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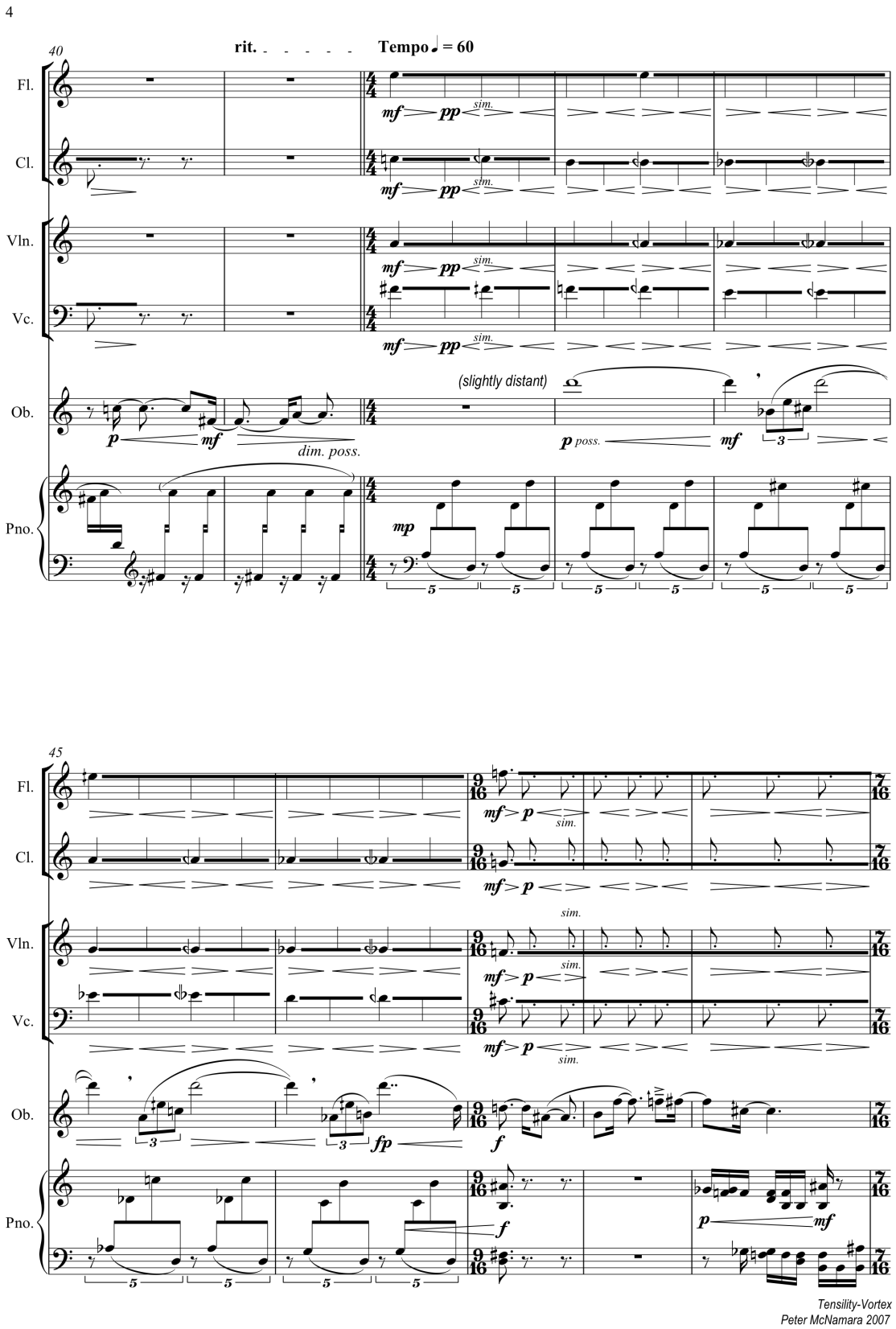
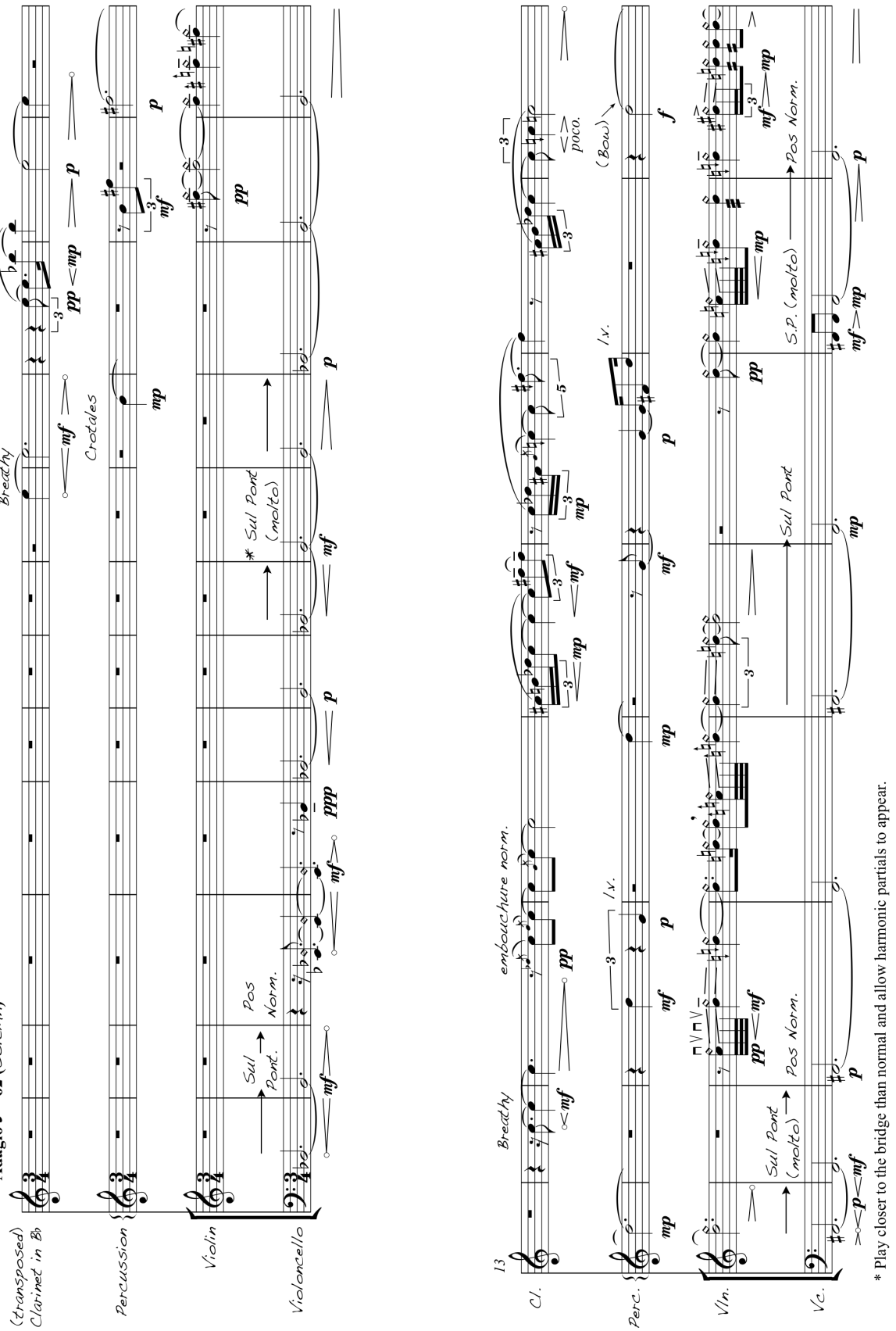
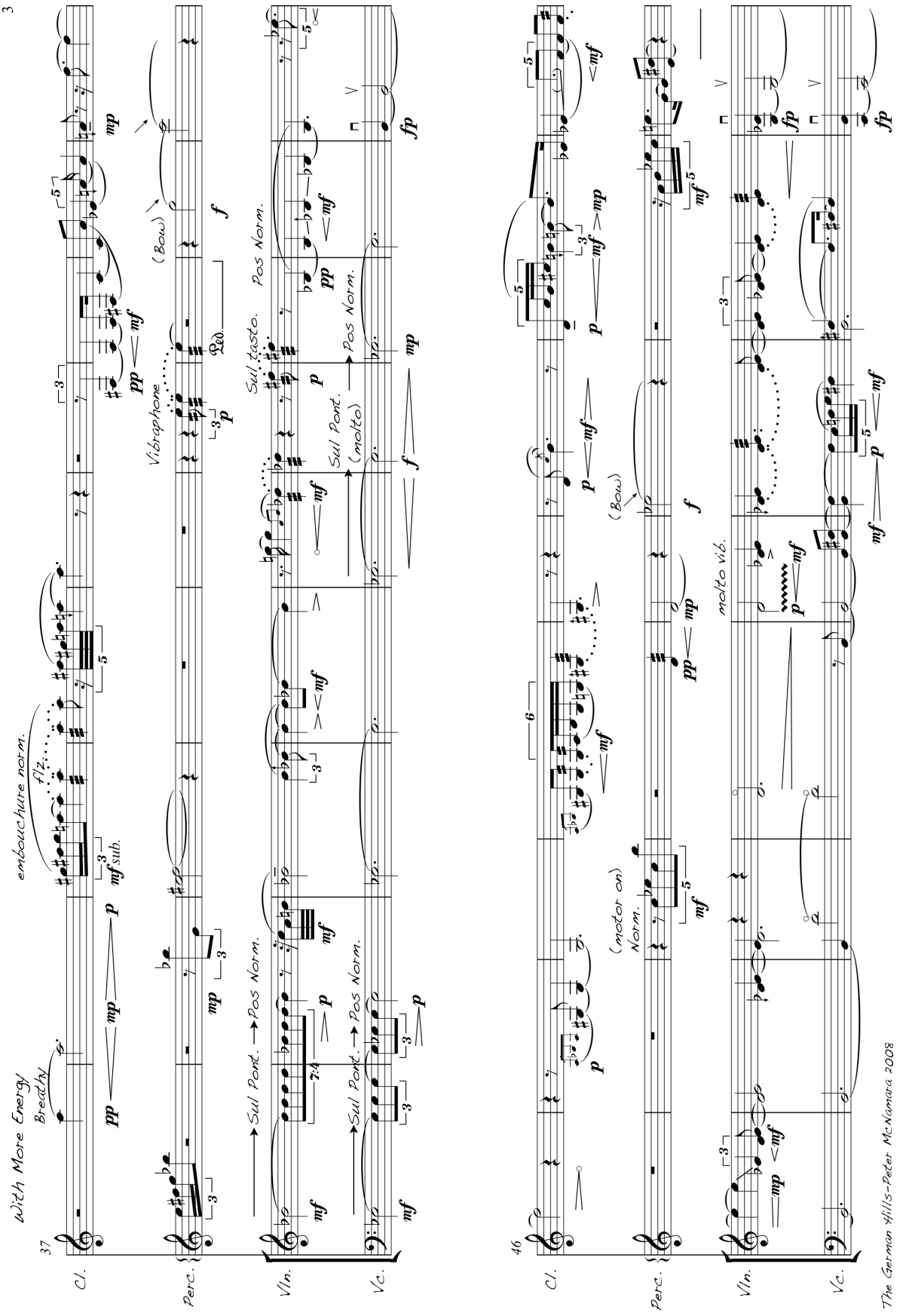
Appendix I: *Tensility-Vortex* bb. 40-9.



