fifth is upon the 2nd line; Note that in stopping you must put your left finger on that line or Note where the fifth is to be done; then move the whole hand higher accordingly. Note also that as G# A b, or A# B b, or also D# E b are not of same Notes you must not stop them with the same Finger.



1732; 2/1734

Johann Georg Neidhart, *Gänzlich erschöpfte mathematische Abtheilungen des diatonisch-chromatischen temperirten Canonis Monochordi* (Königsberg)

Wären denn die Hautbois, Flöten, u.d.g. . . . nach derselben eingerichtet, so müste nothwendig Chor- und Cammer-Ton durch und durch auf das reinste zusammen stimmen . . .

If oboes, flutes and the like . . . were all tuned to [equal temperament], Chor- and Cammer-Ton would naturally blend together throughout in the purest way . . .

pp.87-9:

[When a singer is accompanied by a harpsichord,] dont le Tempéramment est le plus faux,⁴ [the singer's ear is] toujours préoccupée du Son principal du Mode . . . après avoir parcouru plusieurs [successions] qui ne sont pas certainement à l'Unisson de ceux du Clavecin, elle se réunit avec lui dans ce Son principal, ou dans son Harmonie.⁵

p.92:

L'Oreille ne suit pas servilement le Tempéramment des Instrumens . . . [Ils] servent seulement à la mettre sur les voies des Sons fondamentaux. . . elle tempère, sans réflexion . . . tout ce qui peut s'opposer aux justes rapports de ses Sons fondamentaux.

p.91:

. . . les habiles Maîtres [of the violin] . . . diminuent un tant soit peu les Quintes, comme me l'a assuré M. Guignon Ordinaire de la Musique de Sa Majesté, pour y adoucir la dureté de la Sixte . . . [entre] les deux cordes extrêmes.

p.104:

Celui qui croit que les différentes impressions qu'il reçoit des différences qu'occasionne le Tempéramment en usage dans chaque Mode transposé, lui élèvent le génie, & le portent à plus de variété, me permettra de lui dire qu'il se trompe; le goût de variété se prend dans l'entrelacement des Modes, & nullement dans l'altération des intervalles, qui ne peut que déplaire à l'Oreille, & la distraire par conséquent de ses fonctions.⁶

1740

Hubert LeBlanc, *Défense de la basse de viole* (Amsterdam)

p.54:

De tant de Tierces que . . . qualifie être si aimables, vous [le Clavecin] & l'Orgue en avez les trois quarts de fausses. Une Oreille fine ne sauroit chez vous entendre le joueur (pour rendre justice à deux qu'il y a d'habiles), qu'en s'imposant silence sur le défaut de justesse dans l'Instrument, & au rapport que fait l'oreille de tant d'accords qui impatientent l'Auditeur délicat, plutôt que de le flatter.

p.55:

[On a harpsichord,] on n'a pas la faculté d'y retoucher [l'accorde] dans un Concert, au-lieu que sur les instrumens à Chevilles mobiles, on ajuste l'accord sur chaque Ton, où l'on va jouer, & non sur la selle à tous chevaux d'un Ami l'a donné.

L'Art divin de M. Blavet⁷ est de réparer sur la Flute, par le moyen de l'haleine modifiée. Ainsi les Ecolières de Clavecin, lorsqu'elles s'applaudissent qu'il est toujours d'accord, ne sentent pas qu'il n'y est jamais.

[When a singer is accompanied by a harpsichord,] on which the temperament is the most out of tune, [the singer's ear is] continually preoccupied with the tonic of the key . . . after having passed through several [intervals] which are surely not in unison with those of the harpsichord, the voice rejoins the harpsichord on the tonic note or chord.

The ear does not slavishly follow instrumental temperament . . . [Instruments] only serve to orientate the voice on the principal notes . . . singers correct, without thinking twice . . . anything that might obscure pure intonation in relation to the principal notes.

. . . the best masters [on the violin] . . . as I have been told by [Jean-Pierre] Guignon [1707-74], one of his Majesty's musicians, narrow the 5ths slightly, in order to sweeten the overlarge 6th . . . [between] the bottom and top strings.

To those who believe that the different impressions they receive are caused by the difference in temperament in each transposed key, giving each a special character and thereby providing more variety, permit me to tell them that they are mistaken; variety has its origin in the blending of keys and not in the modification of intervals, which can only displease the ear, thus distracting it from its [proper] work.

Of the many 3rds that . . . are considered so reasonable, three-quarters of yours [the harpsichord's] and the organ's are false. A nice ear would only be able to listen to someone play you (to be fair to two who are capable) by ignoring the defect of the instrument's intonation and the discord that is heard in so many harmonies, that vex the fastidious listener rather than gratifying him.

[On a harpsichord] one cannot correct [tuning] during a concert, while on instruments with tuning pegs, the tuning is adjusted for each key in which one plays, and not in a 'one size fits all' manner.

The divine artistry of Mr Blavet consists in adjusting [the tuning of his] flute by his manner of blowing. But students of the harpsichord praise the instrument for its intonation, not perceiving that it is in fact never truly in tune.

p.133:

Un Seigneur qui fait la Virole a témoigné qu'ayant des Touches, elle est inférieure au Violoncel, qui n'en a point: elle est sujette, dit-il, à ce que les demi-Tons Majeurs & Mineurs soient employés indifféremment, & les uns pour les autres.

Pour satisfaire à cette Objection des plus considérables, il faut remarquer que de la part de la Virole, avoir des Touches est différent d'être partagé en demi-Tons fixes, à la manière du Clavecin & de l'Orgue: on ne les accorde qu'une fois pour toutes, pour un Concert, & quelquefois pour une demi-année.

Mais sur la Virole la Cheville mobile point trop multipliée, comme sur le Luth, anéantit le défaut d'avoir des Touches, car elle le répare en accordant à chaque Ton sur lequel on va jouer.

Si l'on regarde l'Objection comme non résolue, parce qu'après le choix du Ton dans lequel on entre, lorsqu'on passera du *b quarre* au *b mol*, la difficulté reste entière à l'égard des demi-Tons Majeurs remplacés par les Mineurs.

Je répons que cela prouve que la fausseté vient d'ailleurs que des demi-tons Majeurs & Mineurs, ils sont un objet trop peu considérable.

La preuve de leur peu d'influence est, qu'il y a des Clavecins où se trouvent les demi-Tons des deux espèces, lesquels néanmoins ne sont pas exemts des juremens dans les changemens de Tons à d'autres. On s'est désisté de cette pratique comme d'un léger avantage.

L'Objection du demi-Ton tire tout son degré de considération du cas où il devient le Ton capital dans lequel on joue alors sur l'Orgue & le Clavecin, il est un jurement perpétuel. Mais la Basse de Virole est tirée de pair par le changement dans son accord facile à mouvoir. On commence à accorder par *ut* sur le Son due demi-Ton donné.

Au contraire dans le Discours Musical, le peu d'attention que s'attirent les demi-Tons, se prouve de ce qu'ils ne tiennent lieu que de particules de liaison conjonctives, ou de transition, telles que *car*, *néanmoins*, &c. Sur lesquelles l'esprit n'appuie pas, comme dans la chute sur un Ton, lorsque le sens finit.

