Shadings in the Chromatic Field: Intonations after Morton Feldman

Marc Sabat

> ... this could be an element of the aural plane, where I'm trying to balance, a kind of coexistence between the chromatic field and those notes selected from the chromatic field that are not in the chromatic series.[1]

Harmony, or *how pitched sounds combine*, implies microtonality, enharmonic variations of tuning. Historically, these came to be reflected in written music by having various ways of spelling pitches. A harmonic series over E leads to the notes B and G#, forming a just major triad. Writing Ab instead of G# implies a different structure, but in what way? How may such differences of notation be realized as differences of sound?

The notion of enharmonic "equivalence," which smooths away such shadings, belongs to a 20th century atonal model: twelve-tone equal temperament. This system rasters the frequency glissando by constructing equal steps in the irrational proportion of vibration $1:\sqrt[12]{2}$. Twelve successive steps divide an octave, at which interval the "pitch-classes" repeat their names. Their vertical combinations have been exhaustively demonstrated, most notably in Tom Johnson's *Chord Catalogue.*

However, the actual sounding of pitches, tempered or not, always reveals a microtonally articulated sound continuum. Hearing out the complex tonal relations within it suggests a new exploration of harmony: *composing intonations* in writing, playing and hearing music. Morton Feldman recognized that this opening for composition is fundamentally a question of rethinking the notational image. In works composed for the most part between 1977 and 1985, inspired by his collaboration with violinist Paul Zukofsky, Feldman chose to distinguish between enharmonically spelled pitches.

> "Could you bring all the pianos down to 440, which is the tuning of my homeland" [laughter], I thought he was going to faint. He said, "It will take three tunings on each piano and there are five." So I said, "Let's just bring it down a little bit, just let's get the brightness away." I wanted to get to the tone of the Steinway. So I'm at 440. Now, when you're involved with tuning, whether it's mean tuning or Pythagoras ... I don't like Pythagoras, it's too oriental. And mean tuning was for the West Coast. It took me a year or two to figure out exactly what do I want and how to notate it. [...]
>
> Then I decided that instead of going into any kind of conceptualization of the pitch—we're talking only about the violin now, I'm not really talking about the cello or the viola, I'm talking about the violin—that all I wanted was a little of this, a little of that, that's all, without losing too ... In other words, if you focus on the pitch you don't lose it too much. And the only way to do that is to say that it could be spelled D, C double sharp, or E double flat. A lot of times I would use pitches like a D, or a G, or an A, or an E only because I have another way of spelling it, you see, and also I have the benefit of an easy natural harmonic. So I have four colors at my disposal with one pitch. Of course, I did not serialize it four-four-four. [Laughs.] That's where you get in trouble. You say, "Oh, look at its potential, let's organize its potential!" That was not the idea, you see, to organize its potential. So just as you want material that is flexible, a lot of times it's very

[1] Morton Feldman, "The Future of Local Music: XXIII, Theater am Turm, Frankfurt, February 1984," in *Give My Regards to Eighth Street: Collected Writings of Morton Feldman*, edited by B.H. Friedman (Cambridge, MA: Exact Change, 2000), p. 183.

> good to have material that is inflexible. So then it really is only what it is and the focus perhaps is even more intense. [...]
>
> Okay. So do it one way and do it another. Spell it one way, then spell it another way. Orchestrate it one way, orchestrate it another way. Use this kind of rhythm and then use another kind. Do it on a chain one after another, do it less on a chain, do it in a simultaneity. All the possibilities of do-it-one-way-and-do-it-another rather than just on a linear situation.[2]

I see Feldman's extreme enharmonic notation as an invitation to pursue more general musical questions: how do our perceptions of pitched sounds vary as they interpenetrate; what in fact is *intonation* and what is its relationship to *composition*, to *instrumentation*? After all, different spellings suggest different intervals: C# - F is a diminished fourth, C# - E# a major third. Is it possible to define such intervals as free, distinct sounds, without necessarily relying on rules and hierarchies from the past?

In this text, I will begin by sketching the history of western notation and intonation, followed by a speculative interpretation of Feldman's spelling in *Composition* (1984), an unpublished fragment for solo violin. I describe the working process which has led to a number of developments in my recent music, and in particular to the notion of *tuneable intervals*.

In the time of Pope Gregory I (590–604), the Catholic Church began to pursue a standardization of liturgical chant.[3] Over the course of several centuries' evolution these melodies were adapted to principles of the ancient diatonic modal system and began to be notated with the eight note names still in use today. This is in contrast to the eastern chants, which retained chromatic and enharmonic "quartertone" inflections.[4]

Greek music theory was known in the Middle Ages largely through Boethius' incomplete Latin reworking of the Euclidean *Sectio Canonis* and of Claudius Ptolemy's *Harmonics*. Here a monochord tuning in Pythagorean intonation is described, using successive octaves, fifths and fourths to obtain new pitches (see Example 1). The procedure divides a string into proportions based on multiples of the numbers 2 and 3, and is demonstrated in geometric diagrams. The compellingly simple correlation of *letters* and *pitches* and their relationship to divisions of *strings* must have inspired the innovations attributed to Guido Monaco of Arezzo in the 11th Century: naming pitches of the musical *gamut* with letters repeating at the octave, teaching solfège based on mnemonic syllables *ut-re-mi-fa-sol-la*, and notating pitches on a staff of parallel lines with clefs.

