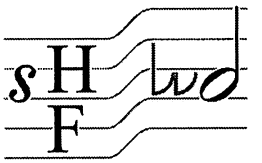
THIRTY-ONE

THE JOURNAL OF THE HUYGENS-FOKKER FOUNDATION



Stichting Huygens-Fokker
Centre for Microtonal Music
Muziekgebouw aan 't IJ
Piet Heinkade 5
1019 BR Amsterdam
The Netherlands
info@huygens-fokker.org
www.huygens-fokker.org

Thirty-One
Estd 2009
ISSN 1877-6949

thirty-one@huygens-fokker.org
www.thirty-one.eu

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KEY ECCENTRICITY IN BEN JOHNSTON'S SUITE FOR MICROTONAL PIANO

Kyle Gann

One of the most pervasive preconceptions about just intonation is that one can only play in the key to which a just intonation scale is tuned; that modulation is impossible. The obverse, more positive way of stating this is that, given a limited just intonation system, each pitch selected as tonic will reconfigure the scale into a different array of intervals. That doesn't mean you can't modulate: it means that each key will have its own personality, its own repertoire of affects, which was also true in 18th-century well-tempered keyboard music. Some of the most inventive composers of just intonation music have not only dared to write in keys unsupported by their central tuning, but have deliberately skewed the music away from the central tuning for more exotic effects. The result can be a kind of three-dimensionality whereby the scale shines through from several different perspectives.

Within the available repertoire, the principle is most obvious in keyboard works in which only twelve pitches in a repeating octave are available, and I will mention three. One is La Monte Young's six-hour improvisatory work *The Well-Tuned Piano*. The keyboard is tuned to seventh and third harmonics of E-flat and their derivatives. The work's primary theme, however, can be transposed within the scale from E-flat 1/1 to D 63/32, G 21/16, and C 7/4; and except for the last (which Young's improvisations have not yet led him to), it *is* so transposed, with attendant variations resulting from the peripheral intervals available in each key. I've written about this at length in 'La Monte Young's *The Well-Tuned Piano*' in *Perspectives of New Music*.[1] A similar though less extreme example is Terry Riley's *The Harp of New Albion*. The scale here is a relatively 'conventional' five-limit, 12-pitch scale centered around C-sharp. However, the eleven movements employ the tonal centers A#, F#, D, A, B#, and B.[2]

Easier to discuss in detail, because it is fully notated, is Ben Johnston's *Suite for Microtonal Piano* of 1977. The piece requires tuning the keyboard to 12 harmonics of the pitch C, namely harmonics nos. 16, 17, 18, 19, 20, 21, 22, 24, 26, 27, 28, and 30. Below are given the 12 keys of the piano scale, then the ratio of each note to C 1/1, and then the note's notation in Johnston's own just intonation notation:

C	C#	D	Eb	E	F	F#	G	Ab	A	Bb	B
1	17	9	19	5	21	11	3	13	27	7	15
1	16	8	16	4	16	8	2	8	16	4	8
C	C17#	D	E19b	E	F7+	F↑	G	A13b	A+	B7b	B

Figure 1: Tuning of the piano in Ben Johnston's *Suite for Microtonal Piano*

In Johnston's notation, C E G, F A C, and G B D are purely tuned 4:5:6 triads. The plus (+) raises a note by 81/80, the syntonic comma, or 21.5 cents. A sharp (#) raises by 25/24 (70.67 cents), and a flat (b) lowers by the same amount (24/25). A seven (7) lowers a pitch by 35/36 (48.77 cents) to alter a 9/5 minor seventh to a septimal minor seventh of 7/4. An

[1] *Perspectives of New Music*, Winter 1993 (Vol. 31, No. 1, pp. 134-162).
[2] Terry Riley, *The Harp of New Albion*, liner notes to Celestial Harmonies CD CEL 018/19.

upward arrow (↑) raises a perfect fourth by 33/32 (53.27 cents) to make it an 11/8, or eleventh harmonic. The 13, 17, and 19 all adjust the pitches affected to the implied harmonics (65/64, 51/50, and 95/96, respectively).