Il faut donc tirer d'ailleurs la raison de décider.

Ce sera des Tons Majeurs & Mineurs transposés de leur ordre naturel dans l'Octave. Car les cinq Tons entiers qui en forment plus des deux tiers, ne gardent pas une distance égale de l'un à l'autre; & lorsqu'on change de Ton, il se fait un bouleversement général, les Tons les plus *espacés* viennent à être remplacés par de plus foibles, ceux qui ont une moyenne *espace* sont relevés de sentinelle par d'autres qui en ont une plus grande ou une moindre à garder, il s'enfuit des juremens excrables sur les Instrumens, qui n'ont pas le secours des Chevilles mobiles, ou qui manquent pour les modérer d'une haleine aussi judicieusement employée que celle de Mr *Blavet*.

Ainsi chaque fois qu'on change de Ton, le déplacement des parties met tout sans-dessus dessous dans la première Octave, & les autres qui en font la répétition.

A gentleman who plays the gamba a little remarked that as the instrument has frets, it is inferior to the cello, which has none: this causes it, he says, to be unable to distinguish or govern the choice of major and minor semitones.

To answer this serious imputation, it should be pointed out that on the gamba the existence of frets is hardly the same as being split up into fixed semitones, as on a harpsichord or organ, which are tuned for a concert once and for all (and sometimes for a half-year).

For the gamba's tuning pegs, not being overly complex as on the lute, overcome the defect of fretting by being tuneable in whatever key one plays.

But it may be objected that the problem is still unresolved, since even after choosing the key in which one is to play, the mode may change from major to minor, requiring minor semitones rather than major.

My answer is that this proves that bad intonation derives not from the major and minor semitones, since they are of themselves of little consequence.

The proof of their nominal influence can be seen in the fact that harpsichords are tuned with both major and minor semitones, which are nevertheless not exempt from problems when there is a change of key. This practice has been renounced despite its occasional benefits.

The problem in using semitones derives from the cases in which it becomes the tonic note in which one plays, and in the case of the organ and harpsichord it is a perpetual curse. The bass viol, however, escapes this difficulty because it can change its tuning easily. It tunes a scale from any given tonic, regardless of which semitone it may be.

During the act of playing music, on the other hand, the slight attention that is accorded the different semitones proves that they merely serve the purpose of conjunctive or transitive particles, such as 'for', 'nevertheless' etc. They hold the attention no more than the last fall of a note when a phrase comes to its end.

The cause must arise elsewhere.

It is the juxtaposition of the natural order of the major and minor semitones within the octave. For the five whole tones that comprise more than two-thirds of the octave are not placed at equal distances from each other, and, when the key changes, this produces a general confusion, as the larger intervals are replaced by smaller ones, and those that guarded a medium-sized interval are relieved of that function by others that were intended to serve for a smaller or larger one. Consequently, the most hideous oaths escape the instruments that are not provided with tuning pegs, or that are unable to moderate their pitch by means of breath pressure, employed as judiciously as is done by Mr *Blavet*.

Each time there is a modulation, in other words, the relationships of the semitones is jumbled in the first octave, and consequently the others that are tuned to it.

1742/3 Georg Philipp Telemann, 'Neues musicalisches System', in L. C. Mizler, *Musikalische Bibliothek*, iii/4 (Leipzig, 1752/R1966), pp.713-19 [plus tables]⁸

p.716:

Mein System hat keine Claviermässige Temperatur zum Grunde, sondern zeigt die Klänge, so, wie sie auf uneingeschränkten Instrumenten, als *Violoncell*, *Violine* etc, wo nicht völlig, doch bey nahe, rein genommen werden können, welches denn die tägliche Erfahrung lehret.

My system is not based on any keyboard temperament; rather, it displays the sounds found on unrestricted instruments like the cello, violin etc, that can play purely (if not always entirely, nearly so), as day-to-day experience teaches.

p.718:

Es bestimmt eine durchgehends proportionirliche Gleichheit unter den Intervallen. . . . Es sind etwan ein Duzend Jahre, da ich selbst noch glaubete, man würde bey Anhörung etlicher von deren Harmonie das Balsambüchschchen zur Hand nehmen müssen. Allein die Erfahrung hat mir den Irrthum benommen, u. dargethan, dass C#, Eb u. Ab-Cbb nach einerley Gewürze schmecken.

It brings about a universal proportionate equality among the intervals. . . . Only a dozen years ago, I myself still believed that the hearing of some of these harmonies would cause one to reach for the smelling salts. But experience has taken this error from me, and shown that C#-Eb and Ab-Cbb taste of the same spice.⁹

1743 Jean-Jacques Rousseau, *Dissertation sur la musique moderne* (Paris), in *Oeuvres*, xix, p.130.

La mécanique du tempérament introduit dans la modulation des tons si durs, par exemple le *re* et le *sol* diesis, qu'ils ne sont pas supportables à l'oreille. . . . La voix ne se conforme jamais . . . à moins qu'elle n'y soit contrainte par l'unisson des instrumens.

In modulations, the mechanisms of temperament cause such unpleasant notes, for example D and G#, that they are impossible to listen to. . . . Singers never conform to them . . . except when forced to do so at points where they are in unison with the instruments.

1744 Georg Andreas Sorge, *Anweisung zur Stimmung und Temperatur sowohl der Orgelwerke, als auch anderer Instrumente, sonderlich aber des Claviers* (Hamburg)

p.24:

. . . die andere [temperament with unequal division of the comma] möchte sich zum musiciren im Cammer-Ton, wenn die Orgel im Chor-Ton stehet, besser Schicken, denn da wird der *Modus As dur* oft, *E dur* aber wohl gar nicht gebraucht. Ingleichen kommt *Es dur* gar oft, *H dur* aber gar nicht vor. Wiederum muss *B dur* oder auch *D dur* oftmals herhalten, da hergegen *Fis dur* nicht leicht erscheinen wird.

. . . the other [temperament with unequal division of the comma] may work better when playing in Cammer-Ton with an organ in Chor-Ton, since the key of Ab major is often used but E major practically never.¹⁰ Likewise, Eb major appears quite frequently but B major almost never. Again, Bb major or also D major will often appear, while on the contrary one rarely sees F# major.

[He gives two versions of an irregular temperament; he says that] . . . die Waldhörner aus dem *Es* wie auch die *Oboen* werden ganz wohl mit dieser *Temperatur* zufrieden seyn.¹¹

[He gives two versions of an irregular temperament; he says that] . . . the horns in Eb and also the oboes will be quite satisfied with this temperament.

p.35:

So dann fange man im *f* an, und stimme solches nach Belieben in Chor- oder Cammer-Ton, nachdem das *Clavier* beschaffen ist, etwa nach einer *Flute douce* oder *Traveriere* [*sic*].

One begins then on *f* and tunes in Chor-Ton or Cammer-Ton (depending on in which the harpsichord is tuned) approximately to the pitch of a recorder or traverso.

p.53:

Die Flöten, sowohl die *Traversen* als die *Flutes douces*, sind bis dato mit einer gar schlechten *Temperatur* versehen, und hätten die Herren Pfeifenmacher hohe Ursache, sich um die Lehre der *Canonic* und *Harmonic* mehr als andere *Musici* zu bekümmern, oder doch ihre *Instrumente* so viel immer möglich nach einer wohl *temperirten* Orgel zu stimmen und einzurichten.