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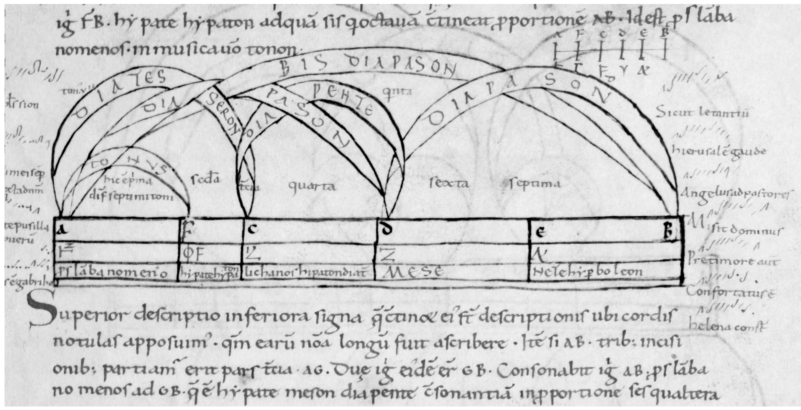
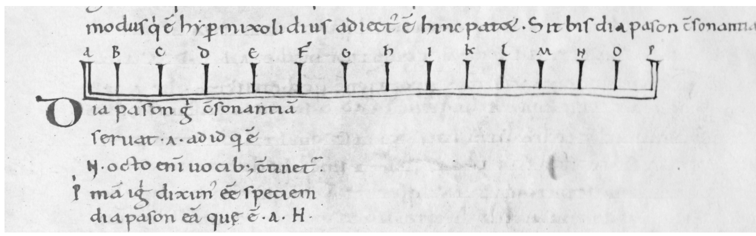
[2] *Morton Feldman in Middleburg—Words on Music*, edited by Raoul Mörchen (Köln: MusikTexte, 2008), pp. 456–458.

[3] Editor's note: For more on the early development of early Christian and Gregorian Chant see James W McKinnon, *The Advent Project: the Later Seventh Century Creation of the Roman Mass Proper* (Berkeley: University of California Press, 2000) and Kenneth Levy, *Gregorian Chant and the Carolingians* (Princeton: Princeton University Press, 1998).

[4] Editor's note: the topic of early model systematization has been discussed in Peter Jeffery's essay, "The Earliest Oktoechoi*:* The Role of Jerusalem and Palestine in the Beginnings of Modal Ordering" in *The Study of Medieval chant : Paths and Bridges, East and West: in Honor of Kenneth Levy*, Peter Jeffery ed. (Rochester, NY: Boydell Press, 2001), pp. 147-209.





Example 1: Diagrams from Boethius: "De Institutione Musica," 11th Century MS, State Library of Victoria

Ptolemy's book, written in the first half of the 2nd Century, extensively describes a Greek system of fifteen named pitches over a two-octave range. This is divided into tetrachords, each with two *fixed* pitches a perfect fourth (4:3) apart and two *moveable* pitches tuned according to variations of three *genera* called diatonic, chromatic, and enharmonic. Two tetrachords separated by one wholetone (9:8) comprise eight tones and construct one octave, which is similarly extended above and below to complete the *Greater Perfect System*. Cycling through this frame gives seven possible starting points, seven different patterns of intervals *(tonoi)*. Each of these was transposed to fit into the central range, generating seven modes called the *harmoniai*. A change of mode meant some or all of the tones would *change tuning*, often microtonally.

By contrast, the post-Gregorian system derived from Boethius consisted of eight pitch-classes in Pythagorean tuning. The ancient modulations were reduced to alterations of one note, B. It had two forms, square/hard (Bh) and round/soft (Bb), giving us the first chromatic accidentals (natural and flat). This move, from a flexible to a theoretically *fixed* tuning scheme, paralleled the increasing prevalence of organs, which were spreading throughout Europe. The wish to replicate diatonic patterns at different pitch heights, whilst avoiding unwanted dissonances, led to a gradual expansion of the original *musica vera* gamut (Bb, F, C, G, D, A, E, Bh) to include the additional *musica ficta* pitches (Ab, Eb and the chromatically raised F#, C#, G#). In the motet *Garrit gallus—In nova fert* from the *Roman de Fauvel* (ca. 1310) reproduced by Willi Apel in *The Notation of Polyphonic Music 900–1600*, one may clearly read F# and C# in addition to the traditional pitches.[5] Similarly, Michael Praetorius depicts a complete twelve-tone manual

[5] Willi Apel, *The Notation of Polyphonic Music 900-1600*, Fifth Edition (Cambridge, MA: The Mediaeval Academy of America, 1953), p. 331. For more on the role of *musica ficta* in *Ars Nova* repertoire see also

on the Halberstadt cathedral organ, which was built in 1361 and renovated in 1495, verifying that this process was gradually taking place in both keyboard as well as vocal music practice.

Extension of a Pythagorean series to twelve pitches results in eleven consonant pure fifths (3:2), and one dissonant "wolf fifth" (G#-Eb or C#-Ab). This diminished sixth is one *Pythagorean comma* smaller than the rest, an interval implicitly notated as the difference between Ab and G# and spanned by six Pythagorean wholetones less one octave (Ab-Bb-C-D-E-F#-G#). Since each tone is a 9:8 frequency ratio, together they exceed one octave by the ratio 531441:524288. This is approximately 1/9 of a wholetone, or about 24 cents. Exactly this argument, already found as Proposition 9 in the Euclidean *Sectio Canonis* from circa 300 B.C. and reiterated by Ptolemy and Boethius, was presented as a rejoinder to followers of Aristoxenus: *six wholetones do not equal one octave*.

