Three explicated buzzes, as if the eardrum were a speaker

for ten instruments

Noah Kahrs

Program Notes

I was initially inspired to write this piece by a peculiar psychoacoustic effect I experienced while practicing the glockenspiel part for Dukas' *The Sorcerer's Apprentice*, in preparation for the October 2016 University of Chicago Symphony Orchestra concert. While playing scales in the very highest register of the glockenspiel, I heard a buzzing noise that seemed to be coming from inside my ear. My usual response was to put earplugs in to protect my hearing, but on a few particular occasions, my curiosity got the better of me. As I continued to practice the part, I noticed that the pitches of these buzzes were the same every time, and that I could mathematically relate them with what notes I was actually playing.

It turns out that these buzzes are known as "otoacoustic emissions"; they result from the eardrum actually working as a speaker and producing sounds of its own. This piece presents an extended exploration of these peculiar sounds and their musical implications.

The first movement attempts to resynthesize these buzzes with the resources available in the ensemble, using traditional techniques and conventional tuning. The second movement requires the performers to play extremely high notes that actually produce otoacoustic emissions; I encourage you to listen carefully for those sounds floating around the hall. The second movement also requires five of the ten performers to retune their instruments to better align with the pitches of the buzzes, which lie outside of our traditional tuning system. In the third movement, I freely explore some of the musical materials developed in the first movement, but with the resources made newly available in the second movement.

Three explicated buzzes, as if the eardrum were a speaker was premiered on May 20th, 2017 by the University of Chicago New Music Ensemble, conducted by Barbara Schubert.

Prefatory Notes

The following notes are intended as an account of compositional techniques and paradigms that I followed in composing *Three explicated buzzes, as if the eardrum were a speaker*. They are emphatically not intended as a definitive analysis of the work, which I would instead imagine to focus on broader aspects of my musical language that I, as a composer, might write off as my "intuition." More than anything else, this essay traces the trajectory of how I thought about and composed this piece; a listener's approach may be completely different.

Initial Inspiration and Introduction to Otoacoustic Emissions

I was initially inspired to write this piece by a peculiar psychoacoustic effect I experienced while practicing the glockenspiel part for Dukas' *The Sorcerer's Apprentice*. While playing an upwards scale in the very highest register of the glockenspiel, I heard an ascending buzzing noise inside my ear. My usual response was to put earplugs in to protect my hearing, but on a few particular occasions, my curiosity got the better of me. As I continued to practice the part, I noticed that the pitches of these buzzes were the same every time, and that they rose with the same intervals as the scale I was playing. After experimenting by playing different pitches in combination, I realized the pitches of the buzzes corresponded to difference tones (that is, when playing two pitches, the buzz heard is at the difference tone of those pitches). Sam Pluta, my BA Advisor, informed me that these were specifically otoacoustic emissions; an effect in which the inner ear acts as a speaker and actually produces sounds of its own.

Although there is extensive literature on the biological mechanics of otoacoustic emissions, particularly in journals of psychology and medicine, I did not extensively consult these works, instead focusing my efforts on figuring out what pitch systems might be implied by difference tones. I particularly focused on the sequences obtained by fixing one note and computing the difference tone between that note and the note one semitone higher, then a whole-tone higher, and so forth. From here on, I will refer to the relevant sounding pitches as difference tones because that term is more familiar and refers to the resultant pitch rather than to the actual psychoacoustic effect.

I determined, both from experimentation at a glockenspiel and from some rote calculations, that such a sequence of difference tones approximates a harmonic series. In particular, if we derive a sequence of difference tones by moving upwards from a fixed pitch by half-steps (e.g. C held constant, against C♯, D, D♯, etc.), the resulting sequence approximates a stretched harmonic series[1] with a fundamental approximately four octaves and a semitone below the fixed pitch. Correspondingly, if we derive a sequence of difference tones by moving downwards from a fixed pitch by half-steps (e.g. C held constant, against B,B♭,A, etc.), the resulting sequence approximates a compressed harmonic series with a fundamental approximately four octaves and a whole tone below the fixed pitch.

Figures 1a and 1b present one example of each type of sequence, both with fundamentals approximately on C2; Figure 1c is the standard harmonic series for comparison. I found that the glockenspiel could not produce audible difference tones for notes further than a major sixth apart, so have only included 9 notes in each of these sequences. As noted prior, difference tones transpose with the notes that generate them, so we can make meaningful inferences about the relations between these sequences from the example. In particular, as shown in Figure 1d, the altered *n*th partials in the two distorted series will be exactly (*n*-1) semitones apart, and will both differ from equal temperament by the same microinterval. For instance, the two second partials are D♭ -36 cents in the stretched harmonic series of 1a and C -36 cents in the compressed harmonic series of 1b; these are one semitone apart from one another.

Initial Planning from Rehearsal H to Rehearsal Y

Once I discovered this material and decided to focus on it for my piece, I began to design the work's structure, with an overall goal of showcasing the effect and implications of otoacoustic emissions. I envisioned the work in three movements, and did not substantially change my formal designs. The first movement is an equal-tempered motivation of difference tones, which approximates their effect but is unable to fully achieve their resonance. The second movement showcases otoacoustic emisssions on their own, and retunes one string of each bowed string instrument as well as the bass clarinet to match justly-intuned sonorities that approximate certain difference tones. The third movement deploys this retuning to harmonies that are generated partially by difference-tone calculations and partially by more intuitive methods.