Flutes, both traversos and recorders, have been provided until now with a very bad temperament, and the gentlemen who make them have more need than other musicians to concern themselves with the acoustics of music, or at least to tune and regulate their instruments as closely as possible to a well-tempered organ. On traversos, the F, G# and B are generally the

Auf den *Traversen* fehlet es gemeiniglich am *f*, *gis* und *b* am meisten. Ich glaube aber, es sey gahr wohl möglich auch diesen Tönen ihr gehöriges Recht zu thun. Mit den *Flutes douces* siehet es noch schlimmer aus, und sind auch noch übler zu zwingen als die *Traversen*. Doch halte dafür, dass sie in der Stimmung zu verbessern sind. Wenn nur die Pfeifenmacher erst *Harmonici* wären, hernach solte es sich auch schon mit ihnen geben.

Die *Oboes* sind auch noch nicht mit der besten *Temperatur* versehen. Sol ihnen geholfen werden, so muss ein *Harmonicus*, ein guter *Oboist* und ein Pfeifenmacher bey einer wohl *temperirten* Orgel zugleich Hand anlegen. Der *Oboiste* und Pfeifenmacher aber dürffen nicht eigensinnig seyn, sondern müssen *Raison* annehmen und spitze Ohren zum Werke bringen. Und solches ist auch von denen Flöten zu verstehen.

Die brauchbaren und unentbehrlichen Geigen habens am besten, jedoch müssen ihre 3 Quinten behörigermassen *temperatè* [*sic*] gestimmt werden, so dass sie ein klein wenig abwärts schweben, sonst kommen sie, wenn z.E. im *g* angefangen, und solches mit der Orgel vollkommen rein gestimmt worden, mit *a*₁ und *e*₂ ein merkliches zu hoch, wenn sie nämlich alle 3 Quinten ohne Schwebung rein stimmen wolten. Das übrige kömmt auf ein gutes Gehör und reinen Griff an . . .

Sorge also advises singers to follow the keyboard temperament (p.55).

worst offenders. But I believe that it should be quite possible to correct even these notes. The situation with recorders is worse yet, and they are even harder to control than traversos, though I believe they can be improved. If only flute-makers were also theoreticians, things would naturally go better.

The oboes are also not furnished with the best of temperaments. They could be helped if an acoustician, a good oboist, and a woodwind maker examined together a well-tempered organ. The oboist and woodwind-maker should not, however, be headstrong and obstinate, but Reason, together with sharp ears, should govern all. And the same goes for the flutes, of course.

The useful and indispensable fiddles are the best off; still, their three 5ths must be correctly [tuned], so they beat a little. Otherwise, if the 5ths are all tuned purely without beating, and (for example) the G is tuned exactly to the organ, the A and E will be noticeably too high [compared to the organ]. For the rest, everything depends on a good ear and accurate fingering . . .

1748 Georg Andreas Sorge, *Gespräch zwischen einem musico theoretico und einem studioso musices* (Lobenstein)

p.21:

Mit einem Wort: Die Silbermannische Art zu temperiren, kan bey heutiger Praxi nicht bestehen.

In a word—Silbermann's way of tempering cannot exist with modern practice.¹²

p.51:

Besser gefällt mir das berühmten Herrn Capellmeister Telemanns *Systema Intervallorum*, als welcher die Octav in 55. geometrische Abschnitte (Commata) die von Stufe zu Stufe kleiner werden, theilet.

The famous Herr Capellmeister Telemann's *Systema intervallo- rum* pleases me better, in which the octave is divided into 55 units, or commas, which become smaller from step to step.

p.52:

. . . die kleinste Secund vom Einklange [ist] unterschieden . . . um den neunnten Theil eines grossen Tons, oder um ein *Comma*. Und um so viel ist auch $\sharp C:bD$, $D:bbE$, $\sharp D:bE$, $E:bF$, $\sharp E:F$, $\sharp F:bG$, $\times F:G$, $\sharp G:bA$, $A:bbH$, $H:bc$, $\sharp H:c$ und $c:bbd$ etc, unterschieden.

. . . the [interval of a] 'smallest second' differs from a unison by the ninth part of a whole tone, or one *comma*. This same amount distinguishes also $C\#/Db$, D/Ebb , $D\#/Eb$, E/Fb , $E\#/F$, $F\#/Gb$, $G\#/Ab$, A/Bbb , B/Cb , $B\#/C$ and C/Dbb etc.

p.58:

O! wie mancher Geiger fängt seine Partie anzuspielden, und hat nicht einmahl seine Geige behörig gestimmt, wo will denn hernach die Reinigkeit herkommen? . . . o Blindheit, o! Unwissenheit! wie gross bist du noch in der musikalischen Welt an manchen Orten.

Oh! When so many fiddlers begin to play their parts without having even properly tuned their instruments, how will pure tuning ever be achieved? . . . Oh blindness! Oh ignorance! How great you remain in so many parts of the world of music.

p.61:

. . . über Herrn Capellmeisters Telemanns *Systema* . . . Mich dünckt es sey gar schicklich, wenn man zu einer jeden Note

. . . about Herr Capellmeister Telemann's *Systema* . . . I would think that it would be more appropriate if each separate note

auch einen besondern Klang oder *Clavem* bestimmt, und nicht einem *Clavi zwey-* bis dreyerley Noten zueignet, wie wir ietzo in unsern Clavier thun müssen. . . . Auf's Clavier wird sich dieses System nicht appliciren lassen;¹³ auf der Geige aber, und einigen Blase-Instrumenten, möchte es eher thunlich seyn; denen Sängern aber ist es am leichtesten.

were produced by its own special sound and key, rather than, as on present-day keyboards, one key for two and even three [different] notes . . . This system cannot be applied to a keyboard instrument, but it may be rather convenient for the fiddle and certain wind instruments, and is the easiest for singers.

1750 Alexander J. Ellis, 'On the History of Musical Pitch', *Journal of the Society of Arts* (5 March 1880); reprinted in A. J. Ellis and A. Mendel, *Studies in the History of Musical Pitch* (Amsterdam, 1968), p.37

I am indebted to Mr E. J. Hopkins, organist of the Temple, for furnishing me with a MS note made by Mr Leffler (d. 1819), organist of St Katherine's, then by the Tower, with Mr W. Russell, then organist of the Foundling, which describes the great peculiarity of this organ [Foundling Hospital, Glyn and Parker, opened by Handel in 1750 and played by him subsequently]. It had the usual 12 keys to the octave, but a means of altering the notes sounded by four of them. There was a slider with three rests above the draw stops on each side. When the sliders were at the central rest, the 12 notes were the usual 12 of the mean-tone temperament, E *flat*, B *flat*, F, C, G, D, A, E, B, F *sharp*, C

sharp, G *sharp*. If the left-hand slider were put full to the left, E *flat* was changed into D *sharp*, and if the right-hand slider were put full to the right, B *flat* was changed into A *sharp*. If, however, the right-hand slider were put full to the left, G *sharp* was changed into A *flat*, and if the left-hand slider were put full to the right, C *sharp* became D *flat*. . . . Mr Hopkins always understood that this arrangement was due to Dr Robert Smith of Trinity College, Cambridge. . . . The Temple Organ and the oldest Durham organ had an E *flat* and D *sharp*, an A *flat* and G *sharp*, that is two and not four additional notes, and these were introduced by divided keys and not by sliders . . .