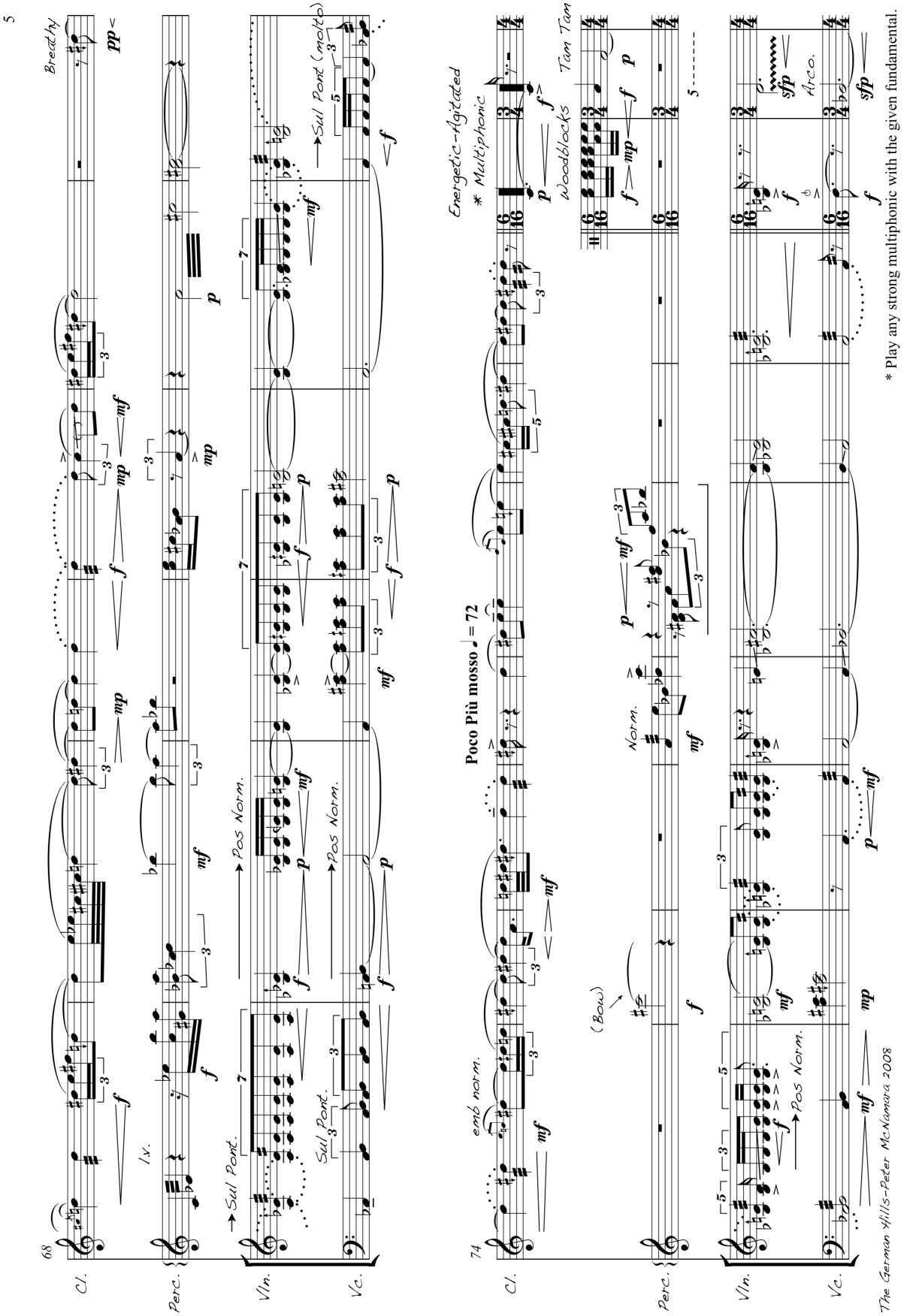
Appendix II: *The German Hills* bb.13-20