Although difference tones have a long history in Spectral composition as well as in electronic music, I do not consider my work to be in this tradition. In particular, Spectral treatments of difference tones tend to focus on difference tones as a byproduct of Amplitude Modulation and

[1] By "stretched" and "compressed," I mean that each of the intervals within the harmonic series is slightly (by less than a semitone) wider or narrower, respectively, with respect to a proper harmonic series.

Frequency Modulation processes, which are primarily used in electronic music, and which were not at all in mind when I composed this work. Difference tones as a pure psychoacoustic effect are treated in music by composers such as Alvin Lucier and Maryanne Amacher, but their works generally consist entirely of the presentation of that psychoacoustic effect, rather than including substantial other material engaging with it more loosely and informally. I found Gérard Grisey's *Vortex Temporum* to be a more relevant model in its usage of stretched and compressed harmonic series as related to a quotation from older repertoire, although *Vortex Temporum* does not reference any immediate audible phenomena as far as I know.

Structurally, I consciously followed a general principle I have observed in Sofia Gubaidulina's *Meditation on the Bach Chorale 'Vor deinen Thron tret' ich hiermit* and *On the Edge of the Abyss*[2] as well as in Gérard Grisey's *Le Noir de l'Étoile*. In particular, all three of these works have an extensive introduction that builds up to a quasi-interlude middle section that showcases a specific effect or peculiar sound, and a more fantasy-like, quasi-improvisatory third section that tries to reconcile that new sound with the material from the opening. The sounds of the middle section are, for the three works just mentioned, tremolo with circular bowing, a waterphone, and a recording of a pulsar, respectively. In my own work at hand, the middle section is the second movement, which showcases otoacoustic emissions in an exposed context where they can clearly be heard. Once I had decided on this framework, I composed the middle movement of the piece (consisting of **O-U** in the final score) as well as its immediate companions, namely the end of the first movement (**H-O**) and the beginning of the third movement (**U-Y**).

At the end of Movement 1, starting at rehearsal **O**, I informally generalize the difference-tone sequences discussed above to an equally-tempered environment. Specifically, I focus on the more general idea of intervals in a sequence being stretched or compressed. Figure 2 shows a reduction of **H-O** to the main sequences that I elaborate. The sequence at **H** is a jumping-off point for the rest of the movement, and is an approximation of a compressed sequence of octaves, reformed to avoid containing any actual octaves. The intervals are a minor ninth, a major sixth, a major seventh, and a major fifth; if we switched the sixth and seventh so that the interval size was consistently decreasing, we would have two D♭s surrounding a C, which would provide too much internal closure. Playing off the sequence at **H**, the sequence at **I** keeps the initial striking minor-ninth but compresses the next two intervals, and the sequence at **J** intensifies the focus on major sevenths juxtaposed against triadic material, leading to the next several sequences. In particular, major sevenths are an unexpected point of overlap between the natural process of otoacoustic emissions and the Dukas excerpt through which I discovered otoacoustic emissions - the first interval in a compressed harmonic series is similar in character to a major seventh due to being less than 100 cents less than an octave, and the Dukas excerpt runs from D♭7 to C8, which is an actual major seventh.

The sequence at **K** is a more accurate mirror of the close-together upper partials of a compressed harmonic series, though is still subject to the alterations induced by equal temperament; **L** picks up selected notes from **K** (and alters one note) to refocus the material on major sevenths versus triadic material. The two sequences at **M** anticipate the opening of the second movement by presenting two sequences that have the same highest note but unfold downwards differently; the first two of three intervals in the second sequence of **M** are each one semitone narrower than the corresponding interval in the first sequence of **M**. **N** unifies **M** with the minor ninths of the opening: the second through fifth notes are the first sequence of **M** transposed down a perfect fourth (so that the penultimate note is the final note of the previous sequence), and the first note is a minor ninth above the second, recalling the opening gesture only one semitone higher.

In Movement 2, starting at **O**, I directly showcase otoacoustic emissions and the stretched and contracted harmonic series they occur in, and I use these pitch relations to derive a retuning for the bowed string instruments and bass clarinet. For example, in the first two measures of **O**, B is held constant while the other voice moves upwards B-C-D-D♯, resulting in a stretched harmonic series. In the third and fourth measures of **O**, D♯ is held constant as the other voice moves D♮-C♯-C-B, resulting in a compressed harmonic series. However, in both cases, the final dyad of the sequence is B5-D♯6, corresponding to a difference tone 33 cents flat from middle C. This resultant difference tone can be approximated within 2 cents by a 7th-partial harmonic on a D fundamental, and the cello does so; this harmonic, serving as a more reliable stand-in for a difference tone, is used to retune the viola's C string. The other moments of retuning in the movement can be explained similarly in their own contexts.

I selected the specific sequence of retunings that I use (seventh partial, then fifth partial, then seventh partial) because in combination, they result in a note that is 76 cents flat, or 24 cents sharp relative to the note a semitone lower. I can then use this pitch to approximate the first and

[2] I have analyzed these two Gubaidulina works in a separate paper, focusing on their paradigmatic structural similarities as observed both through side-by-side comparison and through sketch study of *Meditation*.

third notes of the altered harmonic series, which are 14 and 18 cents sharp relative to twelve-tone equal temperament, respectively.