1751 Francesco Geminiani, *The Art of Playing on the Violin* (London), p.3

Geminiani recommended that beginners finger enharmonic twins at the same place on the neck of the violin, but said,

This rule concerning the Flats and Sharps is not absolutely exact. The Octave also must be divided into 12 Semitones, that is, 7 of the greater and 5 of the lesser.

1752 Johann Joachim Quantz, *Essai d'une méthode pour apprendre à jouer de la Flûte Traversière* [in French and German] (Berlin; Eng. trans. 1966; 2/1987), chap.3 par.2, 3, 5, 8; chap.16, par. 4, 7; chap.17, sec. vi, par. 20; sec. vii, par.4, 8, 9¹⁴

chap.3/5:

On verra par là, que les tons, étant indiqués par le b mol sont d'un Comma plus hauts, que quand ils sont marqués par un Diese.

From these tables you can see that the notes indicated with a flat are a comma higher than those indicated with a sharp.

chap.3/8:

Ce qui m'a porté à ajouter à la Flute encore une Clef qui n'y a pas été auparavant, c'est la difference entre les Demitons majeurs & mineurs. . . . Le Demiton majeur a cinq Comma; le Demiton mineur n'en a que quatre. Il faut par consequent qu'Es (*mi b mol*) soit d'un Comma plus haut que Dis (*re Diese*). S'il n'y avoit qu'une Clef sur la Flute, il faudroit entonner l'un & l'autre, Es (*mi b mol*) & Dis (*re Diese*) de la même façon, comme on fait sur le Clavecin, où on les touche par une même touche; c'est à dire les deux intervalles sont tempérés; desorte que ni Es (*mi b mol*) à B (*si b mol*), comme la Quinte par en bas; ni Dis (*re Diese*) à H (*si*), comme la Tierce en haut, n'accordent parfaitement bien. Pour marquer donc cette difference, &

What led me to add another key not previously used on the flute was the difference between major and minor semitones. . . . The major semitone has five commas, the minor only four. For this reason, Eb must be a comma higher than D#. If there were only one key on the flute, both Eb and D# would have to be played similarly, as on the harpsichord, where they are played from the same key; so that neither Eb to Bb (the ascending 5th) nor D# to B (the descending major 3rd) would be well in tune. In order to make this difference clear, and to place the notes in their correct proportion, it was necessary to add another key. . . . It is true that this distinction is impossible to make on the harpsichord, where each pair of notes we wish to

entonner nettement les tons selon leur proportion, il étoit nécessaire d'ajouter encore une Clef. . . . Il est vrai que cette différence ne peut pas être exprimée sur le Clavecin, où l'on touche tous ces tons qu'on distingue ici, sur une même touche, ayant recours à la Temperature ou Participation. Cependant cette différence étant fondée dans la nature des tons, & pouvant être observée sans peine par les Chanteurs & les Joueurs d'instrumens d'archet, il est juste de l'exprimer aussi sur la Flute, ce qui ne se peut sans l'autre Clef.¹⁵ La connoissance en est nécessaire à qui veut rendre fin, précis & net ce qui appartient à l'oreille dans la Musique.¹⁶

chap.16/4:

Dans une pièce en mode Es (*mi b mol*) & As (*la b mol*), on peut accorder la Flute un peu plus bas qu'à tous les autres modes; les modes avec les b mols étant d'un comma plus hauts que ceux avec les dieses.¹⁷

chap.16/7:

S'il se trouve que les Violons sont plus hauts que le Clavecin; ce qui peut aisément arriver, quand leurs Quintes sont accordées un peu trop haut, au lieu qu'elles doivent l'être un peu plus bas, comme il faut que cela soit observé au Clavecin; ce qui cause en quatre Quintes qui sont ainsi accordées, une différence considérable: alors le joueur de Flute est obligé de se régler plutôt aux Violons qu'au Clavecin, ceux-là se faisant entendre davantage que celui-ci. . . . cette faute ne se commet que par ceux qui traitent la Musique comme un métier, dans lequel ils ne trouvent pas un véritable plaisir, & non pas par des Musiciens raisonnables & expérimentés, qui aiment la Musique & qui jouent pour plaire à des oreilles délicates.

chap.17/vi/20:

Chaque joueur de Clavecin qui connoit la proportion des intervalles, saura aussi, que les Demi tons mineurs comme D (*re*) avec la dièse, & E (*mi*) avec le b mol, &c. différent d'un Comma, & causent par conséquent sur cet instrument, où il n'y a pas des touches partagées, quelque inégalité dans l'intonation à l'égard des autres instrumens, qui donnent ces tons dans leur juste proportion. Cela est surtout sensible quand le Clavecin joue avec quelques uns de ces instrumens à l'Unisson. Or comme on ne peut pas toujours éviter ces tons-là, surtout aux modes où il y a beaucoup de dieses & de b mols; l'Accompagnateur fait bien de les mettre au milieu ou dans la partie inférieure de l'accord, ou si un de ces tons fait la Tierce mineure, de l'omettre tout à fait. Car ce sont particulièrement les Tierces mineures, dont le ton est très imparfait & défectueux, lorsqu'elles se rencontrent avec la partie principale à l'Unisson dans les Octaves hautes. J'entends sous ces Tierces mineures principalement les tons C, D & E à deux lignes (*ut, re & mi seconds de la Flute*), quand il y a un b mol devant eux, ou pour dire brièvement, les tons Ces (*ut b mol*), Des (*re b mol*) & Es (*mi b mol*). Cependant j'y réfère aussi G & A à une ligne (*sol & mi premiers*), & D & E à deux lignes (*re & mi seconds*), lorsqu'ils sont précédés par un dièse; car étant des Tierces majeures, ils sont trop fort dans leur temperature & par con-

distinguish are produced with a single key, making it necessary to have recourse to tempering. But since this difference is based on the nature of the notes and can be produced without difficulty by singers and string players, it is reasonable to observe it on the flute as well (and this cannot be done without the extra key). Appreciation of this difference between flats and sharps is needed by anyone who wants to develop a refined, exact and accurate ear in music.

In pieces in Eb and Ab, the flute can be tuned a little lower than in all the other keys, the flat keys being a comma higher than the sharp.

If the violins should happen to be tuned higher than the harpsichord, which can easily happen if their 5ths are tuned a little wide rather than (as must be done on the harpsichord) a little narrow, the flute player is obliged to adjust more to the violins since they are more audible than the harpsichord. Tuning the four 5ths wide on the violin causes a considerable difference with the harpsichord . . . it is a mistake made only by those who consider music as a mere trade from which they derive no real satisfaction, not by thoughtful and experienced artists who love music and play in order to please refined ears.