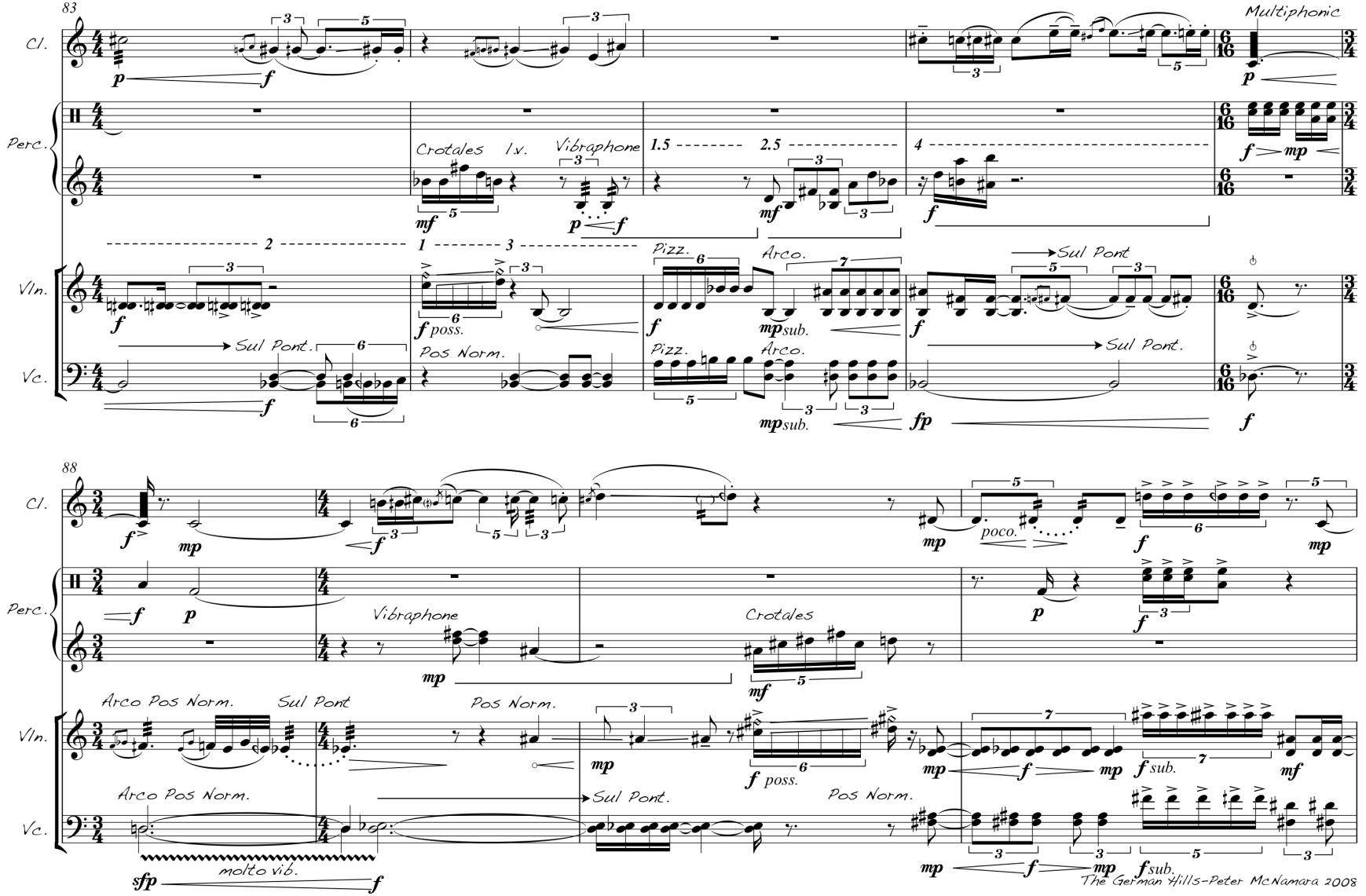


Appendix III: *The German Hills* bb.45-52

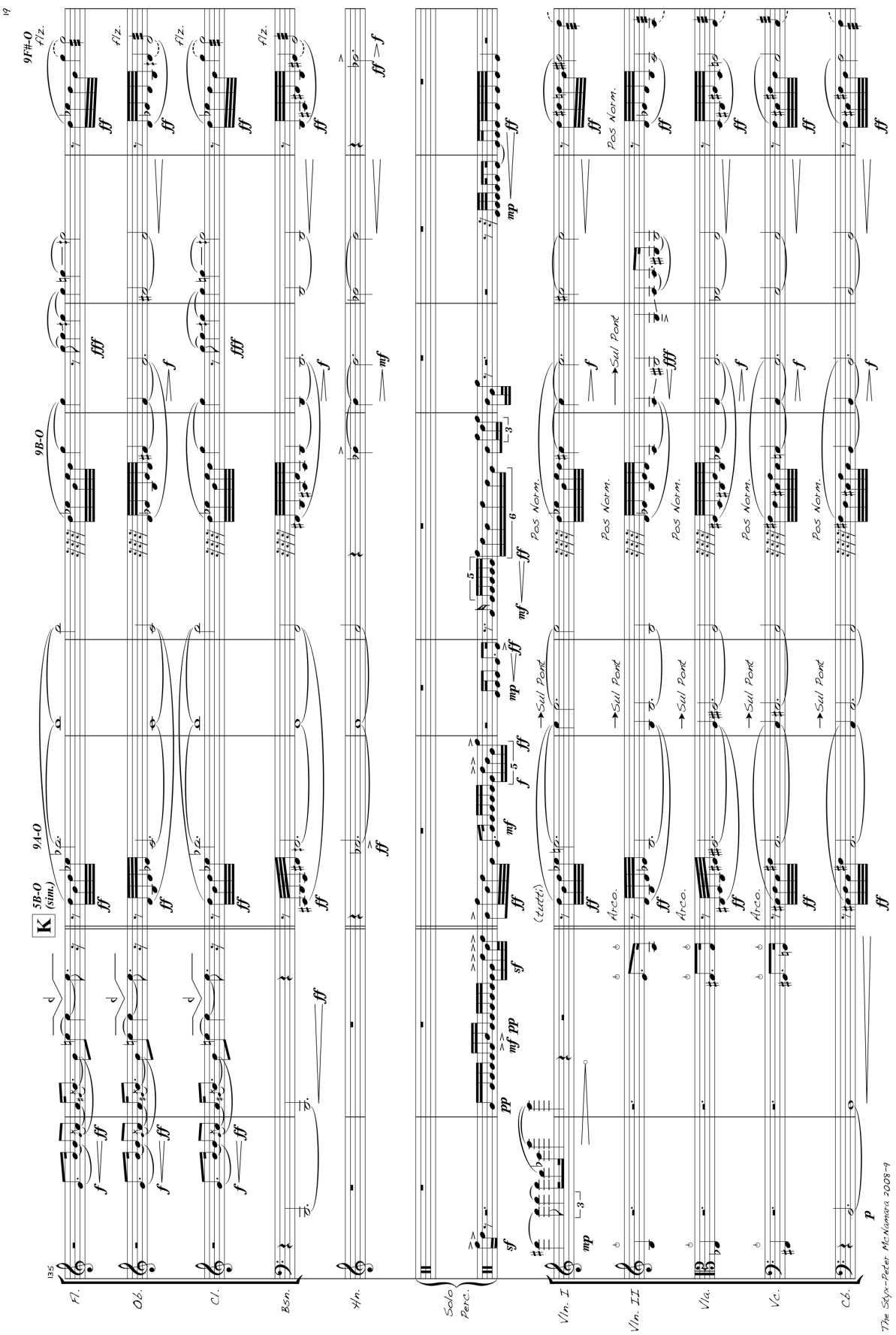


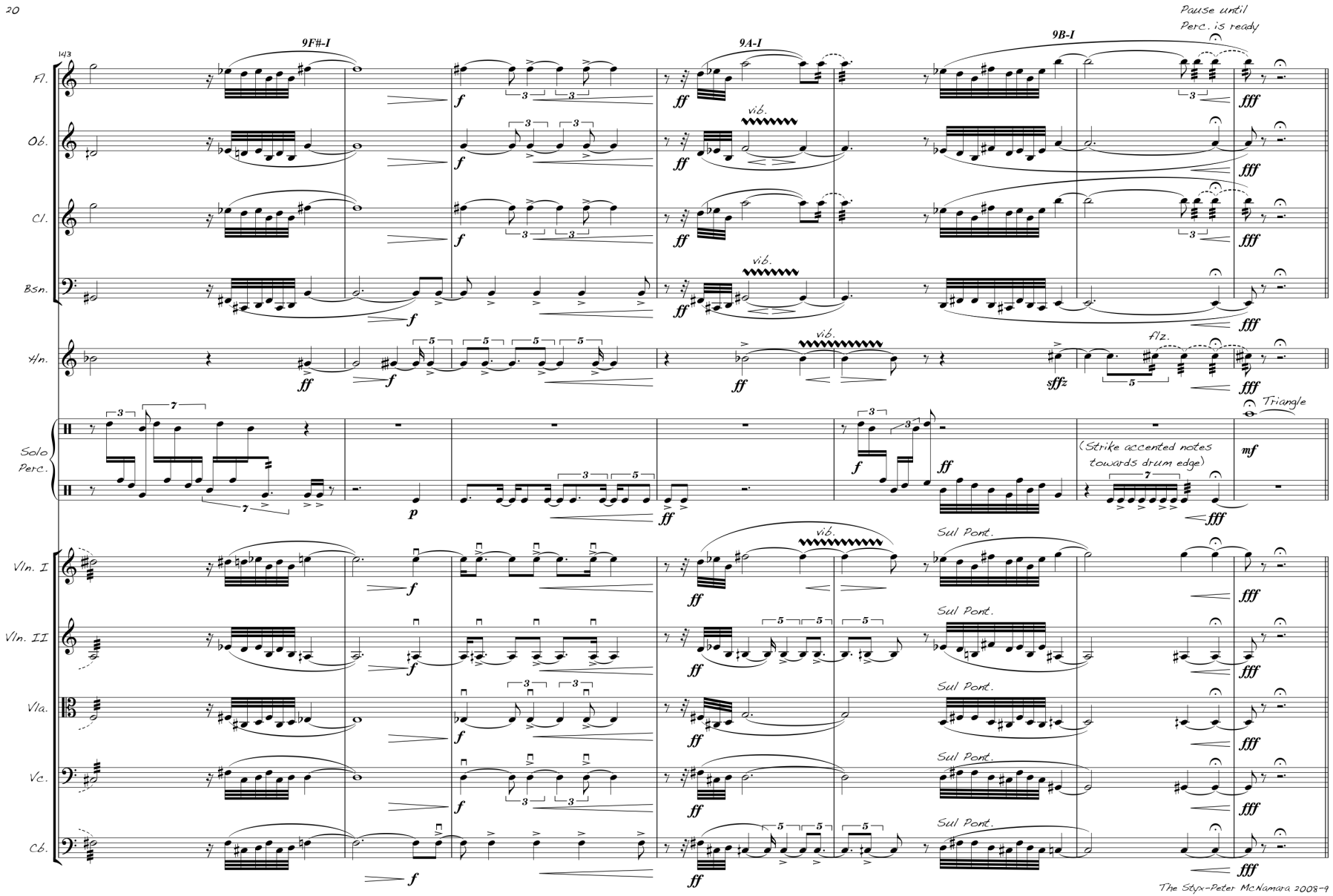
Appendix IV: *The German Hills* bb 81-6