I have worked with similar just-intonation retuning schemes in a number of my other recent works, such as *Two Counterpoints* for piano quartet and *Symmetries Askew* for viola and piano. My specific approach to intonation, which characterizes much of the more improvisatory third movement of this work, is consciously inspired primarily by the works of Ben Johnston, György Ligeti, and Hans Abrahamsen. In particular, the specific technique of retuning to harmonics is inspired largely by Abrahamsen's *Schnee*, which is partially responsible, together with Ligeti's *Horn Trio,* for my attraction to the formal treatment of beating between justly-intuned and equal-tempered intervals, though much of my familiarity with justly-intuned intervals in themselves comes from Ben Johnston's String Quartets, as well as from much time spent experimenting with computer-generated sounds and acoustic tuning forks out of tune from each other.

The first section of the third movement, lasting from **U** to **Y**, returns to the descending sequences from the end of the first movement, but treats them with the newly available microtones. The first sequence, at **U**, is transposed up an octave both so that more notes are available for microtonal variation and to emphasize the descending character of the sequences. Figure 3 shows the three sequences, with annotations indicating which microtonal variants are primarily used for each pitch. Surrounding notes are generally drawn from the difference-tone sequences that might contain a given microtone. In sum, this section, introducing the third movement, is intended as a treatment of the end of the first movement in light of the techniques introduced in the first movement.

The Rest of the Piece

I envisioned the remainder of the third and first movements as completing the processes that the middle section and its accompaniments had set in motion. When composing the piece, I completed the third movement before even starting the remainder of the first movement, so I will address those movements in that order here.

The first section of the third movement, as noted above, shifts from high notes at **U** to low notes at **Y**. Subsequently, **Y** to **AA** slows the music down and brings the notes even lower. At **AA**, high notes are reintroduced, so that the harmonics in the violin and viola have difference tones corresponding to notes in the brass; the energy of this section lasts until **BB**. From **BB** to **EE**, the lowest notes fade out as the high register becomes increasingly dominant. **EE** to the end is essentially a coda: **EE** to **FF** focuses on a few individual tuning differences and possible difference tone consequences, and the last few bars of the piece articulate a quote from *The Sorcerer's Apprentice* (specifically the excerpt in which I originally discovered otoacoustic emissions), distorting the quote with instrumental sustain and tuning deviations. Figure 4 shows the general pitch span and dynamics of each section, showing that the high notes rise to higher and higher pitches from **AA** onwards as the low notes remain in a fairly constant register while fading out.

The first half of the first movement, from the start to **H**, is a generally a structural retrograde of the third movement. The opening of the piece, though not in a strictly high register like the ending, introduces motivic material related to otoacoustic emissions: the second crotale note is doubled by the horn playing an approximation of the difference tone that the first two crotale notes could have produced; the sound of the stopped horn serves as a stand-in for the buzz of an otoacoustic emission. **B-D** develops motivic material in the high register, mirroring the end of the third movement, and **D-F** focuses attention on equal-tempered clusters around C6, mirroring the microtonal clusters around the same pitch at **AA-BB**. Low pitches are introduced, approximating difference tones that may or may not be audible, through much of **D-H**, reversing the decay of low notes of **Y-EE** in the third movement. The rest of the movement, **H-O**, is analogous to the opening of the third movement, **U-Y**, as previously discussed. As the opening of the first movement and the end of the third movement are mirror images around a common central core, the entire piece exhibits an informally symmetrical structure in which to capture the overall progression from equal temperament to microtonality via exposed otoacoustic emissions.

Conclusion

The preceding remarks are not an analysis of the piece. Rather, they are a description of how I composed the piece and what relations I had in mind through the majority of my compositional process. If they were a proper analysis, they would be a self-critique in which I considered what I valued in my compositional process and in my music, and in which I investigated my so-called "intuition" to which I delegated most small-scale local decisions. I have only discussed those aspects of the piece of which I was conscious; if the piece holds together coherently, it is surely in large part due to unconscious decisions that I would find extremely difficult, if not impossible, to justify.