Every harpsichordist who understands the proportion of intervals will also know that minor semitones like D–D# and E–Eb, etc, differ by a comma, and therefore cause on this instrument (unless the keys are split) certain intonation problems with other instruments that play these notes in their correct proportions. This is especially noticeable when the harpsichord plays with any of these instruments in unison. Now, since these notes cannot always be avoided, especially in keys with many sharps or flats, the accompanist does well to put them in the middle or lower part of the chord, or if such a note makes a minor third, to omit it altogether. For it is especially these minor 3rds that sound so imperfect and defective when played in unison with the principal part in the upper octaves. I am referring mainly to the minor 3rds when *c''*, *d''* and *e''* (the second-octave ut, re and mi on the flute) are preceded by a flat, or to put it more briefly, the notes *cb''*, *db''* and *eb''*. I am also referring, however, to *g'* and *a'* (first-octave sol and la), and *d''* and *e''* (second octave re and mi) when preceded by a sharp, since as major 3rds, they are too wide in their temperament and therefore too high. It is true that this difference [in intonation] is not as clear when the harpsichord is played by itself, or when it accompanies a large ensemble. But when the notes are in unison with another instrument, the difference is quite audible, since the other

séquent trop haut. Il est vrai qu'on ne sauroit remarquer cette difference si distinctement, en jouant seul du Clavecin, ou accompagnant dans une Musique de beaucoup de personnes. Mais lorsque ces tons se rencontrent à l'Unisson avec un autre instrument, la difference se fait entendre beaucoup, à cause que les autres instrumens les donnent dans leur juste proportion, pendant que sur le Clavecin ils ne sont que tempérés. C'est pourquoi il vaut mieux de les omettre tout à fait, que d'en blesser l'oreille.

chap.17/vii/4:

Pour accorder d'une maniere précise le Violon, je crois qu'on ne feroit pas mal, si l'on suivoit la règle qu'on observe en accordant le Clavecin c.a.d. que les Quintes feront un peu foibles, & non pas tout nettes, comme on les accorde ordinairement, ni encore moins trop fortes; afin que toutes les cordes nuës soient égales avec le Clavecin. Car si l'on veut accorder toutes les Quintes nettes & fortes, il s'ensuit naturellement, que de quatre cordes il n'y aura qu'une qui sera égale avec le Clavecin. Mais si l'on accorde la corde A (*la*) tout égale avec le Clavecin, & E (*mi*) un peu foible contre l'A (*la*), D (*re*) un peu fort contre l'A (*la*), & G (*sol*) de même contre D (*re*); les deux instrumens seront d'accord ensemble.

chap.17/vii/8:

Il y a des personnes qui sentent fort bien, moyennant leur finesse naturelle de l'ouï, quand un autre joue faux; mais elles ne s'en apperçoivent pas quand elles commettent la même faute elles mêmes, & ne sauroient y remédier. Le meilleur moyen pour se tirer de cette ignorance, est le Monochorde, sur lequel on peut apprendre le plus distinctement à connoître les proportions des tons. Il seroit nécessaire, que non seulement chaque Chanteur, mais aussi chaque joueur d'instrument s'en rendit familier l'usage. Ils acquerroient par-là, de beaucoup plus de bonne heure, la connoissance des Demi tons mineurs, & apprendroient que les tons marqués par un b mol, doivent être un Comma aplus hauts que ceux qui ont un dièse devant eux; au lieu que sans ces lumieres ils sont obligés de se fier absolument à l'oreille, dont le jugement est pourtant quelquefois bien trompeur. Une telle connoissance du Monochorde se demande principalement des joueurs de Violon & d'autres instrumens à archet, auxquelles on ne peut pas, par rapport à la mise des doigts, prescrire des bornes comme aux instrumens à vent.

chap.17/vii/9:

Lorsqu'on trouve les Soudemi tons proprement dits, c.a.d. qu'un ton baissé par le b mol se change en celui, qui lui est immédiatement inferieur & qui est haussé par un dièse, ou qu'un ton haussé par le dièse se change en celui, qui lui est immédiatement superieur & qui est baissé par le b mol . . . le ton avec le dièse est un Comma plus bas, que celui avec le b mol. Quand ces deux notes sont liées ensemble, v. Tab. XXIII.

instruments play them in their correct ratios, whereas on the harpsichord they are merely tempered. For this reason, it is better to omit them entirely, rather than offend the ear.

To tune the violin accurately, I believe one would not do badly to follow the same rule as for tuning the harpsichord, that is, with the 5ths a little narrow (and not entirely perfect, let alone a little wide, as commonly happens), so that the open strings will agree with the harpsichord. If one tries to tune all the 5ths purely or wide, the result will be that only one of the four strings will be in tune with the harpsichord. But if the A is tuned precisely to the harpsichord, the E slightly flat to the A, the D a little sharp to the A, and the G likewise to the D, the two instruments will be in tune together.

There are some players who have a very good ear and who can easily perceive false playing by others, but are unaware of committing the same mistake themselves, and would not know how to remedy it. The best manner of escape from this ignorance is the monochord, on which one can clearly learn the intervals. Every singer and instrumentalist should become familiar with its use. They would thereby learn to recognize minor semitones much earlier as well as the fact that notes marked with a flat must be a comma higher than those with a sharp in front of them. Without these insights one is obliged to depend entirely on the ear, which can however deceive one at times. Knowledge of the monochord is required especially of players of the violin and other stringed instruments, on which one cannot use the placement of the fingers as an exact guide, as one can on wind instruments.

If sub-semitones (to use their correct name) appear consecutively, in other words if a note lowered by a flat becomes transformed into the note just below it, raised by a sharp [or vice versa], . . . the note with a sharp is a comma lower than the one with a flat. [For example, G \sharp should be a comma lower than A \flat .]¹⁸ If these two notes are tied to each other (as in [ex.1]), one must draw back one's finger a little for the sharp

Fig.6. il faut retirer le doigt un peu sur le dièse qui suit le b mol; autrement la Tierce majeure seroit trop haute contre la partie fondamentale.

Si au contraire le b mol suit après le dièse, v.Fig.7. il faut auprès de la note avec le b mol, avancer le doigt autant qu'on le retire dans l'exemple précédent . . . On observe la même chose à tous les instrumens, excepté au Clavecin, où l'on ne peut pas effectuer des Sous-demi tons, & lequel pour cette raison doit avoir une bonne Temperature, afin qu'on puisse souffrir l'un & l'autre de ces tons. Sur les instrumens à vent ce changement se fait par le moyen de l'embouchure, de façon que sur la Flute on hausse le ton en la tournant en dehors, & on le baisse en la tournant en dedans. Sur l'Hautbois [sic] & le Basson les tons se haussent, quand on avance l'anche plus dedans la bouche, & qu'on presse plus les levres ensemble; & ils deviennent plus bas, quand on retire l'anche & relache les lièvres [sic].

Ex.1



following the flat; otherwise the major 3rd will be too high against the fundamental note.

But if, as in [ex.2], the flat follows the sharp, the finger must be advanced as much for the flat as it was drawn back in the preceding example . . . This same thing is done on all instruments except the harpsichord, where the sub-semitones cannot be effected, causing it for this reason to have recourse to a good temperament which allows either note to be enduring. On wind instruments, these changes are accomplished through embouchure corrections. On the flute, the pitch is raised by turning it outwards and lowered by turning it inwards. On the oboe and bassoon, the pitch is raised when the reed is advanced in the mouth and the lips are pressed together. It is lowered by withdrawing the reed and relaxing the lips.