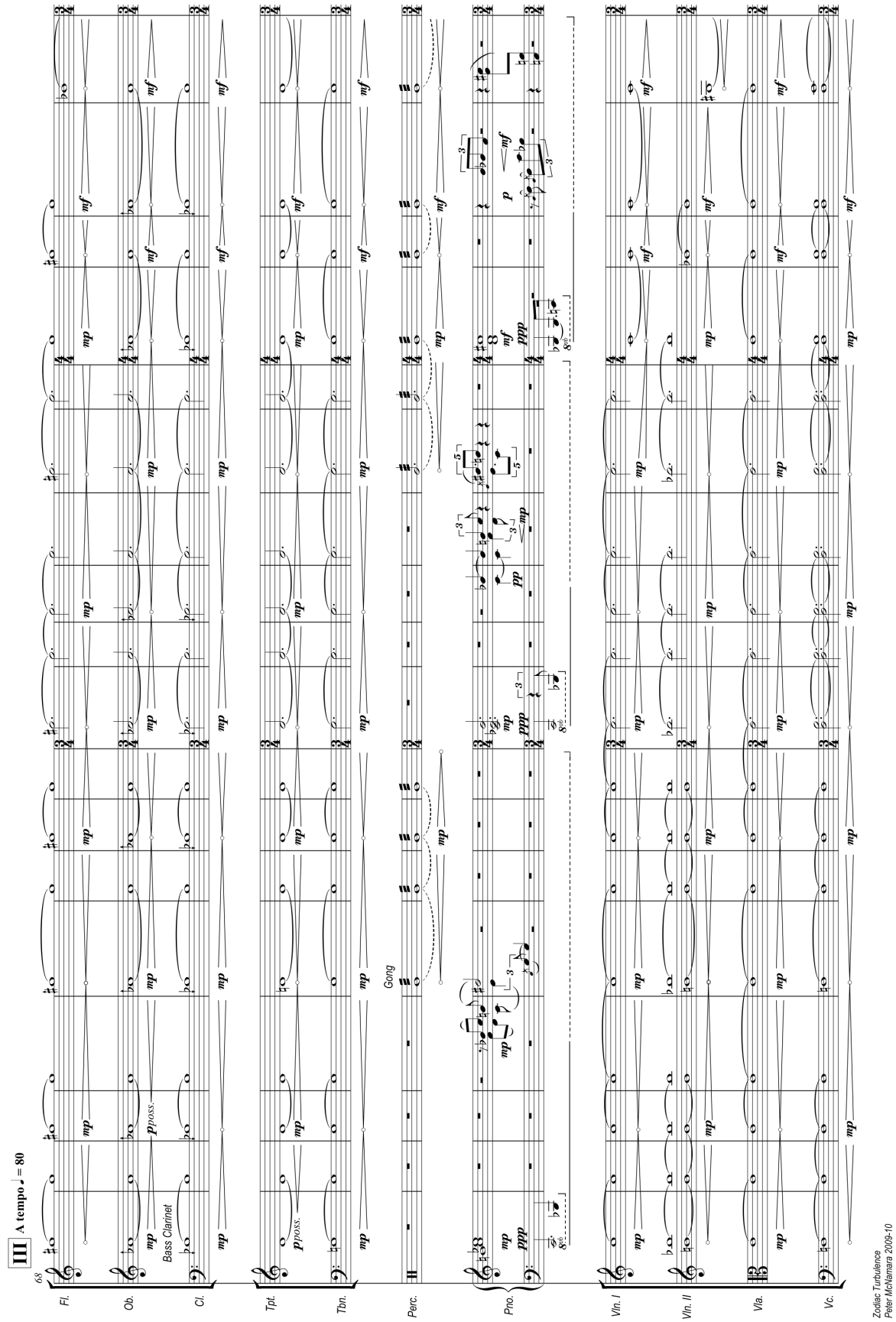

83
Cl.
Perc.
Vln.
Vc.
Crotales l.v.
Vibraphone
Multiphonic
Pizz.
Arco.
Sul Pont.
Pos Norm.
88
poco.
Arco Pos Norm.
molto vib.
The German Hills-Peter McNamara 2008