As vocal music evolved, it came to no longer move in parallel motion by fifths, fourths, and octaves. Increasingly, the beauties of consonant sung thirds, which do not exist in a strictly Pythagorean system, were discovered. The "major thirds" found on the Pythagorean tuned organ were actually dissonant *ditones* made up of two Pythagorean wholetones. This combination produces the ratio 81:64, whereas a consonant major third has the much simpler ratio 5:4, equivalent to 80:64. Therefore, the Pythagorean thirds are larger than the sung ones by a *Syntonic comma* 81:80. This happens *also* to be approximately 1/9 of a wholetone, in this case about 22 cents.

In addition to having eight transposed versions of the ditone, a twelve-tone Pythagorean tuning has four diminished fourths: either E-Ab or G#-C, as well as B-Eb, F#-Bb, and C#-F. Each of these is narrower than a ditone by one Pythagorean comma, which happens to be *almost the same size* as a Syntonic comma. As Klaus Lang observes in his elegant monograph on the history of European tuning systems, "Auf Wohlklangswellen durch der Töne Meer," these diminished fourths sound like slowly beating, slightly mistuned consonant major thirds.[6]

These two properties of the Pythagorean organ tuning—the dissonant wolf fifth and the discovery of near-consonant diminished fourths—initiated a process of creative compromise. Various departures from the Pythagorean system become common: organ builders experimented with intentionally mistuning the twelve pitch-classes to replace harsh dissonances with agreeably beating sonorities. In 1482, Ramos de Pareja published a revolutionary monochord tuning, which uses, for the first time since Claudius Ptolemy, 5-limit ratios to tune consonant thirds and sixths. These changes led in the 16th Century to the invention of *meantone temperaments*, first described pragmatically in Pietro Aron's 1/4-comma tuning method and, most elegantly, in Gioseffo Zarlino's 2/7-comma system of temperament.

Zarlino recognized the basis of consonance in vocal music to be 5-limit Just Intonation (JI), based on small number ratios including multiples of the number 5,

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Margaret Bent's and Alexander Silbiger's article "Musica ficta" in *Grove Music Online*. *Oxford Music Online*. Oxford University Press, accessed November 7, 2012, http://www.oxfordmusiconline.com.ezproxy.library.uvic.ca/subscriber/article/grove/music/19406.

[6] Klaus Lang, *Auf Wohlklangswellen durch der Töne Meer. Temperaturen und Stimmungen zwischen dem 11. Und 19. Jahrhundert* (Graz: Institut für Elektronische Musik [IEM] an der Universität für Musik und darstellende Kunst in Graz, 1999), p. 40.

effectively ending the theoretical hegemony of the Pythagorean system. His keyboard temperament was designed to better approximate consonant singing. This was made possible by constructing an irrational geometric division of the Syntonic Comma into 7 equidistant microintervals, using a device known as a *Mesolabio*. Only the octave (2:1) and the chromatic semitone (25:24) remain just. The major and minor thirds are each made 1/7-comma smaller than their respective ratios (5:4 and 6:5), and thus their combination, the fifth, is made 2/7-comma smaller. Major and minor triads beat similarly.

There are many variations of meantone temperament, but in all cases the fifths are tuned substantially smaller than just, so that three fifths (less an octave) more closely approximate a major sixth (5:3) and four fifths (less two octaves) a major third. In 5-limit JI a major third is divided into two wholetones of *different size*: the major (8:9) and the minor wholetone (9:10), differing by a Syntonic comma. In meantone temperaments, the major third is divided into two *meantones* of equal size, falling in between the major and minor wholetones.

The most significant consequence of all these developments, from the perspective of notation, is a change in the relationship between the *spelling* of pitches and the *intonation implied thereby*. Reconsider how six Pythagorean wholetones exceed one octave by one Pythagorean comma: Ab-Bb-C-D-E-F#-G#, where G# is *higher* than Ab by 24 cents. In meantone temperament, the goal is to approximate just thirds. Taking Ab-C-E-G# as three 5:4 intervals (equal to six 1/4-comma *meantones*) falls short of an octave by the ratio 128:125, known as a *diesis*. In this case, G# is *lower* than Ab by approximately 41 cents, and by a completely different microtonal interval!

To recapitulate: Music notation had originally established a gamut of eight pitch-classes based on the Pythagorean series of just fifths. Modification with accidentals (b and #) extended the set to twelve. Vocal music practice incorporated pure thirds, which vary from Pythagorean thirds by small commas. These differences (both accidentals and commas) were *not explicitly notated*, but simply sung based on common practice rules. Polyphonic parts were corrected in a musical context according to vertical sonority and melodic line, and organists were able to emulate some of these sonorities by using enharmonic substitutions. Gradually, keyboard temperaments were developed to more closely approximate the sung thirds.

In the course of all these changes, the same system of notational signs came to represent two distinct practices: a moveable network of pitches in which alterations of intonation in real-time were employed to interpret harmonies and a fixed twelve-note gamut of pitches tuned or tempered according to various schemes.

As music became increasingly chromatic during the high Renaissance in Italy, accidentals came to be written out. Keyboard instruments with split keys were built, and singers were trained to differentiate the diesis between meantone-tempered enharmonically related sharps and flats. In the vocal music of Nicola Vicentino, which to this day remains largely unknown, these "quartertones" were even explicitly notated in some scores by means of dots written above the notes. His theoretical arguments and examples envisioning diatonic, chromatic and enharmonic melodies integrated into polyphonic compositions inspired several generations of composers.

However, his efforts were several hundred years ahead of their time, and keyboard music slipped back into twelve-tone *well-temperaments*. These systems, in which every chord is differently mistuned, eliminate the wolf fifth and allow keyboard instruments to give an impression of modulating to distant keys with only twelve pitches. They became popular during the Baroque period and eventually were standardized on the modern piano as the currently ubiquitous system of twelve-tone equal temperament—what Feldman calls the chromatic series: Finally, Ab and G# represent the *same* pitch.