Ex.2



1754 Jean Laurent de Béthizey, *Exposition de la théorie et de la pratique de la musique* (Paris), p.135

. . . comment la voix s'ajuste-t-elle au tempérament . . . d'un . . . instrument: Pour entonner la première note d'un air, elle se règle sur la note tonique du mode principal, telle qu'elle est rendue par l'instrument, & forme ensuite les différens intervalles . . . sans égard à l'altération des notes que l'instrument fait entendre. . . . Lorsqu'un nouveau mode paroît, la voix est obligée de se conformer à la manière dont l'instrument rend la nouvelle tonique. . . . Si la voix & l'instrument forment ensemble une tenue à l'unisson ou à l'octave, la voix est forcée de se conformer à l'instrument. . . . Quand la voix est accompagnée de plusieurs instrumens, si l'un d'eux se fait mieux entendre que les autres, la voix se conduit, comme si elle n'était accompagnée que de cette [sic] instrument. Si tous ou quelques-uns se font entendre aussi bien l'un que l'autre, la voix . . . ne s'ajuste au tempérament d'aucune [sic] d'eux, à moins que ce tempérament ne tienne le milieu entre les autres, mais se fait alors un tempérament que lui est particulier.

. . . how a singer adjusts to the temperament . . . of an . . . instrument: to sing the first note of an aria, the singer refers to the tonic note of the principal key as played by the instrument, and subsequently adjusts the different intervals . . . without reference to the notes played by the instrument. . . . When a new key appears, the singer is obliged to conform to the new tonic as rendered by the instrument. . . . if the voice and instrument play a unison or octave together, the voice is obliged to conform to the instrument. . . . When the singer is accompanied by several instruments, of which one is more audible than the others, the singer performs as if accompanied by this instrument alone. If several or all of them are equally audible, the singer . . . does not adjust to any of their temperaments (or perhaps finds their average), but performs in his own particular temperament.

1754 Giuseppe Tartini, *Tratatto di musica* (Padua, R1966), pp.99-100

Di fatto il Basso organico rinchiude tutta l'armonia; e cantanti, e suonatori si accordano con l'organo per ben' intunare. Ma organo, e clavicembalo (se non si moltiplichino i tasti a dismisura) non hanno altro intervallo perfettamente accordato, se non la ottava; e quasi tutti gli altri intervalli di quinte, quarte, terze maggiori, e minore, tuoni, e semitoni sono accordati per discretivo temperamento, e non secondo la ragione, o sia

In fact, the organ bass contains the complete harmony; and both singers and instrumentalists tune to the organ for the sake of good intonation. But (unless the keys are multiplied excessively) the organ and harpsichord have no other perfectly tuned intervals besides the octave; almost all the other intervals, such as 5ths, 4ths, major and minor 3rds, 2nds and semitones are tuned by arbitrary temperaments, and not in their

forma dell'intervallo rispettivo. Dunque è impossibile l'uso della scala suddetta in precisione di ragioni, perchè in tal necessario temperamento le ragioni restano alterate nella loro forma.

. . . Io nel mio Violino, dove suonando a doppia corda posso incontrar fisicamente la forma dell'intervallo, di cui è segno fisico dimostrativo il tal terzo suono, che deve risultare, ho il vantaggio per me, e per i miei scolari¹⁹ della sicura intonazione, e in conseguenza dell'uso reale della scala suddetta in precisione di ragioni. Bisogna però avvertire, che questa scale, benchè dimostrativamente dedotta, non è perfetta intieramente in ciascun possibile confronto delle note musicali costituenti . . .

correct ratio, or according to their respective intervals. The use of the above-mentioned [purely tuned] scale is therefore impossible in its exact ratios, because the necessity of using a temperament alters it from its true form.

. . . When I play my violin, using double stops, I find an interval's proper ratio through a physical sensation, which can [also] be established scientifically. The correct 3rd that I play results inevitably, and gives me, and my students, the advantage of assured intonation, and in consequence the true usage of the above-mentioned scale in its precise ratios. I should, though, point out that this scale, however convincingly derived, is still not completely perfect in every possible situation in its constituent musical notes . . .

1756

Leopold Mozart, *Versuch einer gründlichen Violinschule* (Augsburg)²⁰

p.66, note:

Auf dem Clavier sind Gis und As, Des und Cis, Fis und Ges, u.f.f. eins. Das macht die Temperatur. Nach dem richtigen Verhältnisse aber sind alle die durch das (b) erniedrigten Töne um ein Komma höher als die durch das (#) erhöhten Noten.

On the keyboard, G# and Ab, D# and Eb, F# and Gb, etc, are the same. That makes the temperament. But according to the correct ratios, all the notes lowered by a flat are a comma higher than those raised by a sharp.

p.69, note:

das (b) erniedrigten Töne um ein Komma höher als die durch das (#) erhöhten Noten. Z.B. Des ist höher als Cis; As höher als Gis, Ges höher als Fis, u.s.w. Hier muss das gute Gehör Richter seyn: Und es wäre freilich gut, wenn man die Lehrlinge zu dem Klangmässer (*Monochordon*) führete.

Notes lowered by a flat are a comma higher than those raised by a sharp. Db, for instance, is higher than C#; Ab higher than G#, Gb higher than F#, etc. An accurate ear must be the guide here; it would be very useful for the student to make use of a monochord.

p.191:

Ich habe die Probe auf der Violin, dass bey dem Zusammenstreichen zweener Töne auch so gar bald die Terz, bald die Quint, bald die Octav u.s.f. von sich selbst auf eben dem nämlichen Instrumente dazu klinge. Dieses dienet nun zur untrüglichen Probe, womit sich ieder selbst prüfen kann, ob er die Töne rein und richtig zu spielen weiss. Denn wenn zweene Töne, wie ich sie unten anzeigen werde, gut genommen und recht aus der Violin, so zu reden, heraus gezogen werden; so wird man zu gleicher Zeit die Unterstimme in einem gewissen betäubten und schnarrenden Laut gar deutlich hören: sind die Töne hingegen nicht rein gegriffen, und einer oder der andere nur um ein bisschen zu hoch oder zu tief; so ist auch die Unterstimme falsch.

I have noticed that on the violin, when two notes are played simultaneously, the 3rd, 6th or octave, etc, also spontaneously sound on the instrument. Everyone can use this as a reliable manner of checking if notes are being played in tune and correctly. For if two notes (which I will indicate more specifically below) are drawn out of the violin in a good and correct manner, then the lower voice will also be clearly audible, though muffled and rasping in sound. If, however, the notes are not played in tune, and one or other is fingered even slightly too low or too high, the lower note will also be false.

1758 Georg Andreas Sorge, 'Anmerkung über Herrn Quantzens . . . dis und es-Klappe auf der Querflöte', F.W. Marpurge, *Historisch-kritische Beyträge* (Berlin, R1970), iv, pp.1-7²¹

Sorge concludes that the comma described by Quantz is the same as Scheibe's (1739) and Telemann's (1742/3), as it is the only one that will fit exactly 55 times into an octave.

Betrachten wir dieses commatische System gegen das rationalgleich gestimmte Clavier, so finden wir einen beträchtlichen Unterschied . . .