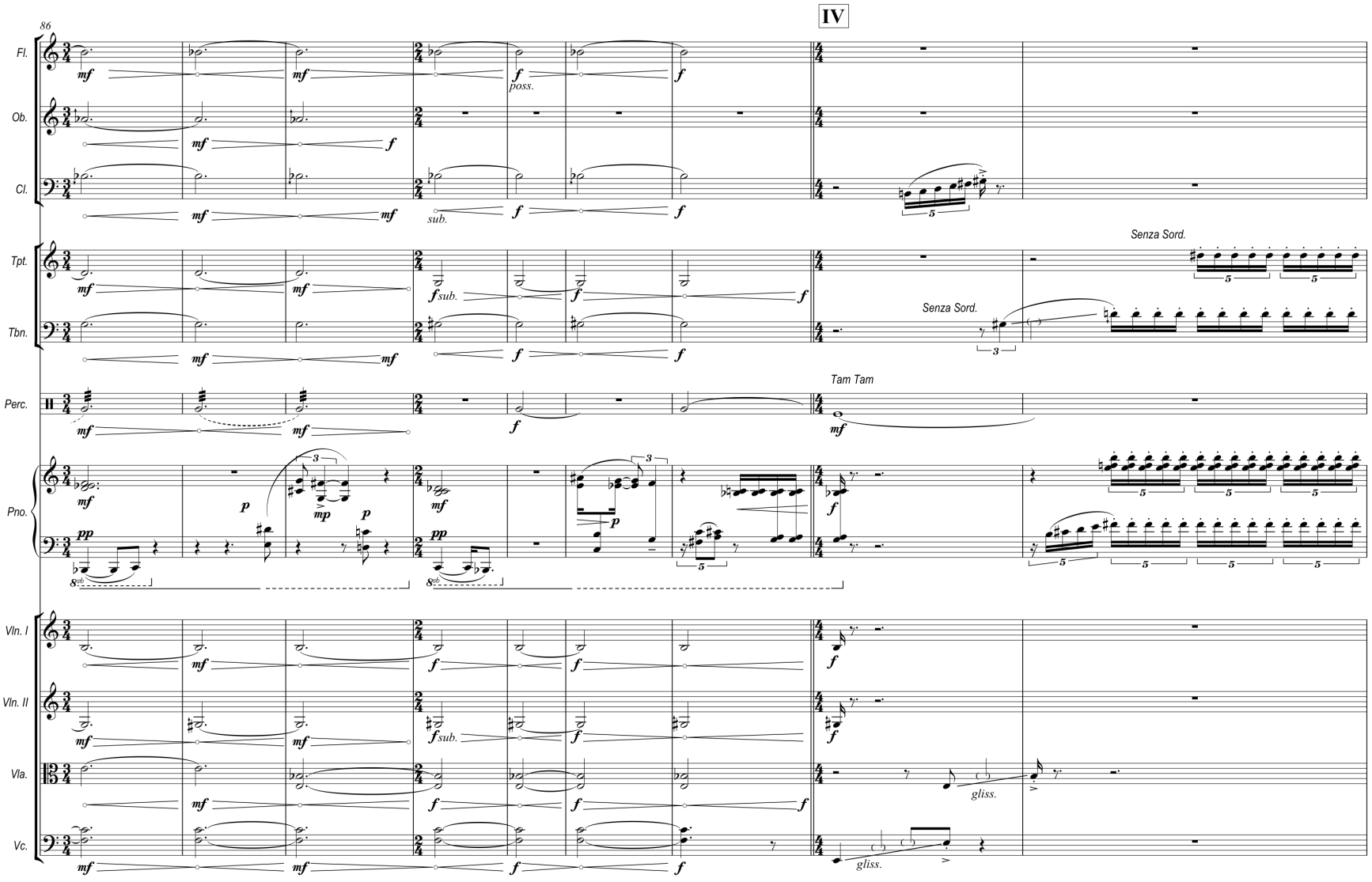
Appendix V: *The Styx* Section K



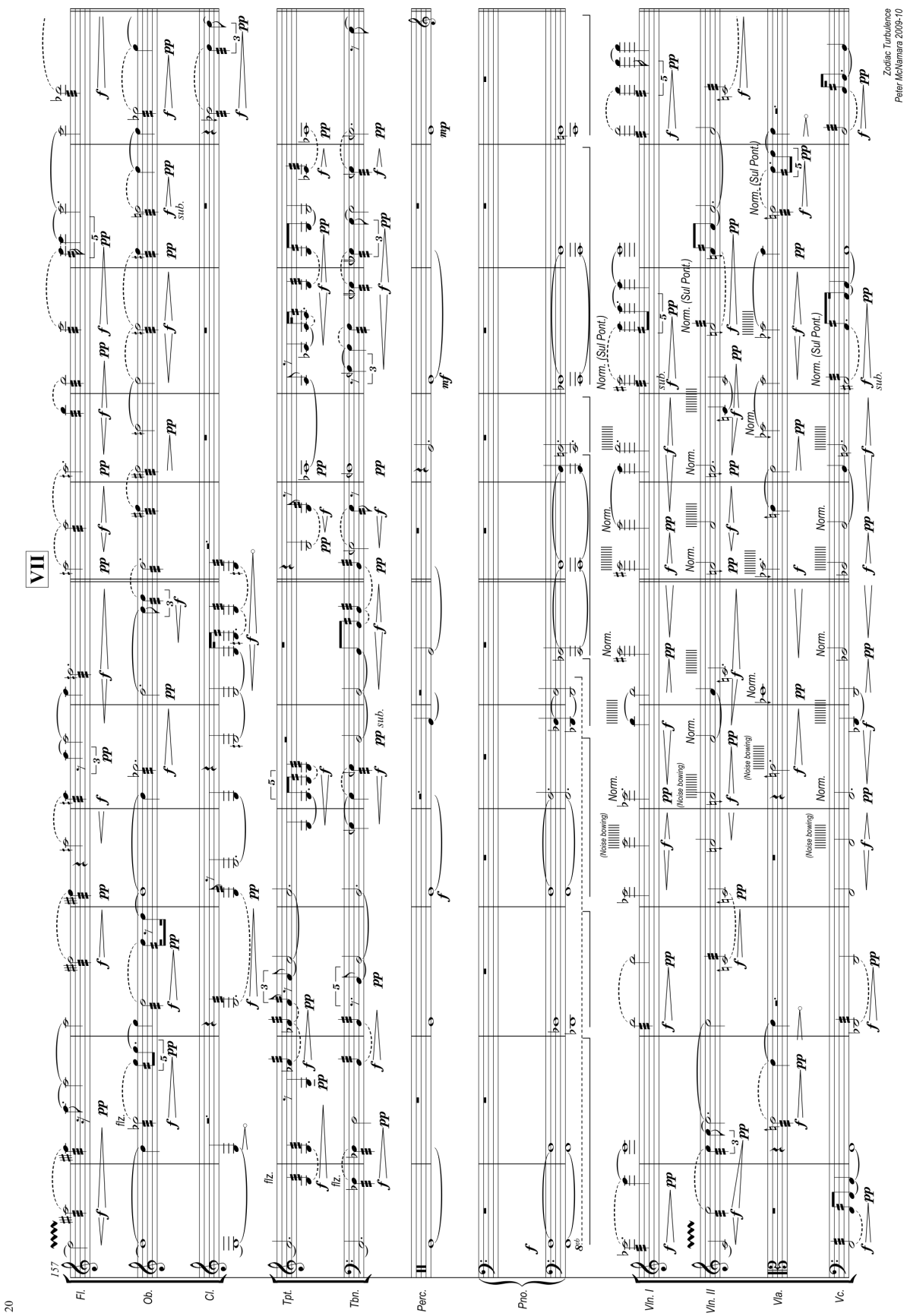


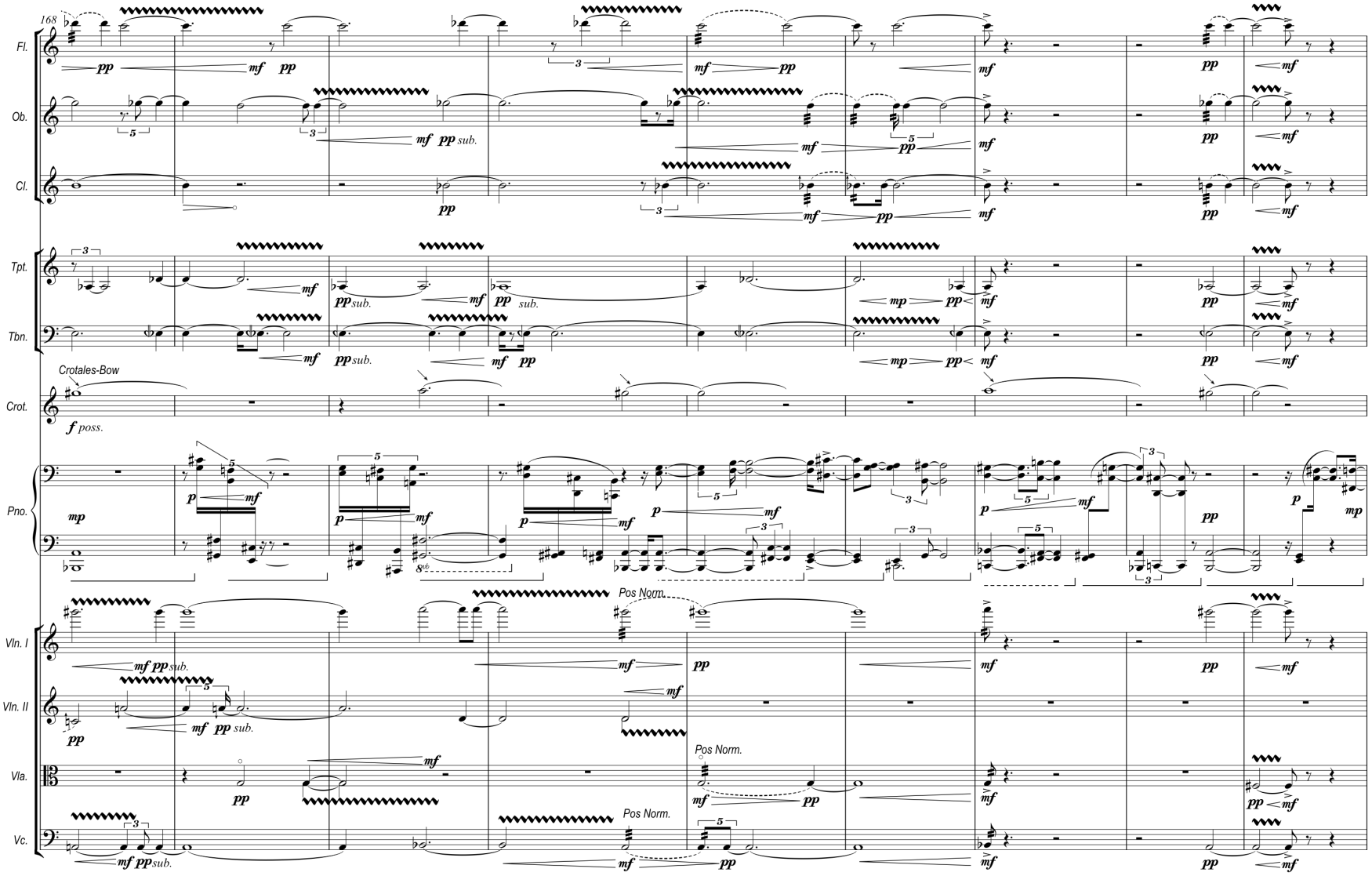
Appendix VI: *Zodiac Turbulence* Section III