Nevertheless, flexible intonation continued to be practiced in vocal music and in instrumental consorts like the Baroque trio sonata and later, the string quartet. Composers and theorists of the 18th Century became aware of the overtone series and began speculating on its implications. Tartini explored how difference tones produce virtual bass lines and included tunings using the natural seventh harmonic, even devising a special accidental sign for it. In 1739 mathematician Leonhard Euler invented the *tonal lattice*, a two-dimensional model of triadic harmony. Here microtonal differences of intonation generated by the interlocking just fifths and thirds of 5-Limit JI may be graphically differentiated. Euler reasserted Zarlino's principle that harmony and intonation are based on the ratios of whole numbers, and also advocated exploring the musical potential of the seventh harmonic. Gradually the stage was being set for a JI incorporating higher prime partials.

The attempt to establish a more precisely differentiated theory, practice and notation of tuning was once again taken up in the mid-19th Century. Rejecting the equal tempered system as a false compromise, Hermann von Helmholtz proposed radical reform: studying how sound is actually perceived, taking *the sensations of tone as a physiological basis for the theory of music*. He demonstrated that harmony is connected to the recognition of timbre, to the process of spectral fusion, to the beating of common partials, to combination tones; most fundamentally: to *intonation*. Helmholtz clarified this by drawing on a technique pioneered by Moritz Hauptmann in 1853 and refined by Arthur von Oettingen in 1866: notating differences of a Syntonic comma explicitly. Thus Euler's geometric model could be translated into an unambiguous letter notation.

The remaining step to a microtonal staff notation is a simple one, but took another hundred years. In the meantime the existing tone system was reaching its harmonic limits: distant and sudden tonal modulations; chords suggesting the higher overtones; non-functional harmonic sonorities. Finally, the *emancipation of dissonance*, which freed all of the previously excluded pitch combinations of the twelve-tone gamut, and became a major force in redefining the potential materials of music to include all possible sounds, intentional and non-intentional.

However, the seemingly unlimited new pitch possibilities were musically exhausted after only a few decades, showing that the equal tempered system they are based on *is insufficiently precise to comprehensibly differentiate complex dissonances*. Instead, experimental music focussed on a freer exploration of sound by seeking out new timbres, new playing and composing techniques. Noise, electronic and environmental sounds, chance and indeterminate methods, sound spatialization, computer analysis—all remain influential in musical practices today. As I see it, Helmholtz's intuition that music might grow from research into perceptual phenomena, understood from a position accepting all sonorities as potentially musical, invites us *now* to reinvent harmony with the tools of a precise notation and a precise intonation.

In the late 1920s the self-taught American composer Harry Partch already made a conceptual leap into what his student Ben Johnston later came to call *Extended Just Intonation.* Partch hypothesized that purely tuned chords of even higher partials could reinvigorate investigations of harmony in music. He extended the symmetry of 5-limit major-minor triads into an 11-limit system of interlocking *otonal-utonal hexads* structured in a form he called the *tonality diamond*

This abstraction from harmonic series intervals into a lattice of relationships is generalized in James Tenney's model of *harmonic space*, described in *John Cage and the Theory of Harmony* (1983).[7] Here the characteristic musical interval of each prime number (frequency ratio p:1) yields a new mathematical dimension, rather than being collapsed into a linear and approximate system of temperament. Composing the microtonal shadings of enharmonically similar intonations can be most clearly imagined by considering these dimensions as musical building blocks.Working together in the years 2000–2004, Wolfgang von Schweinitz and I undertook to translate Helmholtz's letter notation and Tenney's harmonic space into a staff notation for composers and musicians we call *The Extended Helmholtz-Ellis JI Pitch Notation*, or simply *Helmholtz-JI-Notation*. Ben Johnston's JI notation, developed in the 1960s, takes a 5-limit C major scale as its starting point. We decided instead to begin from a strictly Pythagorean basis: returning to the roots of staff notation and taking Ab to be one Pythagorean comma lower than G#. To write pitches related by just thirds, we use *arrows* representing Syntonic commas, attached to the conventional flats, naturals and sharps (see Example 2).

Recalling the example Ab-C-E-G#, notice that each major third must be made one comma smaller. For example, take E from the basic Pythagorean series, one fifth above the concert tuning pitch A, matching the open E string on the violin. Then C is *raised* by one arrow, and the diesis is written as the difference between Ab raised by two arrows and G# lowered by one arrow. This simple case shows the absolutely *conceptual* power of such a notation: the enharmonic confusion between sharps and flats which prevailed for almost a thousand years is now clarified by a simple graphic sign (see Example 3). For intervals derived from higher prime partials we have devised other accidentals, drawing in part on historical precedent (7) and contemporary practice (11, 23, 29, 31).

Having a way of explicitly writing up intonation opens experimental possibilities for composition of new music, and it also suggests a new genre, namely composed *intonations* of already existing music. *Johann Sebastian Bach RICERCAR Musikalisches Opfer 1 INTONATION* was begun in 2001 as a collaboration with Wolfgang von Schweinitz, followed in 2004 by my *Morton Feldman: Composition 1984 INTONATION*, which takes as its material an unpublished fragment for solo violin. (Most recent in the cycle is *ERIK SATIE Vexations INTONATION*, composed 2011.)