Was nun hier von dem Tonart C gesagt ist, das gilt bey allen übrigen Tonarten. Denn wir setzen voraus, dass ein Flötenist allemahl seine Flöte nach dem Grundtone der jenigen Tonart einstimmen müsse, woraus er spielet.

If we compare this system with the well-tempered harpsichord, we will discover a considerable variation . . .

What is said here for the key of C major is valid also for all the other keys, as we are assuming that a flautist must always tune his instrument to the tonic of whichever key he will be playing.

Hier scheint es nun, als wenn man zu wünschen Ursach hätte, dass das Clavier mit noch mehrern Tasten in der Octav möchte versehen werden. Allein wenn man erweget, dass der natürliche Sprengel einer Tonart so weit nicht gehet, dass die Abweichung ein ganzes Comma betrüge; und dass bey Auf-führung eines Stücks es auch viel auf die Moderation des Flö-tenisten ankomme: So wird man finden, dass es nicht rathsam sey, das Clavier mit noch mehrern Tasten zu versehen.

Wenn man auch bedenket, dass die Querflöte eben nicht 24 Tonarten nöthig habe, wie das Clavier, so kann man mit einer ungleichen Temperatur der Eubereinstimmung mit der Quer-flöte, in den meisten Tonarten, noch näher kommen, als mit der rational gleichen Temperatur.

Sorge gives an example for D major and compares it with Telemann's system; while it is close, it offers only D \sharp and G \sharp , etc, and so fails to solve the question of enharmonic equivalents. Sorge offers several other irregular temperaments, each adapted to a particular key, which, as he points out, obliges the flautist to limit strictly his choice of keys in a concert. He concludes with his own personal opinion that equal temperament would eliminate the need for enharmonic distinctions.

1767 Georg Philipp Telemann, *Letzte Beschäftigung G. Ph. Telemanns im 86. Lebensjahre, bestehend aus einer musikalische Klang- und Intervallen Tafel*, in *Unterhaltungen*, iii (Hamburg)²²

Man schmelzet beyde nahen Klänge [C \sharp /Db] nach Veranlas-sung des Claviers in einen zusammen . . .

Dass des und és zween unterschiedene Klänge ausmachen, sol-ches findet sich auch bey den Violinen, wo des mit dem 4ten, und és mit dem kleinen Finger gegriffen wird; desgleichen haben die Traversieren hierzu zwo besondere Klappen . . .²³

Now, it appears (if one could have every wish) that the harp-sichord actually needs to be provided with more keys in the octave. But when we consider that the natural space required by each tonality does not exceed the divergence of a whole comma; and that, in the performance of a piece, much depends on the discretion of the flautist, we can conclude that it is not advisable to provide the harpsichord with additional [split] keys.

When we also consider that the traverso does not actually need all 24 keys, as does the harpsichord, it would be easier to approach the tuning of a traverso in most keys with an irregu-lar temperament rather than the well-tempered one.

Because of the harpsichord, the two neighbouring sounds [C \sharp /Db] are fused together into one . . .

That D \sharp and Eb are two separate sounds is demonstrated by the violin, where D \sharp is played with the fourth finger and Eb with the fifth; traversos are the same with their two separate keys. . .

1773 Charles Burney, *The Present State of Music in Germany, the Netherlands, and the United Provinces . . .* (London), i, p.313

. . . in the . . . divisions of tones and semi-tones into infinitely minute parts, and yet always stopping on the exact fundamental, Signora Martinetz was more perfect than any singer I had ever heard: her cadences too, of this kind, were very learned, and truly pathetic and pleasing.

[?1774] Jean-Jacques Rousseau, 'Extrait d'une réponse du petit faiseur', *Oeuvres* (1781)

While not advocating equal temperament, Rousseau was very early in discussing the concept of 'tendency notes'. In suggesting that B natural should be *higher* because it leads to C, he says:

Ceci, je le sais bien, est directement contraire aux calculs établis et à l'opinion commune, qui donne le nom de semi-ton mineur au passage d'une note à son dièse ou à son bémol, et de semi-ton majeur au passage d'une note au bémol supérieur ou au dièse inférieur.

I know well that this is in direct contradiction to established reckoning and the general opinion, which gives to the passage of a note to its sharp or flat the name 'minor semitone', and to the passage of a note to its next-higher flat or next-lower sharp the name 'major semitone'.

1777 F. de Castillon, 'Flûte traversière à deux clés', Diderot and d'Alembert, *Encyclopédie*, supplement²⁴

Castillon included an interesting comment that applies to the over-small interval between the low IV/IV \sharp on all the woodwinds of the period (F/F \sharp on traverso and oboe, Bb/B on recorder and bassoon):

. . . les flûtes de M. Quantz diffèrent encore des autres par le tempérament. Ordinairement le *fa* des flûtes traversières est tant soit peu trop haut & le *fa* dièse est juste; dans les nôtres, au contraire, le *fa* est juste, & le *fa* dièse un peu trop bas. . . Rare-

. . . M. Quantz's flutes differ from all others in their tuning. Usually the F on the transverse flute is not flat enough and the F \sharp is correct; in his, on the contrary, the F is true and the F \sharp a little flat. . . Rarely, if ever, is music written in the key of F \sharp ,

ment, ou plutôt jamais, on ne compose une pièce en *fa* dièse, soit majeur, soit mineur; mais on en compose très-souvent en *fa*, majeur & mineur. Le *fa* dièse ne paroît donc guère comme fondamentale, & il vaut bien mieux l'altérer que le *fa* qui est la fondamentale d'un mode, non-seulement très-usité, mais encore un des plus beaux pour la flûte; d'ailleurs, on peut forcer le *fa* dièse par le moyen de l'embouchure, mais le *fa* devient d'abord faux.

either major or minor, but very often in F major and minor. The F# appears but seldom as a tonic, and it is much better to have the F in tune, since it is the keynote of a tonality not only much used, but one of the most beautiful on the flute. F#, when it appears, could easily be tempered by the embouchure; but as it stands, F natural remains a bad note.²⁵

1785-7

Wolfgang Amadeus Mozart

John Hind Chesnut (pp.263-71) has pointed out that from a close look at Thomas Attwood's notes on his studies with W. A. Mozart in 1785-7, it is clear that Mozart's normal concept of instrument tuning distinguishes the small and large half steps of a mean-tone temperament similar or identical to 1/6-comma. The usual discrepancy between keyboard and other instruments exists.

1783 Alessandro Barca, 'Introduzione a una nuova teoria di musica, memoria prima', *Accademia di scienze, lettere ed arti in Padova: Saggi scientifici e letterari* (Padua, 1786), pp.365-418. Cited in Barbour, *Tuning and Temperament*, p.43

Barca wrote that to make the 5ths 1/6-comma smaller than pure was the

. . . temperamento per comune opinione perfettissimo, quale suole applicarsi alle quinte diatoniche . . .²⁶

. . . temperament considered generally as perfect, although it is usually applied [only] to the diatonic 5ths . . .