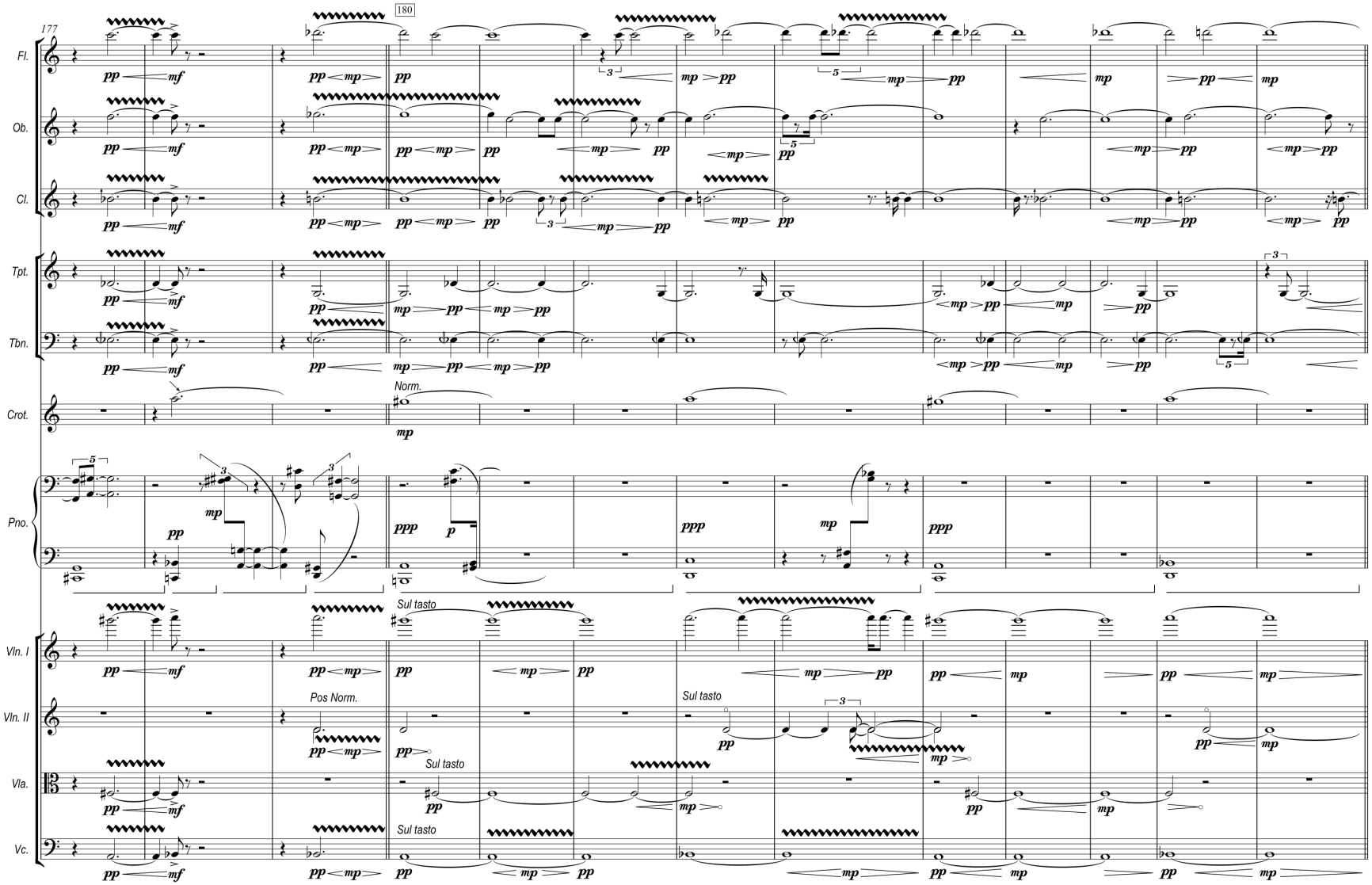



IV
86
Fl.
Ob.
Cl.
Tpt.
Tbn.
Perc.
Pno.
Vln. I
Vln. II
Vla.
Vc.
poss.
sub.
Senza Sord.
Tam Tam
gliss.

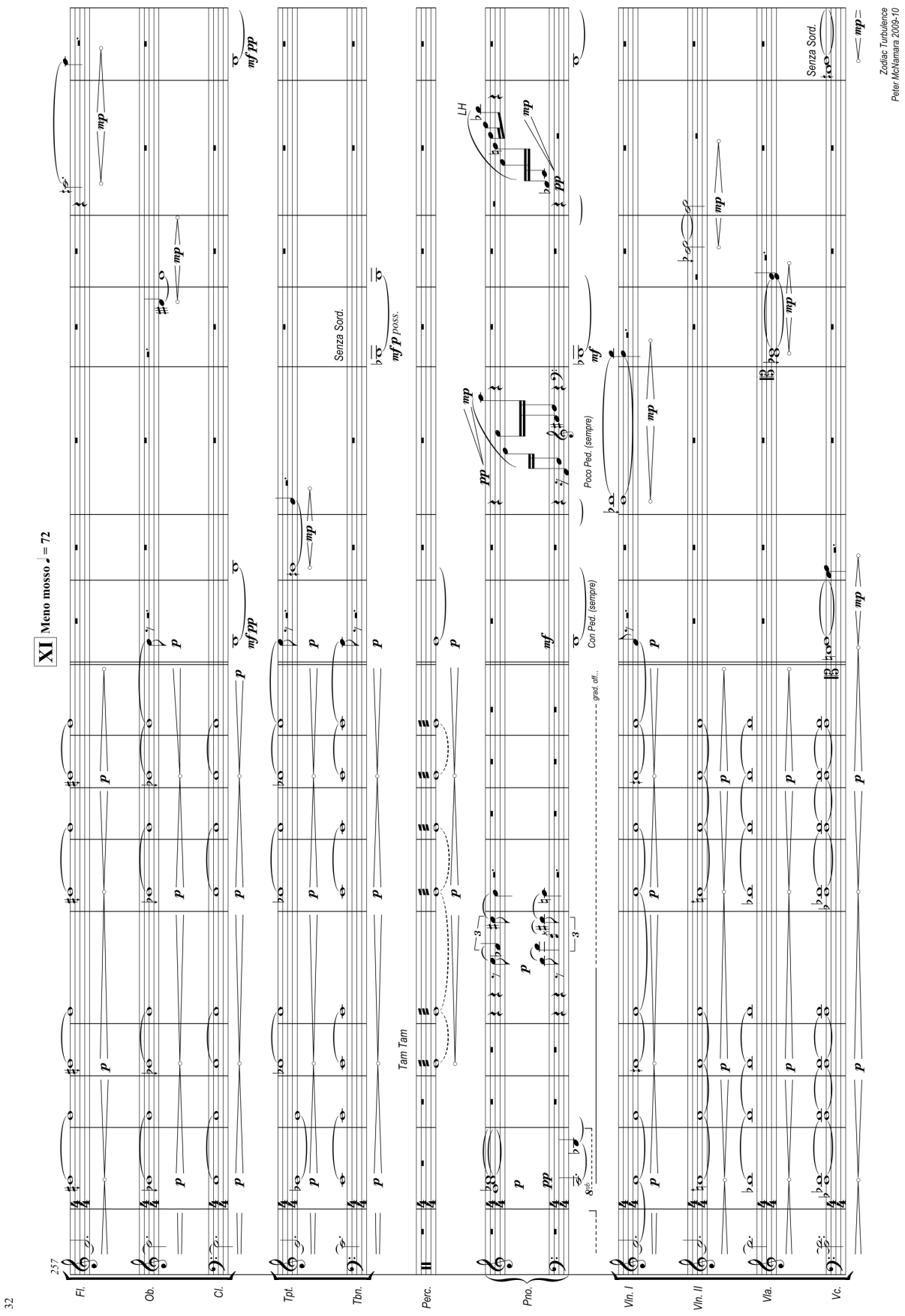
Appendix VII: *Zodiac Turbulence* Section VII