By the conventional wisdom, this keyboard can only be played in the key of C. However, of the five movements of Johnston's *Suite*, only the first and last are in the key of C. The second movement is in D, the fourth in E, and the middle movement is atonal, organized according to 12-tone method. Though the scale remains the same in all five movements, the movements in D and E have different interval resources available than the ones in C. For instance, and perhaps most importantly, only five of the 12 pitches have perfect 3/2 fifths built on them: B7b, C, D, E, and G. Johnston uses fifths to ground chords on roots, and only five such roots are available. The key of C, then, possesses a dominant chord (G-D), but no subdominant, since there is no F a 3/2 perfect fifth below C. The key of D, on the other hand, possesses a subdominant (G-D) and no dominant chord, since A-to-E is a beat-ridden 'wolf' fifth of 40/27.

Of course, Johnston could use whatever intervals he wants from the scale, dissonant or not. But by using an unequal scale, and limiting himself (in certain respects) to transposable intervals, he treats the scale analogously to a mode. For instance, the medieval Lydian mode contains no subdominant triad; the Phrygian contains no dominant; the Ionian has no perfect fifth on the subtonic while the Mixolydian does, and so on.

For much of the first movement, Johnston introduces his scale by emphasizing its derivation from the harmonic series. A low C is held silently at first as a melody made up of the simpler harmonics (3, 7, 9, 11) bring out sympathetic resonances. Higher harmonics are introduced largely in the upper register, and at one point a large harmonic series is arpeggiated. Toward the end, however, he introduces more complexity, closing on an unusual repeated chord with the harmonics out of order (from the bottom upward): 27, 11, 9, 13, 19. Stated in terms of the aggregate frequency ratios, this is 27:44:72:104:152 – a pungent, ambiguous sonority, and not one we hear every day.

Our primary concern here, however, will be the two movements *not* in the key of C. The second movement, 'Blues', is in the key of D. Transferring the tonic to D gives us the following array of intervals in relation to D:

D	E19b	E	F7+	F↑	G	A13b	A+	B7b	B	C	C17#
$\frac{1}{1}$	$\frac{19}{18}$	$\frac{10}{9}$	$\frac{7}{6}$	$\frac{11}{9}$	$\frac{4}{3}$	$\frac{13}{9}$	$\frac{3}{2}$	$\frac{14}{9}$	$\frac{5}{3}$	$\frac{16}{9}$	$\frac{17}{9}$

Figure 2: Interval relationships in Johnston's *Suite for Microtonal Piano,* with D regarded as the tonic

The statement of the blues melody takes place over a melody of perfect fifths in the left hand, using all five available perfect fifths on B7b, C, D, E, and G (actually the G is inverted as a fourth, D-G). We have gained a perfect fifth on the flat submediant, which wasn't available in the key of C, and which, along with the subdominant and flat subtonic, become the primary alternatives to the tonic harmony. What we do not have here is a dominant chord, because the fifth A+/E is not perfect, but a wolf fifth of 40/27. This in itself gives a nuance of folk or pop influence to the 'Blues' movement, since pop and folk music de-emphasize the dominant chord, relative to European classical music.

At times when Johnston is aiming for relative consonance, his choice of left-hand harmony determines distinctions among melodic pitches. For example, in mm. 14-16, he uses F7+ when the root of the underlying chord is G, and F↑ when it is C:

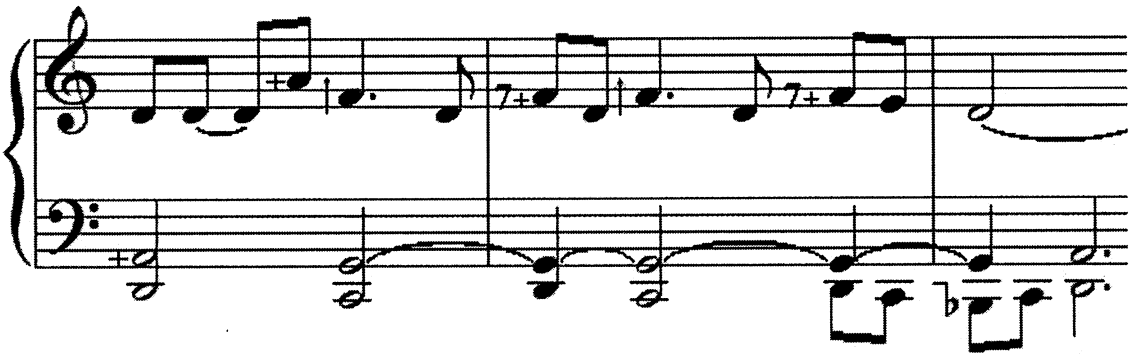


Figure 3: Johnston, *Suite for Microtonal Piano,* mov.2, mm.14-16

The D-G-F7+ chord gives a frequency ratio set of 3:4:14; the C-G-F↑ chord of 2:3:11. Were one to reverse the F7+ and F↑, the results would be D-G-F↑ (9:12:44) and C-G-F7+ (4:6:21), requiring higher numbers and therefore more dissonant. More simply put, F7+ is the 7th harmonic of G, and more closely related than it is to C, and F↑ is the 11th harmonic of C, whereas it is 11/6 above G. In each case Johnston uses the F in the harmonic series of the root, or lower in the harmonic series.

Later the 'Blues' does become considerably more dissonant, but there remains a tendency to contrast thicker chords on C or G with the comparative clarity of simpler chords on the tonic D. Here, a virtual harmonic series on C, containing the 3rd, 5th, 7th, 9th, and 17th harmonics, and then the 13th and 19th, resolving to a spare fifth on D (mm. 26-27):

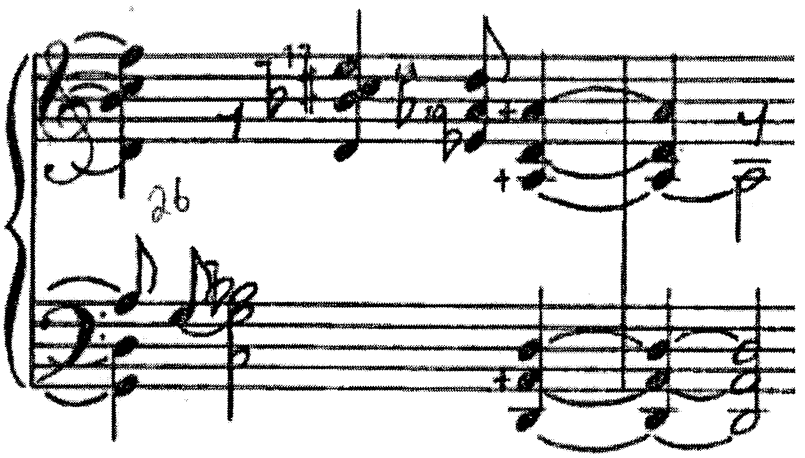
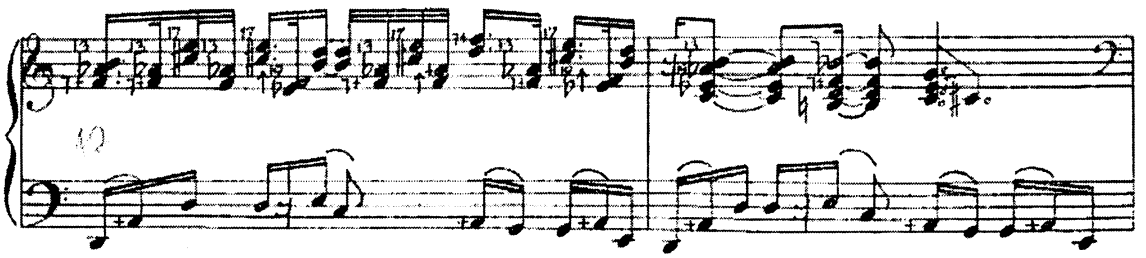


Figure 4: Johnston, *Suite for Microtonal Piano,* mov.2, mm.26-27

This is one of the effects Johnston enjoys most in just intonation music, and that he employs to greatest advantage. Just as JI consonances are even simpler and more consonant than equal-tempered consonances, so are JI dissonances more exotic and differentiated. Johnston enjoys moving from one extreme to another to accentuate that difference, and a more dramatic instance will occur later in the movement.