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[7] James Tenney, "John Cage and the Theory of Harmony," in *Soundings 13: The Music of James Tenney,* ed. Peter Garland (Santa Fe: SOUNDINGS Press, 1984), pp. 56–83.

ACCIDENTALS **EXTENDED HELMHOLTZ-ELLIS JI PITCH NOTATION**

for Just Intonation
designed by Marc Sabat and Wolfgang von Schweinitz

The exact intonation of each pitch may be written out by means of the following harmonically-defined signs:

Pythagorean series of fifths – the open strings
(… c g d a e …)

lowers / raises by a syntonic comma
81 : 80 = ***circa 21.5 cents***

lowers / raises by two syntonic commas
circa 43 cents

lowers / raises by a septimal comma
64 : 63 = ***circa 27.3 cents***

lowers / raises by two septimal commas
circa 54.5 cents

raises / lowers by an 11-limit undecimal quarter-tone
33 : 32 = ***circa 53.3 cents***

lowers / raises by a 13-limit tridecimal third-tone
27 : 26 = ***circa 65.3 cents***

lowers / raises by a 17-limit schisma
256 : 255 = ***circa 6.8 cents***

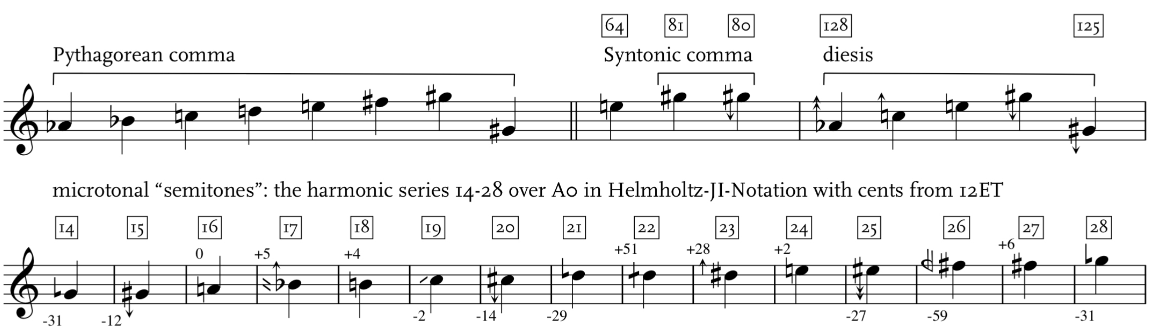
raises / lowerss by a 19-limit schisma
513 : 512 = ***circa 3.4 cents***

raises / lowers by a 23-limit comma
736 : 729 = ***circa 16.5 cents***

In addition to the harmonic definition of a pitch by means of its accidentals, it is also possible to indicate its absolute pitch-height as a cents-deviation from the respectively indicated chromatic pitch in the 12-tone system of Equal Temperament.

The attached arrows for alteration by a syntonic comma are transcriptions of the notation that Hermann von Helmholtz used in his book "Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik" (1863).
The annotated English translation "On the Sensations of Tone as a Physiological Basis for the Theory of Music" (1875/1885) is by Alexander J. Ellis, who refined the definition of pitch within the 12-tone system of Equal Temperament by introducing a division of the octave into 1200 cents.
The sign for a septimal comma was devised by Giuseppe Tartini (1692-1770) – the composer, violinist and researcher who first studied the production of difference tones by means of double stops.

Example 2



Example 3

Starting with *Spring of Chosroes* (1977), written for violinist Paul Zukofsky, Morton Feldman explored the use of enharmonic spellings in his music, particularly when writing for string instruments. Zukofsky describes Feldman's intentions:

> Morton Feldman's later music, which explores small variations in various domains (pitch, duration, register, timbres, attacks and decays) over long periods of time, forces us once again to think seriously about intonation systems. This is not the place to discuss specifically how such systems might operate in music since Schoenberg, i.e. in music based a concept of twelve equal tones. Suffice it to say that while it is theoretically possible for string players to adopt an equal temperament system for such music, it is not clear that they can, or do, do so; and certainly, a true equal temperament prevents us from using what might be called an "opinionated" intonation, i.e. a colouring device that allows us to indicate where we think we are going "harmonically." Feldman utilised a system where, for example, an e-flat is played sharper than a d-sharp, or to generalise, for any enharmonic pair, the higher pitch label always implies the higher pitch. In short, Feldman returned us to a world where double sharps and double flats have real and individual physical, musical and emotional meaning, as opposed to equal microtones, which simply present finer slices of equal temperament. To quote Cage in regard to equal microtones: "When the apple is rotten, cutting it in half does not help."[8]

In other words, the late music of Morton Feldman, without specifying a particular system of tonal reference, invites an *opinionated intonation*, one that resembles meantone enharmonic variations. Here, I would like to underline a point that is often misunderstood: the available evidence clearly states *Feldman did not intend his accidentals to imply a Pythagorean tuning*. This is exactly the opposite of John Cage's *Cheap Imitation* in the 1977 version for solo violin edited by Zukofsky, where an exaggerated Pythagorean intonation is explicitly indicated. Feldman did not want to espouse any organised system of tuning, yet his scores and statements consistently indicate an awareness that for string players spellings sharing the same note-name a chromatic accidental apart are closer together than ones with different names. So between D and Eb one finds the pitches Ebb and D#.