1788 Tiberius Cavallo, 'Of the Temperament of those Musical instruments, in which the Tones, Keys, or Frets, are Fixed, as in the Harpsichord, Organ, Guitar, &c,' *Philosophical Transactions of the Royal Society of London*, lxxviii, p.238

When the harpsichord, organ &c is to serve for solo playing, and for a particular sort of music, it is proper to tune in the usual manner . . . but . . . when the instrument is to serve for accompanying other instruments or human voices, and

especially when modulations and transpositions are to be practiced, then it must be tuned according to the temperament of equal harmony.²⁷

c.1790 John Robison, 'Temperament', *Encyclopaedia Britannica* (Edinburgh, 3/1801)

[Players of instruments with flexible tuning] when unembarrassed by the harpsichord . . . [should not temper their scales] but keep it as perfect as possible throughout; and a violin performer is sensible of violence and constraint when he accompanies a keyed instrument into these unfrequented paths.

1813

Thomas Busby, *Universal Dictionary of Music* (London, 4th edn)

As late as 1813, Busby discusses major and minor semitones, and states that temperament is applied:

in order to remedy, in some degree, the false intervals of those instruments, the sounds of which are fixed; as the organ, harpsichord, pianoforte, &c.

¹Quoted in Lindley, 'Stimmung und Temperatur', p.263

²Quoted in Lindley, 'Stimmung und Temperatur', p.244

³It is interesting to compare this with Rameau's diametrically opposed later statement on the same subject. See Rameau (1737), p.104.

⁴Lindley, 'Stimmung und Temperatur', pp. 245-6 thinks Rameau is probably discussing $\frac{1}{6}$ -comma mean-tone here.

⁵Quoted in Lindley, 'Stimmung und Temperatur', p.245

⁶Quoted in Lindley, 'Stimmung und Temperatur', p.246

⁷Michel Blavet (1700-1768) performed at the Concert Spirituel more frequently than any other performer, and was unanimously praised for his tone, intonation and technique. See N. Zaslav, 'Blavet, Michel', *New Grove*.

⁸Telemann's system is discussed in Sorge (1748) and (1758). In (1758), pp.2-5, Sorge equates Quantz's temperament with that described by Scheibe and Telemann, and discusses the 'Comma telemann', which Telemann himself says is half that of 'mean-tone'. (As noted above, in $\frac{1}{4}$ -comma mean-tone—'mean-tone' in its strictest sense—the difference between flats and sharps is indeed about twice that in the 55-part octave.)

⁹Translation by Carlo Novi

¹⁰J. S. Bach's surviving cantatas do not bear out this observation. Cf. Neumann.

¹¹The temperament is shown in Lindley, 'Stimmung und Temperatur', p.273 (20b).

¹²Translated in Barbour, *Tuning and Temperament*, p.196

¹³Cf. Telemann's own statement: 'my system is not based on any keyboard temperament . . .'

¹⁴The French version of the *Essai* is not, properly speaking, a translation. It appeared simultaneously with the German version and was prepared for the benefit of Quantz's patron, Frederick of Prussia, who had difficulty reading and speaking German. See N. Mitford, *Frederick the Great* (London, 1970/R 1984), pp.20, 205. G. A. Sorge, in 'Anmerkungen über Herr Quanzens . . . #D und bE-Klappe auf der Querflöte', equates Quantz's temperament with that advocated by Scheibe and Telemann.

¹⁵Quantz's invention was welcomed by Castillon and other writers on the flute of this period. See E. R. Reilly, 'Quantz and his *Versuch*; Three Studies' (New York, 1971), pp.55, 91, citing J. S. Petri, *Anleitung zur praktischen Musik* (Lauban, 1767/82) and J. G. Tromlitz, *Ausführlicher und gründlicher Unterricht die Flöte zu spielen* (Leipzig, 1791).

¹⁶See Castillon (1777).

¹⁷This is presumably on account of the stringed instruments with which the flute is playing, whose basic pitch is entirely unfixd. Sorge (1758), p.9 says that it is assumed that the flautist tunes his instrument to the tonic of the piece he is playing.

¹⁸This sentence appears in the German version only.

¹⁹Cf. Lindley, 'Tartini-Schüler', on M. Stratico, a student of Tartini.

²⁰'It can be shown that for whichever of the standard commas we choose, the perfect fifths in Leopold Mozart's system were theoretically flatted by about one-sixth of that comma.' Chesnut, 'Mozart's Teaching of Intonation', p.260.

²¹See Chesnut, 'Mozart's Teaching of Intonation', p.260.

²²Reprinted in *Georg Philipp Telemann: Singen ist das fundament zur Musik in allen Dingen*, ed. W. Rackwitz (Leipzig, 1985), pp.266-73. This is a continuation of Telemann's *System* of 1742/3.

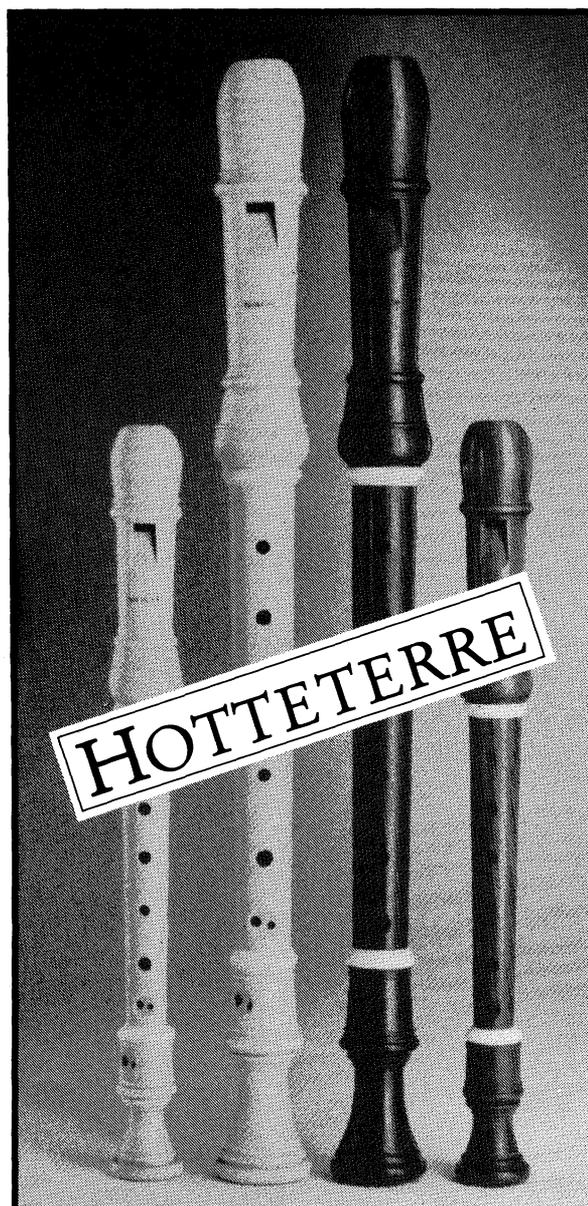
²³Cf. Quantz (1752)

²⁴E. Halfpenny, 'A French Commentary on Quantz', *ML*, xxxvii (1956), pp.61-6 contains a complete English translation.

²⁵Translation from Halfpenny, 'A French Commentary', pp.65-6

²⁶Chromatic notes may therefore be irregularly placed in Barca's system.

²⁷It is not clear whether 'equal harmony' = 'equal temperament' or 'a regular temperament'.



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