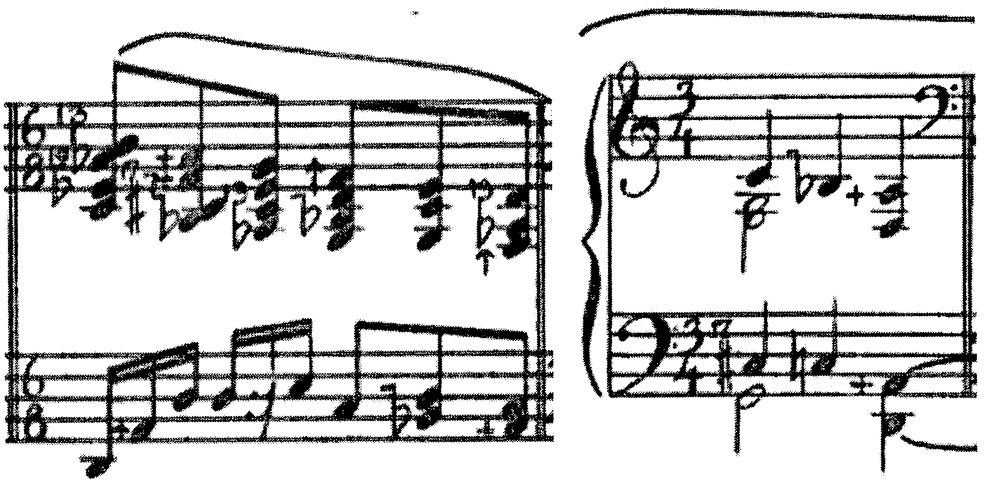
The middle section of the movement, constituting the climax, takes place over an ostinato in 13/16 meter, during which Johnston introduces more and more of the chromatic pitches, first as 'minor thirds' of a wide array of sizes (m. 42):



A13b/B	15/13	247.7
F7+/A13b	26/21	369.7
C17#/E	20/17	281.4
E19b/F↑	22/19	253.8
B/D	6/5	315.6
F↑/A+	27/22	354.5
D/F7+	7/6	266.9

Figure 5: Johnston, *Suite for Microtonal Piano,* mov.3, mm.42-43

In the next few measures he applies this same strategy to parallel clusters and minor triads. In the aftermath of this buildup, the chords that descend from the climax (mm. 53-54) make a general but nonlinear descent in complexity of frequencies, as the size of the numbers show (reinterpreting the ratios of each note from the bass note as 1/1):



1/1	32/9	38/9	52/9	20/3	9:32:38:52:60
1/1	14/9	17/9	7/3	3/1	9:14:17:21:27
1/1	13/9	16/9	20/9	8/3	9:13:16:20:24
1/1	3/2	7/4	9/4	11/4	4:6:7:9:11
1/1	9/7	12/7	16/7	20/7	7:9:12:16:20
1/1	32/27	44/27	52/27	8/3	27:32:44:52:72
1/1	17/12	5/3	2/1	8/3	12:17:20:24:32
1/1	4/3	5/3	2/1	7/3	3:4:5:6:7
1/1	3/2	2/1	3/1		2:3:4:6

Figure 6: Johnston, *Suite for Microtonal Piano,* mov.2, mm.53-54

This is an immense, curved decrescendo of harmonic complexity, over a wider range than a conventionally tuned piano could afford.

In the movement's coda (mm. 55-59), Johnston eventually wanders through all of the notes of the chromatic scale (excluding the subdominant G, generally avoided in jazz scales) over a D/A+ drone, revealing in a sparer context the full array of unfamiliar X/9-based intervals that were avoided in the introduction. Thus within this brief movement Johnston goes through five stages of exploring his 9-based D scale or mode:

1. Aligning the most consonant intervals above the available chord roots
2. Contrasting harmonic series' on G and especially C with purer chords on D
3. Increasing complexity of dyads and triads over a D ostinato
4. Moving through 'parallel' chords of varying tuning
5. All available intervals (except the fourth) over a D drone

It's a satisfying, thorough, and efficient exploration of the D scale's potentials.