> Many times, the whole idea of a minor second—but it depends on the piece and it depends on the instruments—between D and E flat between two trumpets with the beating—that's low D and E flat—is not too wide for me. But between two string instruments it's very wide. So I might want to go to the cracks and fill it in a little bit with turpentine.[9]

I first began to explore the question of intonation in Feldman whilst recording *Spring of Chosroes* and *For John Cage* with Stephen Clarke and Michael Hynes for mode records. Later, Walter Zimmermann drew my attention to an untitled composition for solo violin from 1984, mentioned in the worklist from Sebastian Claren's book *Neither.*[10] With the kind cooperation of Barbara Monk Feldman and the Trustees of the Morton Feldman Estate, I obtained a copy of the two-page manuscript from the Paul Sacher Stiftung (see Example 3). The piece consists almost entirely of double stops

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[8] Paul Zukofsky, *Aspects of contemporary technique (with comments about Cage, Feldman, Scelsi and Babbitt)*. Originally published in *The Cambridge Companion to the Violin*, edited by Robin Stowell. Cambridge University Press, 1992.
[9] *Morton Feldman in Middleburg—Words on Music*, p. 614.
[10] Sebastian Claren, *Neither. Die Musik Morton Feldmans* (Hofheim: Wolke, 2000), p. 573.

grouped into short progressions, each of which is immediately repeated. An initial repertoire of patterns is presented and for a while, these elements are reordered in various constellations. Eventually new patterns are introduced, establishing a second section, followed by a return to earlier material. No tempo is indicated, but assuming the usual MM circa 63–66, the fragment lasts around 12 minutes. Immediately remarkable are the extremely unconventional pitch-spellings: interspersed amongst normal intervals like perfect fourths and major sevenths are triple-diminished fourths and double-augmented thirds. At the time, I wondered how Feldman expected these pitches to be interpreted. Feldman's notation often exploits visual analogies and paradoxes to suggest expressive inflections of sound. Seemingly identical rhythms may be notated in various unorthodox ways, for example—*Piano Piece 1952* consists entirely of dotted quarter notes instead of simply quarters, somehow implying a different dynamic shape, an inner division into three parts. As in his notations of rhythm, Feldman plays both with visually distinct notations of "the same pitch" (enharmonic variation) and with visually similar notations of different pitches (chromatic variation). Observe the first bar of his *Composition*: Bb-G# followed by B#-Gbb! (see Example 4).

Example 4

It seems clear to me that these accidentals may be read as pitches from a larger microtonal "chromatic field" rather than as simply respelled pitch-classes of the tempered "chromatic series." Since the musical material in this case consists almost entirely of double stops, the starting point is to find a logic by which the various resulting *intervals* might be tuned. In conversation, Zukofsky related to me his own model of intonation in practice, loosely described in terms of the series of fifths: equal temperament "in the middle," Pythagorean tuning "on one side" and meantone temperament "on the other side." With his legendary precision, Zukofsky could articulate intervals in pure tuning as well as micro-subdivisions of the tempered scale, and certainly he would have demonstrated these possibilities to Feldman.

The meantone model loosely resembles Leopold Mozart's advice: to tune "according to the right ratio, all the notes lowered by a flat are a comma higher than those raised by a sharp." Mozart explicitly adds: "Here the good ear must be judge, and it would indeed be well to introduce the pupils to the monochord"[11]—in other words, to *Just Intonation*. Strict Pythagorean intonation—melodic or "expressive" intonation—is based on the opposite principle: higher sharps, lower flats resulting in raised leading tones, narrow semitones.

When Feldman refers to pitch being "directional," I believe he is actually addressing a different point. He states:

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[11] Leopold Mozart, *A Treatise on the Fundamental Principles of Violin Playing*, trans. Editha Knocker, Second Edition (Oxford University Press, 1951), p. 70.

> I don't do it conceptually. I do it within the focus of the pitch. To me pitch is direction, I cannot conceive of using pitch without its direction. It's not only timbre but it's the direction of that timbre. So if it's a double sharp or a double flat or just a plain little old note . . . still I want the focus of the pitch.[12]

The direction of a *timbre*, to me, suggests more than simply melodic direction. Rather: to also consider how the spectral structures of two pitches relate to each each other: how they beat, what unisons they share.

Simultaneous tones are acoustically drawn into special relationships, which do not conform to any fixed system of temperament; instead these depend primarily on how closely the ratio of the sounding frequencies approaches a simple whole-number ratio. These special relationships, which I have called "tuneable intervals," are for me the empiric basis of Extended JI, micro-variations of tuning which the ear can learn to perceive as *harmonic relations between tones*. They establish precisely-tuned and focused sonorities, with characteristic *periodic signatures*: simpler sounds which may be tuned directly, and more complex sounds which must be constructed.

Distinguishing intervals in this way requires both flexibility and focusing of one's perception. First, each conventional interval is allowed to *widen*, to accomodate a larger *range of tolerance*. Between the traditional intervals new ranges—the quarter-tone sounds, less familiar to western ears—are to be found. Finally, within each range, a number of precisely tuned new intervals with distinct characteristics emerge, gradually shifting us away from the equal tempered chromatic series. With practice, one becomes more familiar with these intervals as they establish their own identities and ranges of tolerance.

To compose an intonation after Feldman's enharmonic notation, I first compiled a list of all distinctly spelled intervals used in the piece, giving them names like "1x diminished 3rd" or "3x augmented 3rd." For each a tuning was chosen, taking into consideration the principle that flats were to be taken higher and sharps lower, and generally taking commonly spelled pitches to be easily tuneable to the open strings of the violin. I assumed that conventionally spelled intervals would be tuned in the simplest way possible: for example, a fourth would be a just fourth (4:3) and a major seventh would be a just fifth plus a major third (15:8) (see Example 5). For the more unusual spellings I chose some tuneable intervals (i.e. 12:7 for a diminished 7th) and some which may only be constructed, and are therefore subject to unpredictable variations each time when played (i.e. 64:35 for a twice diminished octave, which sounds like a slightly beating 11:6). Rather than using a fixed gamut of pitches, I studied the context in which an interval appeared to find an interesting tuned sonority. Choice was limited to just intervals constructed from the lower prime partials 3, 5, 7, 11 and 13, because most of the double-stops are in fairly close position whilst the higher-prime-based intervals are generally most sonorous in wide voicing. Once the intonations had been defined, I wrote up the sequence of tuned intervals following Feldman's score (see Example 6).