Figure 1a

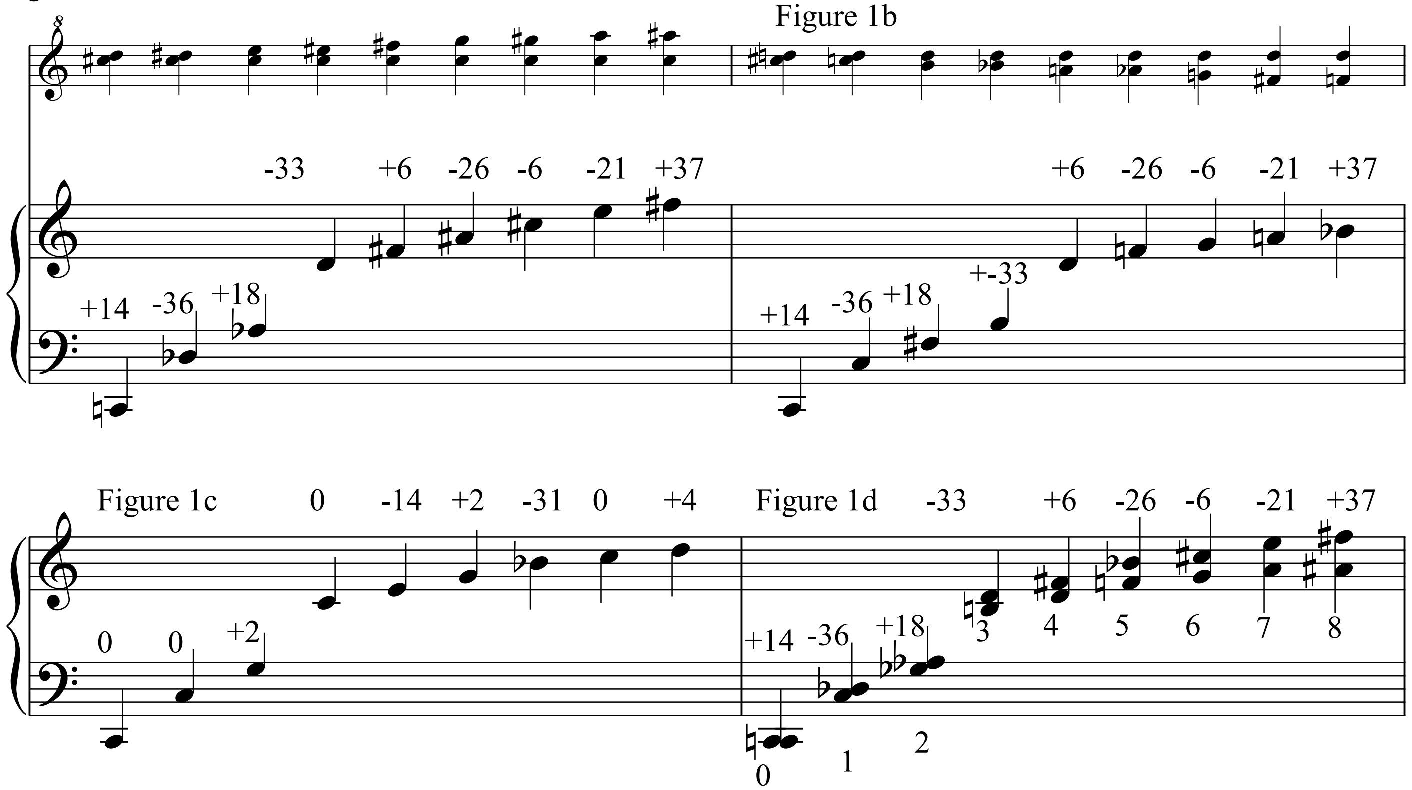


Figure 2

Figure 3

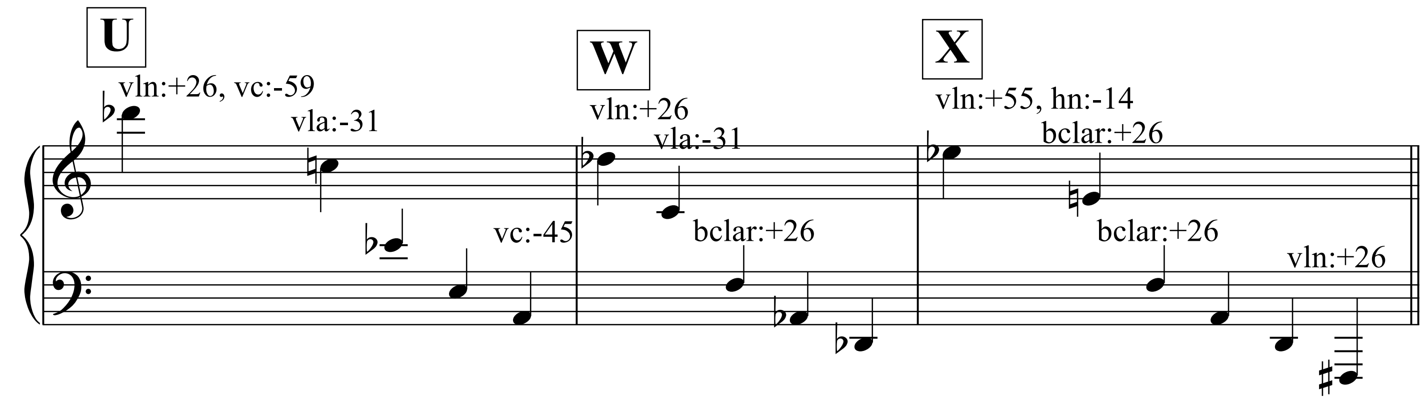
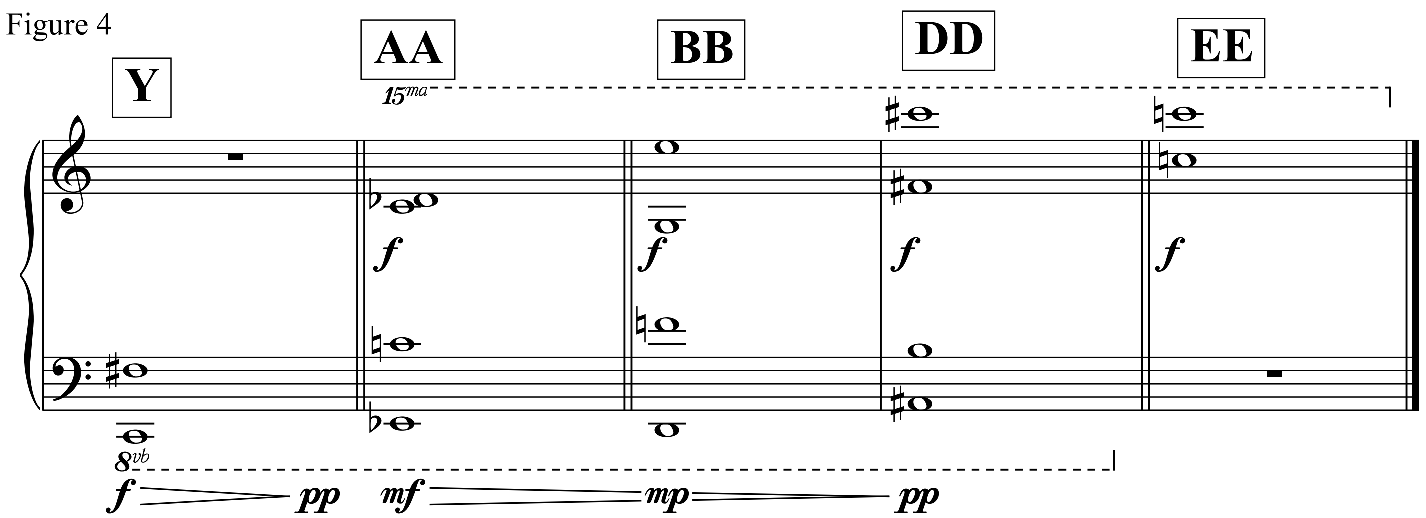