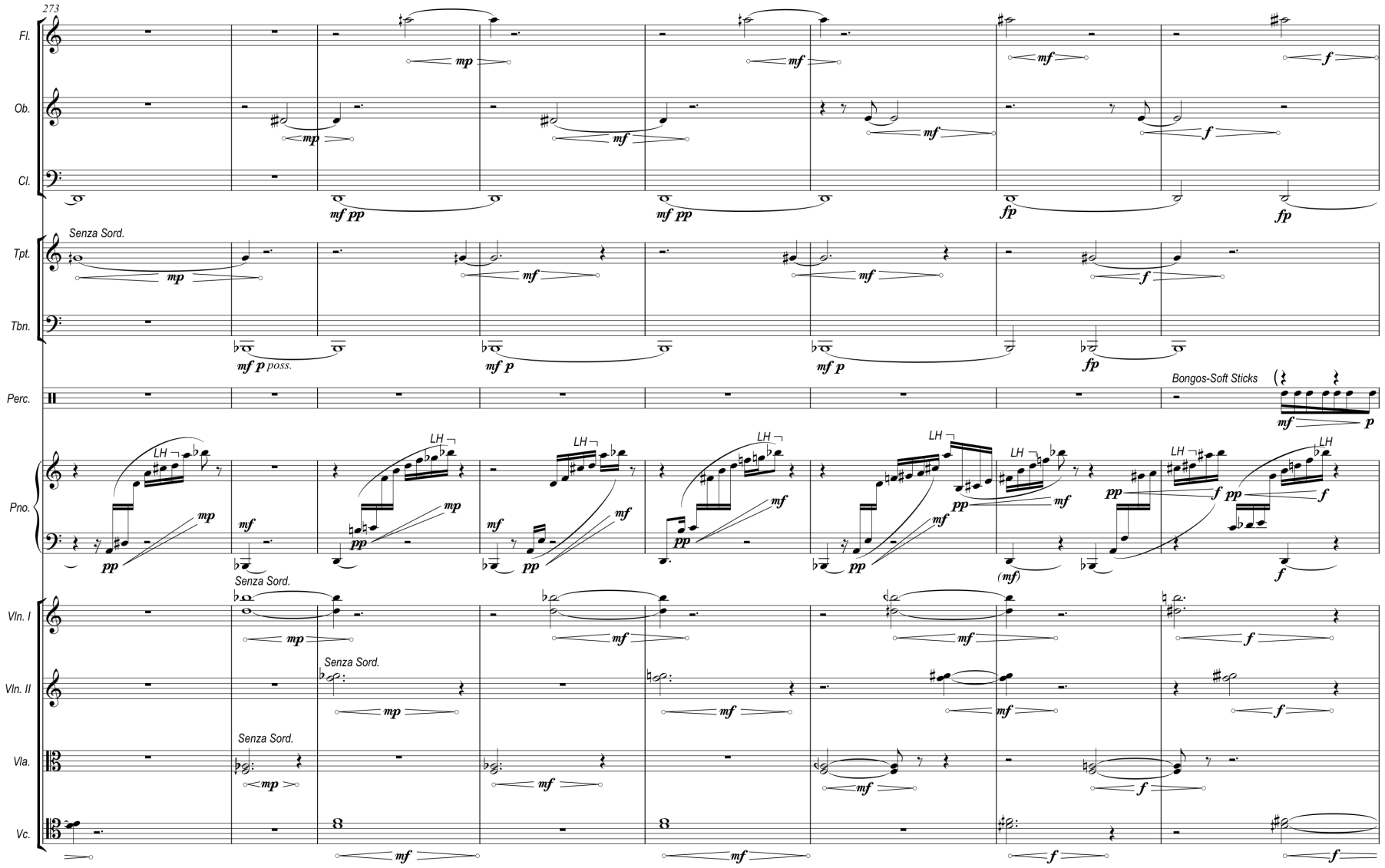


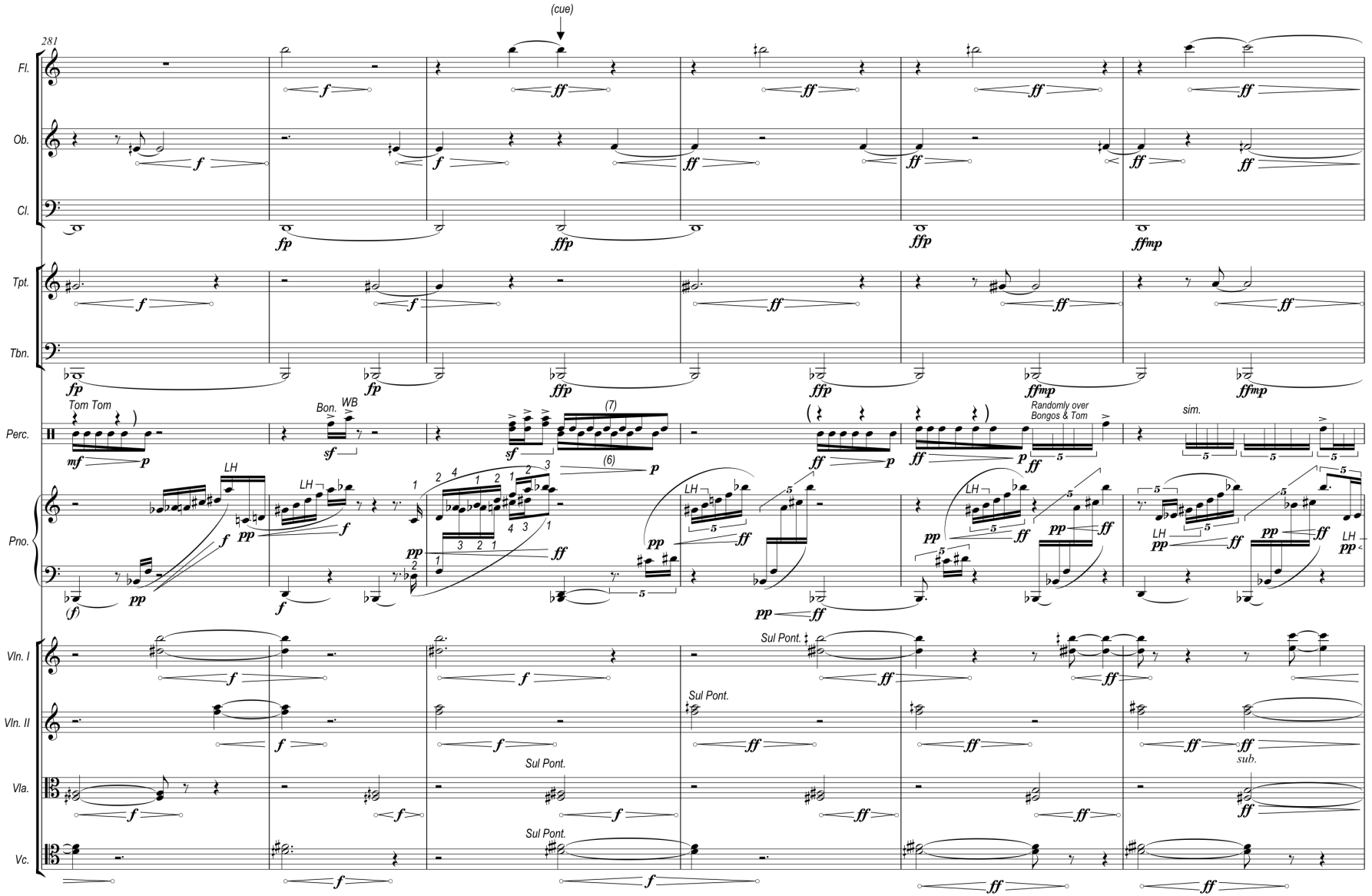

168
Fl.
Ob.
Cl.
Tpt.
Tbn.
Crotales-Bow
Crot.
Pno.
Vln. I
Vln. II
Vla.
Vc.
Pos Norm.
Pos Norm.
Pos Norm.

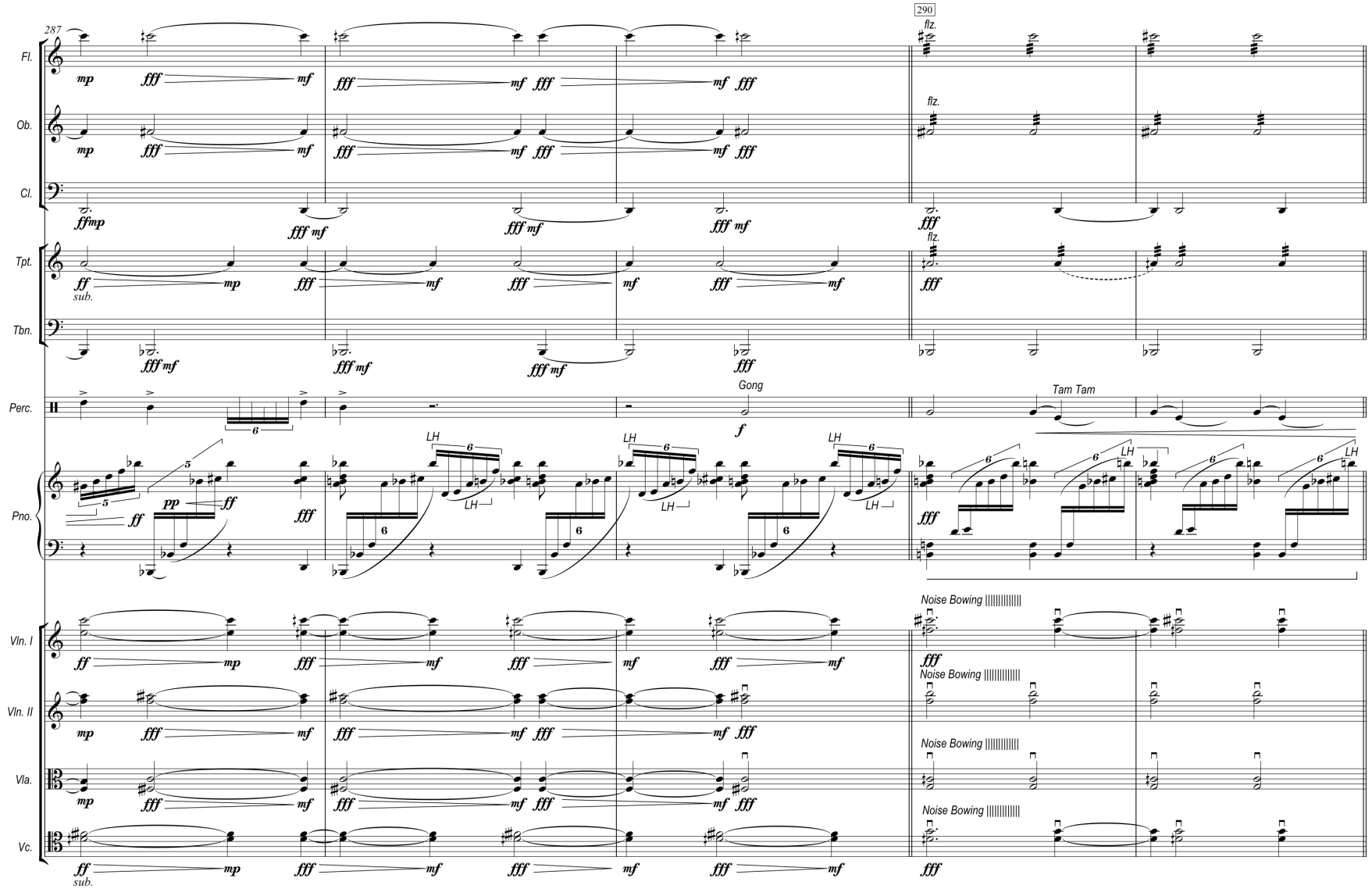

177
180
Fl.
Ob.
Cl.
Tpt.
Tbn.
Crot.
Norm.
Pno.
Vln. I
Vln. II
Pos Norm.
Vla.
Vc.
Sul tasto

Appendix VIII: *Zodiac Turbulence* Section XI




273
Fl.
Ob.
Cl.
Tpt.
Tbn.
Perc.
Pno.
Vln. I
Vln. II
Vla.
Vc.
Senza Sord.
Bongos-Soft Sticks
LH


281
(cue)
Fl.
Ob.
Cl.
Tpt.
Tbn.
Perc.
Pno.
Vln. I
Vln. II
Vla.
Vc.
Tom Tom
Bon.
WB
(7)
(6)
Randomly over Bongos & Tom
sim.
LH
Sul Pont.
sub.



Zodiac Turbulence
Peter McNamara 2009-10

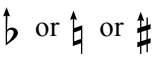
Appendix IX: *Microtonal Accidentals and definitions of Harmonic, Inharmonic and Sub-harmonic Spectra.*

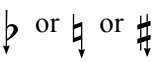
Quartertonal Accidentals:

 A quartertone flat  Three-quartertone flat

 A quartertone sharp  Three-quartertone sharp

Microtonal Accidentals:

 Slightly sharp (c.a. 1/8th tone) from  or  or  .

 Slightly flat (c.a. 1/8th tone) from  or  or  .

Harmonic Spectrum: a harmonic spectrum follows the natural and normal logarithmic curve of the harmonic series, beginning with large intervals and progressively becoming smaller.

Sub-harmonic Spectrum: a sub-harmonic spectrum is an inversion of a harmonic spectrum, beginning with large intervals and progressively becoming smaller, but in a downward direction.

Inharmonic Spectrum: an inharmonic spectrum is un-natural and occurs when the logarithmic curve of the harmonic series (or sub-harmonic series) is in some way disrupted. This results in the interval series becoming uneven (i.e. each not necessarily becoming progressively smaller).

Appendix X: *Definition of the Harmonic Series.*

The Harmonic Series.