On a few occasions, the chosen interval would be transposed up or down by a Syntonic comma to facilitate connections from sound to sound (Feldman's directionality of timbre). For example, compare bar 2 and its first reiteration in bar 17. The second dyad

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[12] *Morton Feldman in Middleburg—Words on Music*, pp. 612.

in bar 1 combines a comma-raised F, a major third below the open A string, and a septimally-lowered C, a seventh partial of D. The first dyad of bar 2 combines a Db with its 11th partial. Db is raised by two Syntonic commas to connect it with the preceding comma-raised F by a simple interval, the minor sixth 8:5. In the second dyad, the comma-raised C is tuned a Pythagorean ninth (9:4) above the comma-raised Bb from bar 3. In bar 17, however, the melodic connections before and after work better with both intervals one comma lower. The Db raised by *one* comma in bar 16 is kept in bar 17, rather than being raised further. Also. the septimally raised D in bar 18 relates to the preceding C by a 8:7 septimal wholetone, and the octave harmonic of the lowered Eb moves to D by a diatonic sixthtone 49:48. Similar examples where the intonation is adapted to the context may be found throughout the score. One interesting consequence, to my ears, of this work, is that the floating quality of Feldman's harmony is retained. Each new sonority seems to erase what came before, rather than building longer tonal constructions, even though the tuned sounds are often closely related to their neighbors. Perhaps the most striking difference from playing the piece on the piano is the intensity and variation of the sonorities, which are so clearly differentiated by their intonations. The complexity of the movements in harmonic space, along with changes of register and color, ensure that the music does not fuse into one particular tonality, but rather seems to slip freely from sound to sound, and from pattern to pattern.

The extreme intervals notated by Feldman lead to tunings that sometimes enter the quarter-tone realm; perhaps he may have found such consequences too radical for his taste. But on the other hand, consider the second sound he writes into his score: a Gbb-B# (3x augmented third). This is a perfect fifth *twice smaller* enharmonically (Dbb-C-B#). No matter how small an alteration is taken here, the wolf will soon start to howl! So I have simply allowed myself to accept the tuned dissonance here.

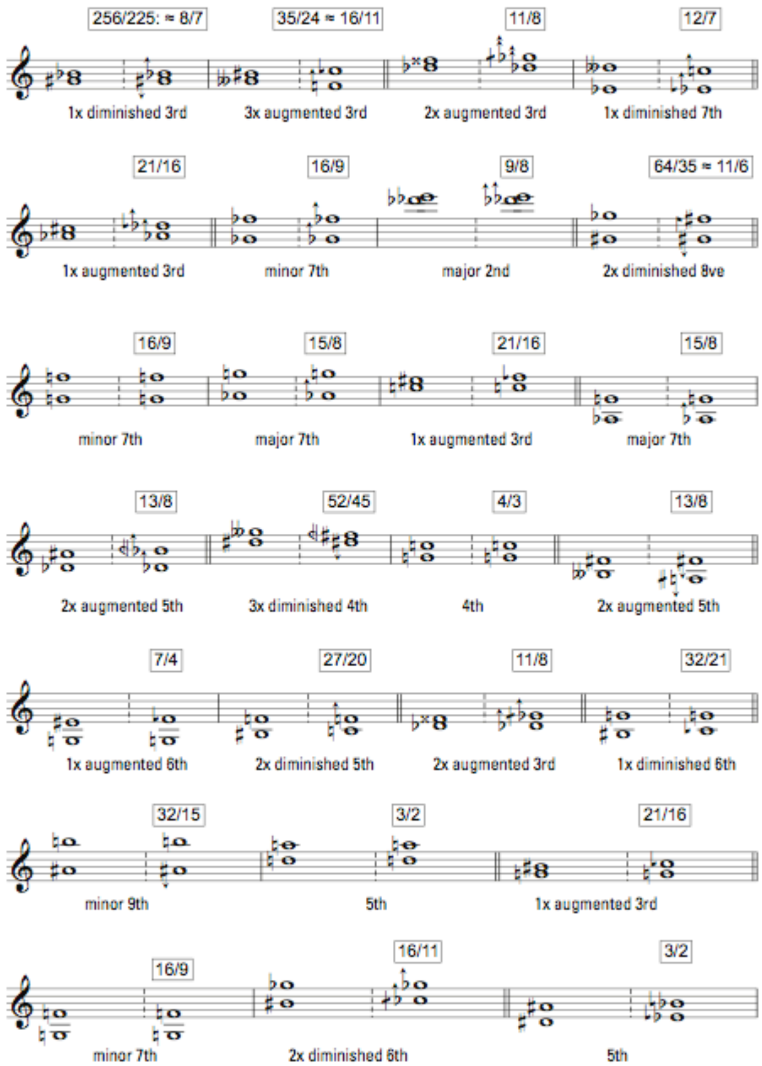
It is often maintained that only by deliberately mistuning natural intervals is it possible for a music to modulate between tonal centers or to abandon them altogether. My experience composing intonations, and in particular after tuning Feldman, leads to a different point of view. As long as a music is working with pitch as primary material, it is necessarily suggesting and slipping between possible tonalities. Pitched timbres are composed of vibrations, which form harmonic series. Recognizing common partials or harmonic series intervals between two or more pitched sounds is the most basic tonal relationship. Therefore, Just Intonation informs listening to any music concerned with pitch, whether it is deliberately tuned or not. Precisely calibrated *variations of intonation*, explicitly or implicitly chosen, or simply heard, are the actual *basis* of modulation. Of musical interest to discover and to work with here are cues and limits to comprehensibility: for example, implied common fundamentals, shared partials, beatings in a composite sound, or the distance between tones—in physical space, in register, in volume, in time, or in harmonic space.