Figure 4



Performance Notes

String Notation

Natural harmonics beyond the second partial are notated with diamond noteheads at the appropriate node on the fingerboard; the string is indicated by a roman numeral. Sounding pitches are sometimes included for clarity in parentheses or on an ossia staff. Sounding pitches on retuned strings are presented at the retuned pitch (rounded to the nearest quarter-tone); fingered pitches are notated as if the string were not retuned. Second partial ("touch octave") harmonics are notated as usual (with an empty circle above the note).

Double-node harmonics are used, particularly in the third movement in the Violin I (from **U**) and Cello (from **BB**) parts. Multiple nodes are indicated on the same stem; these nodes should both be touched with natural-harmonic pressure on the same string. Expected resultant pitches are indicated at first appearance and where otherwise helpful.
Artificial harmonics are notated as usual.

All harmonics, both natural and artificial, should be played without vibrato.

Percussion

Unpitched percussion is as according to the following key:

A downbow indication in the crotales (⊓) indicates that a note should be bowed. At m72, the downbow below the staff indicates that only the lower voice should be bowed; likewise, at m75, only the upper voice should be bowed.
Instruments should generally be left to vibrate freely; this is often indicated by a tie into a rest when the note otherwise appears to be short in duration.

Horn

In a few places, the intended fundamental of a note is indicated above a pitch or succession of pitches (following the notation of Ligeti's *Horn Trio*), with microtonal variation intended.

+ indicates stopped notes.

Piano

The D♭4 string should be prepared by placing a small rubber disc at the midpoint of the string. A harmonic sounding at D♭5 should be audible, as should a less clear undertone. Throughout the piece, D♭4 is written with x-noteheads.

Pedal can generally be added as appropriate. In the third movement, pedal markings are sometimes explicitly indicated; the pedal should not be fully depressed, but should allow all sonorities to continue freely without too much extra resonance from other strings. For example, at **AA**, the notes from the previous 3 measures should all continue ringing across the double bar, but the octave Fs at **AA** should nonetheless have distinct and audible articulations.

Difference Tones

Throughout the entire piece, high notes have often been chosen specifically to produce certain audible difference tones. This effect is the primary focus of the second movement. In Movement II, an additional staff is present that includes the expected sounding pitches of these difference tones (rounded to the nearest quarter-tone). The timbres of the instruments producing differences tones should be adjusted to maximize the clarity of difference tones.

Retuning

During Movement II, one string is microtonally re-tuned on each string instrument, and the bass clarinet is also microtonally re-tuned. All five re-tunings persist for the duration of Movement III. Each measure containing a re-tuning in it (the exact procedure, usually matching one instrument's open string to a natural harmonic on another instrument, is indicated in text in the score), has a long fermata over it (𝄐), indicating that the measure should last for as long as the instrument in question requires to retune their instrument.

For example: at the fifth bar of **O**, the cello and viola play simultaneously. As the cello sustains its harmonic, the viola retunes its C string to match the cello's pitch three octaves lower, but with the same microtonal variation. This measure lasts as long as the violist needs in order to securely retune.

Brackets

Thick horizontally oriented brackets are used to indicate a primary voice, as with *Hauptstimme* in serial music. At K, an important secondary voice in the clarinet is indicated with the standard *Nebenstimme* notation.

Time between Movements

Movements should not quite be played *attacca*; there should be a brief pause of 3–4 seconds between the first and second movements and of 1–2 seconds between the second and third movements. However, the pauses should not be so drastic as to completely halt the flow.