The fourth movement, 'song', is in the key of E, with a modal interlude on G. The opening and closing sections on E remain, until their final measures, within a Phrygian mode with the following tuning:

E	F7+	G	A+	B	C	D
1	21	6	27	3	8	9
1	20	5	20	2	5	5

Figure 7: Phrygian mode used in mov.4 of Johnston, *Suite for Microtonal Piano*

Like the one on D, this mode offers perfect fifths on the flatted seventh and sixth scale degrees, but adds a chromatic perfect fifth below the Neapolitan scale step, of which Johnston will make use. Here, there is neither a consonant dominant nor subdominant triad. In fact, one of the determinants of the counterpoint is that the A+ is a wolf dissonance with the tonic E, but consonant with D. Of the 13 A+'s used in the first 15 measures, 11 are sounded either with or immediately before or after a D, one is a quick passing tone and the other a neighbor note. The first two can be seen here:

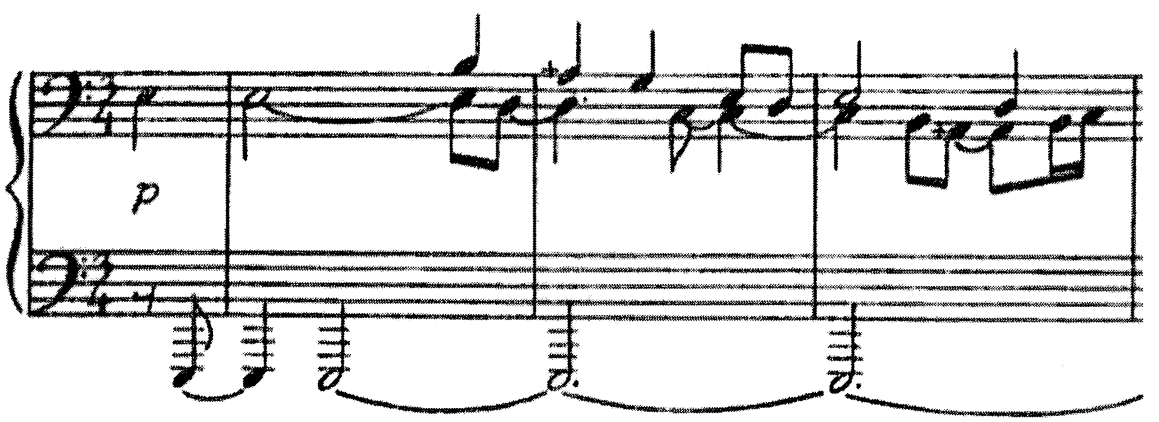


Figure 8: Johnston, *Suite for Microtonal Piano,* mov.4, opening

The E/A+ sonority is avoided throughout the movement except in the middle section in mm. 46-48, where either one note or the other is treated as an appoggiatura or passing tone over a bass D drone. (In m. 63 the A+ appears once over E as a passing tone.) Such meticulous dissonance treatment shows that Johnston is aware of where his wolf interval is, and is not allowing it to ring as such.

Beginning in m. 12 and increasing in importance, Johnston makes use of the flat subtonic triad D F7+ A+, a septimal minor triad with the tuning ratio 6:7:9 (actually more consonant than the Renaissance-era minor triad of 12:15:18). In the transition to the middle section, he suddenly raises the ambiguity level tremendously by running through an eerie series of chromatically descending 'augmented' triads beneath an E drone, harmonies deliciously unfamiliar without being terribly dissonant:

F↑ B7b D	11:14:18
F7+ A+ C17#	21:27:34
E A13b C	10:13:16
E19b G B	19:24:30
D F↑ B7b	9:11:14