The harmonic series is a group of frequencies that are present above every pitch. The harmonic series is not perceived as individual pitches, but rather as a whole. The presence or lack of presence of the harmonic series determines the tone colour of a sound, as some of the frequencies of the harmonic series are more prevalent than others depending on the sound or instrument. Microtones exist naturally in the harmonic series and as a result, whenever we hear a pitch, we are also hearing microtones at the same time. **Diagram 1** is a diagram of the harmonic series of C. This diagram shows pitches up to the sixty-fourth partial, but the pitches continue into infinity.

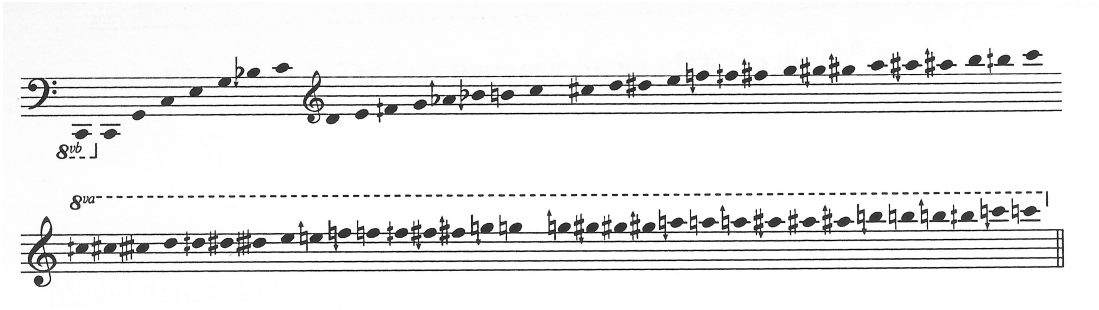


Diagram 1: The Harmonic Series of C to the 64th Partial.

As can be seen by the notation, many pitches cannot be notated by the equal tempered system such as partial number seven and so on. The exact tuning of these pitches is reliant on interpretation. Many measure them by way of quarter, sixth and eighth-tones, which are known as tempered microtones and fit best with the equal tempered tuning system. These tempered microtones are not completely accurate though, and are more of a compromise of the actual mathematical frequency. Some composers

measure them by an even smaller interval called a cent; there are one hundred cents in a semi-tone, which shows its minute status. The harmonic series also accounts for why many pitches in acoustic instruments are out of tune, particularly brass instruments. The harmonic series has large intervals at the bottom and progressively smaller intervals at the top, following a mathematical logarithmic curve. Spectral composers often used an artificial construction called the *Sub-Harmonic Series*, which is the inversion of the harmonic series having large intervals at the top and progressively smaller intervals at the bottom. **Diagram 2** is a diagram of the Sub-Harmonic Series of C.

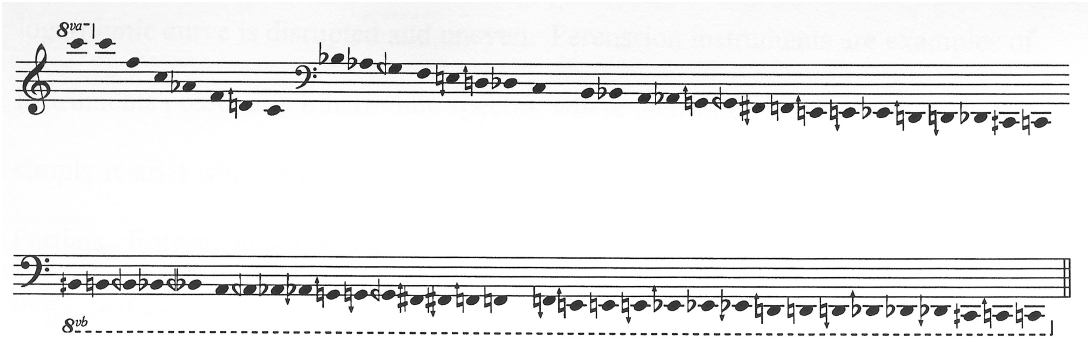


Diagram 2: The Sub-Harmonic Series of C to the 64th Partial.