Transposition

The score is in C. The horn part is transposed as usual. The clarinet part is generally transposed as usual, and transposes an additional 80¢ flat for notes on the re-tuned bass clarinet. (Note that although the score shows the bass clarinet as transposing 20¢ sharp relative to a C score, the part sounds as 80¢ flat relative to the standard transposition.)

Three explicated buzzes, as if the eardrum were a speaker

I

Score in C

Noah Kahrs

9
B
C
poco vib
Fl.
B. Cl.
To Cl.
Clarinet in B♭
Hn.
B. Tbn.
Perc.
tam tam bass drum
Crot.
Glock.
Pno.
15ma
Vln. I
Vln. II
Vla.
Vc.


18
Fl.
Cl.
Hn.
B. Tbn.
Crot.
Glock.
Pno.
Vln. I
Vln. II
Vla.
Vc.
non vib
II
sul pont
sul pont, poco vib
ord
sul pont
vib
ord
sul pont, vib


25
D
E
Fl.
Cl.
Bass Clarinet
in B♭
Hn.
B. Tbn.
Crot.
Glock.
Pno.
Vln. I
ord
Vln. II
Vla.
sul pont, vib
poco sul pont
ord
Vc.


32
F
Fl.
B. Cl.
Hn.
B. Tbn.
Crot.
Glock.
Pno.
Vln. I
Vln. II
Vla.
Vc.
III
ord
sul pont
non vib
vib
poco vib


39
G
Fl.
B. Cl.
Hn.
B. Tbn.
Crot.
Glock.
Pno.
Vln. I
Vln. II
Vla.
Vc.
vib
ord
sul pont
shift to ord...

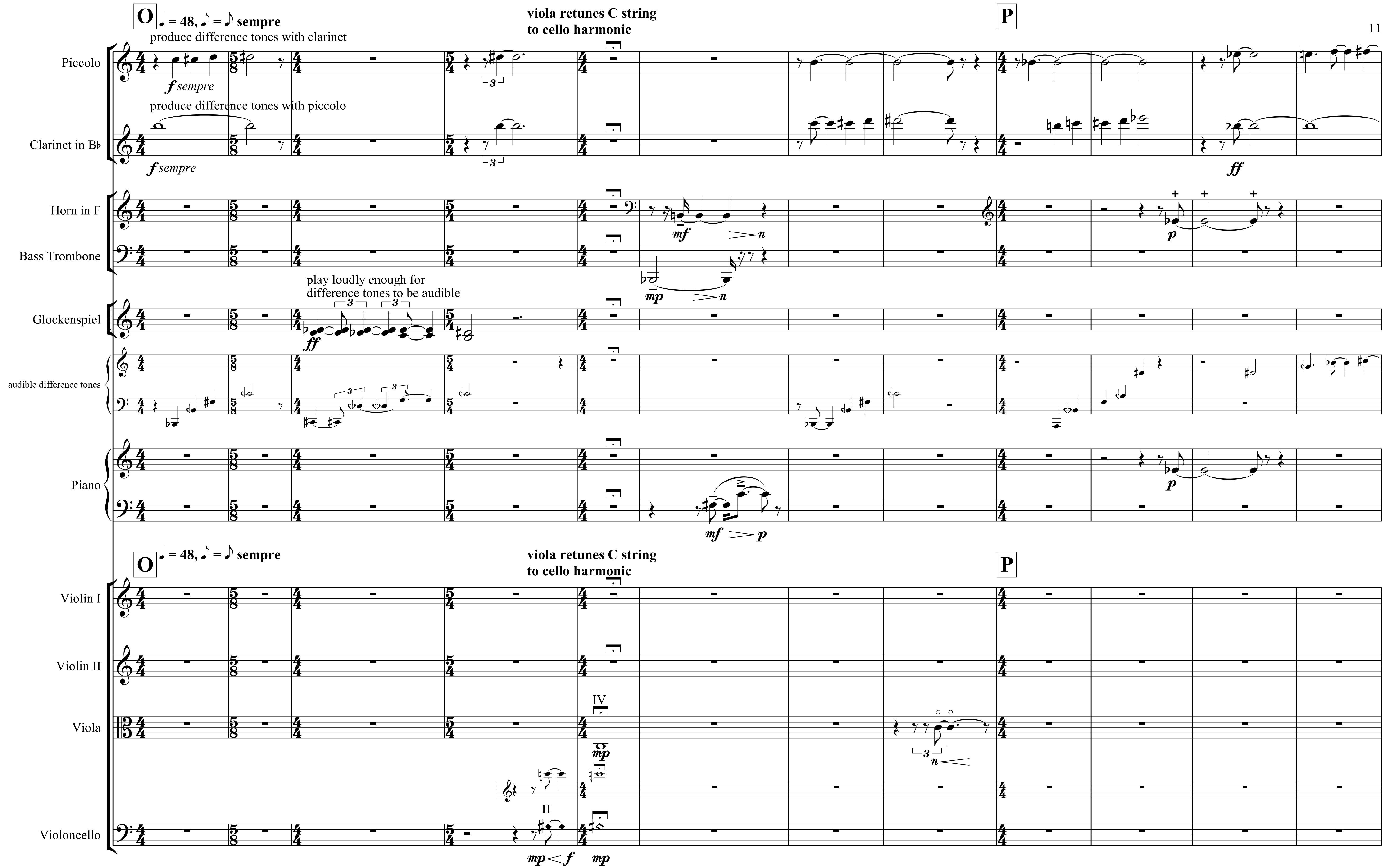

47
H
I
Fl.
B. Cl.
Hn.
B. Tbn.
Perc.
Crot.
Pno.
Vln. I
Vln. II
Vla.
Vc.
non vib sempre
To Picc.
To Cl.
Clarinet in B♭
turn snare drum on for sympathetic resonance
toms
low tom, bass drum
(tbn)
(vc)
slight overpressure....ord
sub sul tasto non vib
ord
III
vib
IV
sul pont
vib
vib, sul pont
sul pont - ord