Figure 9: 'Augmented' triads in mov.4 of Johnston, *Suite for Microtonal Piano*

The transition then settles into a drone on C, above which all pitches are harmonics. The middle section is a more relaxed episode in G mixolydian, over an arpeggiation of three of the five available perfect fifths (the largest chain of perfect fifths available in the scale, in fact), and with a delightfully flat seventh scale degree:

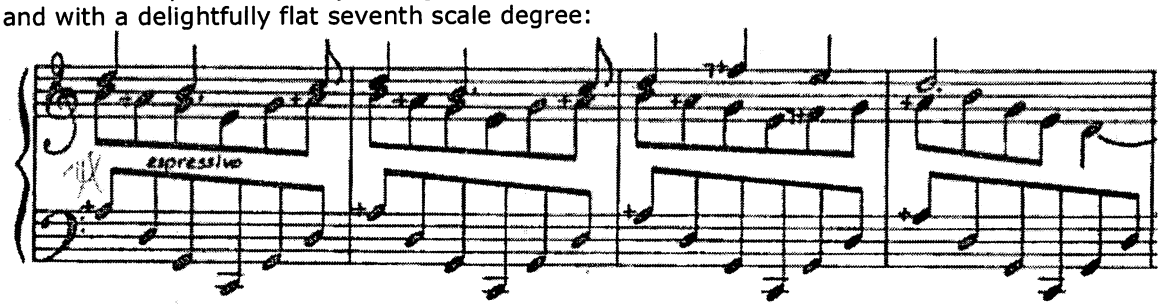


Figure 10: Johnston, *Suite for Microtonal Piano,* mov.4, mm.35-38

The final section returns to the motives and texture of the first, though with the upper melody switched into the bass, and harmonized in spare fourths and fifths. All scale degrees can be harmonized with a fifth either above or below within the Phrygian scale (E with B, D/A+, C/G, B/E, A+/D, G/C) except for the F7+, and Johnston adds unexpected spice to this line by harmonizing F7+ with B7b, the tritone of the tonality. Once again, as in the first section of 'Blues', he's fashioned a line from all five available fifths. In the last three measures, Johnston cadences on a picardy third by sounding an E drone note, then bringing in a 5/4 G# harmonic by having the pianist touch the string at the proper node for the fifth harmonic. Thus, on a keyboard tuned to 12 pitches, Johnston writes a piece employing 13.

As a composer writes, his imagination flows outward to take in all the resources he or she has available. Obstructed by limitations, the imagination turns in another direction, and can find new possibilities that might not have originated in pure thought. There is a give-and-take with the material, as a potter might have with clay or a sculptor with a block of granite. The kind of compositional thinking demonstrated above is shaped by possibilities of just intonation that no equal temperament can offer. Unless a composer is content to remain within a single key, a fixed, limited just intonation scale pushes him to think in terms of modes, and of harmonic

variety among tonalities. By contrast, in any kind of equal temperament, any scale can be transposed to any pitch step; different modes can be constructed if one wants to define them, but the structure of the scale does not mandate or encourage them.

To make the kind of distinction between wolf fifths and perfect fifths that Johnston makes in movement 4, for instance, would require a very fine equal tempered grid indeed: the distinction is that between 680 cents and 702 cents, whereas, for instance, a 31-step equal scale would provide 658 cents, 697 cents, 735.5 cents, with interval distinctions twice as wide as needed. This is not to say that just intonation is superior to extended equal temperaments, merely that the two systems are conducive to different tendencies. Of course, non-modal, complete transposability is also available in an *unlimited* just intonation system, as Johnston has shown in some of his string quartets. But limitations are not a bad thing for a creative artist, and a limited just intonation system offers a resistance to the composer that can spur creativity.

Different tonalities applied to the same unequal scale can reveal the scale from different vantage points, and achieve varying levels of exoticism without the need for new pitch materials. The scale 'speaks' differently through different tonalities, as an actor might speak through different characters but still reveal a unifying sensibility. For those of us who work this way, it can be gratifying to enter into a dialogue with the scale and feel it 'push back' and force other potentials than the ones we first thought of. The varied results of that process are among the subtler pleasures we receive from hearing Johnston's, Young's, and Riley's piano music.