It is clear that composing intonations of existing music raises questions. New notational images are being superimposed on the "original" works, and an area thought to belong to the real-time subjectivity of interpretative expression is being decided in advance. Of course we must consider what is lost and what is gained. Especially with an author like Feldman, his own notation cannot be simply overwritten; it retains important cues to his imagination of the music and therefore must coexist with a composed intonation. Also, just because a particular tuned sound has been associated with each interval notated does not preclude deliberate inflections of that tuning in the course of performance. On the other hand, the kind of contextual decisions about complex harmonic sonorities described here are made possible by having the ability to notate them. Namely: in this way an opinionated intonation may become also an *informed* intonation. I am certain that having this information enriches the expressive palette of a performance, and in no way hinders it.

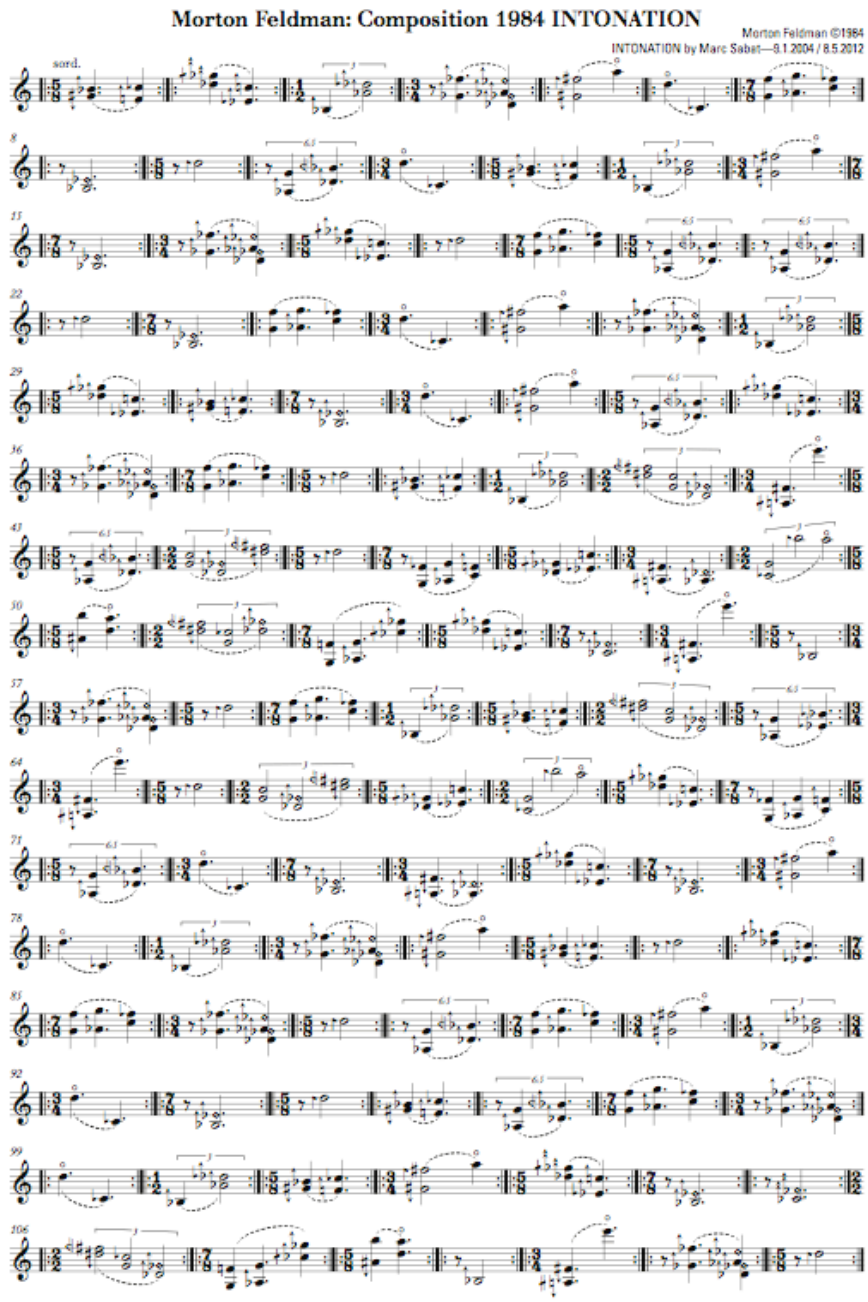
The possibilities opened up by a notated intonation can fundamentally enrich music, by introducing a new sensitivity to how sounds flow and interact in time. Counterpoint, harmony, and modulation—the arts of changing one's points of reference—are unique developments of western music, which have perhaps fallen into disuse or cliché, not because *they* cannot offer us new possibilities, but rather because we have exhausted the usefulness of an oversimplified theoretical system: twelve-tone equal temperament. Our ears know better, and are curious.

MORTON FELDMAN : Composition 1984 INTONATION

INTERVAL TUNINGS



Example 5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Example 6