57
J
K ← ♪. = ♩ → = 80
L
Picc.
Cl.
Hn.
B. Tbn.
Crot.
Glock.
Pno.
Vln. I
Vln. II
Vla.
Vc.
snare drum off
vib
non vib
non vib,sul pont
sul pont
ord, non vib
sub sul pont
ord
II
sub mf

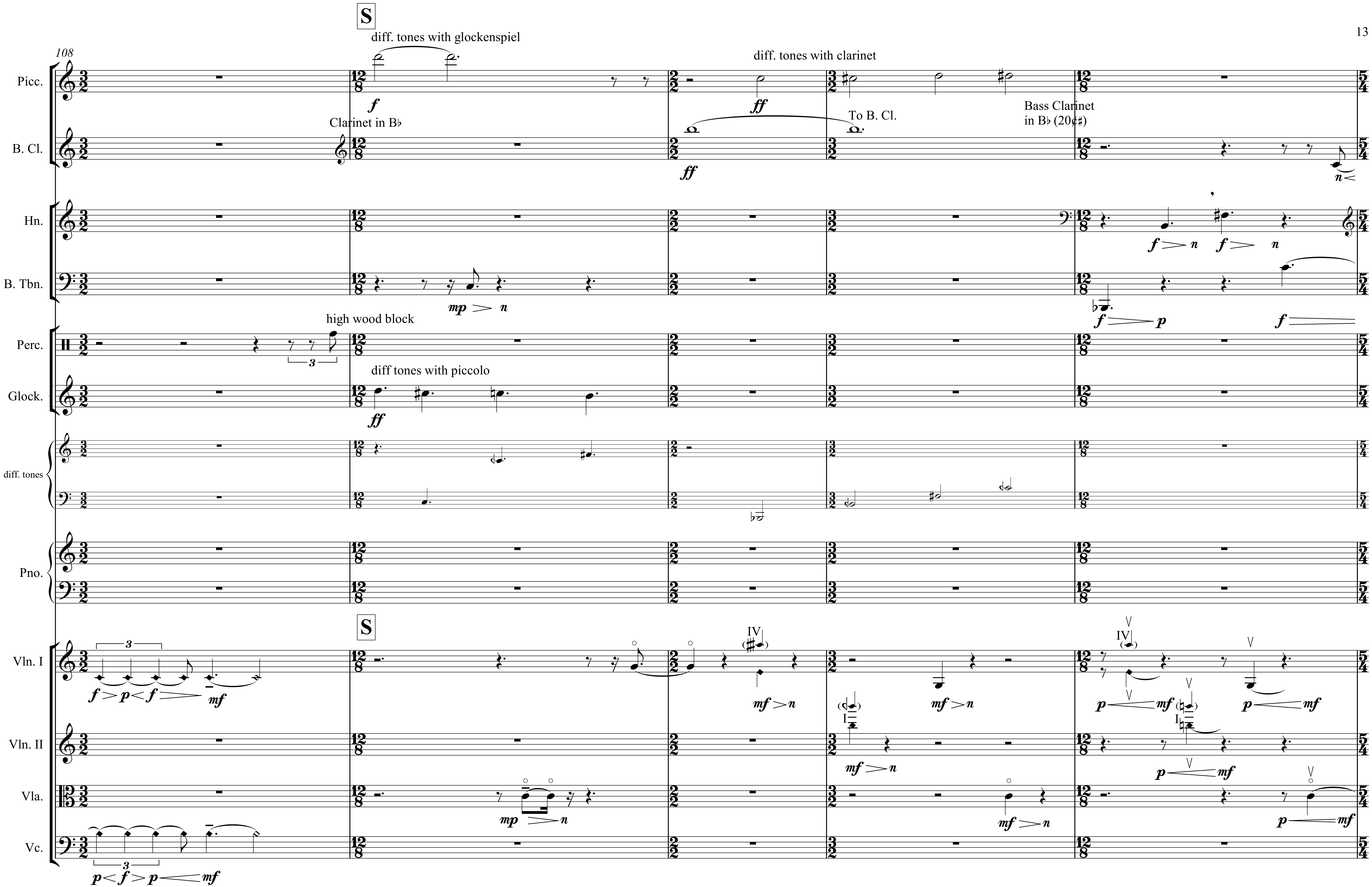

68
M
← ♩ = ♪. → (♩ = 60)
Picc.
Cl.
To B. Cl.
Bass Clarinet in B♭
Hn.
B. Tbn.
Crot.
Pno.
Vln. I
IV
sul pont, non vib
Vln. II
ord
Vla.
ord
sul pont
Vc.
ord
sul pont


75
N
Picc.
B. Cl.
To Cl.
Clarinet in B♭
Hn.
B. Tbn.
Perc.
snare drum on
tom toms
snare drum off
Crot.
Pno.
N
Vln. I
sul tasto, vib
Vln. II
sul pont
ord
sul pont, vib
Vla.
sul pont, vib
sub ord
sub mp
Vc.
ord

II


O
♩ = 48, ♪ = ♪ sempre
produce difference tones with clarinet
viola retunes C string
to cello harmonic
P
Piccolo
f sempre
produce difference tones with piccolo
Clarinet in B♭
f sempre
ff
Horn in F
mf
n
p
Bass Trombone
mp
n
play loudly enough for
difference tones to be audible
Glockenspiel
ff
audible difference tones
Piano
mf
p
O
♩ = 48, ♪ = ♪ sempre
viola retunes C string
to cello harmonic
P
Violin I
Violin II
IV
Viola
mp
n
II
Violoncello
mp
f
mp


95
Q
R
violin II retunes E string to viola harmonic
cello then retunes A string from violin E string
violin I retunes G string to cello harmonic (F♯)
bass clarinet retunes to violin 1 G string
produce difference tones with crotale
produce difference tones with piccolo
Bass Clarinet in B♭
To Cl.
Picc.
Cl.
Hn.
B. Tbn.
Crot.
Glock.
diff. tones
Pno.
Vln. I
Vln. II
Vla.
Vc.


S
diff. tones with glockenspiel
108
diff. tones with clarinet
Picc.
Clarinet in B♭
To B. Cl.
Bass Clarinet
in B♭ (20¢♯)
B. Cl.
Hn.
B. Tbn.
high wood block
Perc.
diff tones with piccolo
Glock.
diff. tones
Pno.
S
IV
I
Vln. I
Vln. II
Vla.
Vc.

113
T
diff tones with crotale
To Fl.
Picc.
B. Cl.
ff
mf
mf
p
D
F
D
Hn.
B. Tbn.
mp
p
mf
mp
mp
Perc.
Crot.
diff tones with piccolo
ff
diff. tones
Pno.
mp
f
T
Vln. I
Vln. II
Vla.
Vc.
f

III


Flowing but with distinct subdivisions, ♩. = 54
U
vib sempre
To Cl.
Clarinet in B♭
Flute
Bass Clarinet in B♭ (20¢♯)
Horn in F
Bass Trombone
Spaces: 3 Toms, Bass Drum Tam-tam
Lines: 2 Woodblocks, 2 Wood Slats
Crotales
Glockenspiel
Piano
Flowing but with distinct subdivisions, ♩. = 54
U
IV
Violin I
Violin II
IV
Viola
Violoncello


V
124
Fl.
Cl.
Hn.
B. Tbn.
Perc.
Crot.
Glock.
Pno.
Vln. I
Vln. II
Vla.
Vc.
To B. Cl.
Tom-toms
BD
I, sul pont
sub p


130
W
Fl.
Bass Clarinet
in B♭
Cl.
Hn.
D
B. Tbn.
Toms
Perc.
wood slats
Pno.
sub f
W
Vln. I
Vln. II
Vla.
II
Vc.


135
X
Fl.
B. Cl.
Hn.
B. Tbn.
Perc.
Pno.
Vln. I
Vln. II
Vla.
Vc.
toms
slats
B
I
(in tune)
II
I
sub sul pont
ord


140
Fl.
B. Cl.
Hn.
B. Tbn.
Perc.
Pno.
Vln. I
Vln. II
Vla.
Vc.
To Picc.
slats and blocks
I
I, sul tasto
sul pont
---ord
sul pont


147
Y
(♩ = 40)
Z
Fl.
B. Cl.
Hn.
B. Tbn.
Perc.
Pno.
Vln. I
Vln. II
Vla.
Vc.
mp
f
mf
p
pp
bass drum
tam-tam
(holdover from tie)
p, but enough to sustain
sul pont
I


156
AA
Fl.
B. Cl.
Hn.
B. Tbn.
Perc.
Crot.
Pno.
tam-tam
bass drum
Vln. I
Vln. II
Vla.
Vc.
match detuning of C string
mp
mf
p
f
pp
ff
n

162
♩. = 54 (♪ = ♪)
BB
Piccolo
Fl.
B. Cl.
To Cl.
Clarinet in B♭
Hn.
B. Tbn.
Perc.
Crot.
Pno.
Vln. I
Vln. II
Vla.
sub mp


CC
non vib sempre
167
Picc.
Cl.
Hn.
B. Tbn.
Crot.
Glock.
Pno.
CC
Vln. I
Vln. II
Vla.
Violoncello
(partial 10)


174
DD
EE
Picc.
Cl.
Hn.
B. Tbn.
Crot.
Glock.
Pno.
15ma
Vln. I
Vln. II
Vla.
Vc.
sul pont
8va
I
(15)
(10)
(20)
sub mp


180
FF
Picc.
Cl.
Hn.
B. Tbn.
Perc.
Crot.
Glock.
Pno.
Vln. I
Vln. II
Vla.
D (11)
C (14)
high woodblock
mp
mf
p
f
sub f
sub ff
(12)
(20)