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HETEROPHONIC TUNINGS IN THE MUSIC OF LARRY POLANSKY

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Abstract: This paper explores the use of *heterophonic tunings*, the gradual substitution of pitches from one harmonic series to another resulting in the simultaneous sounding of different and sometimes contrasting intonations, in the music of the American composer Larry Polansky. The discussion is contextualised by an exploration of the innovations in tuning practice in the work of an earlier generation of American composers. The ramifications of Polansky's compositional ideas in terms of notation and performability are examined with reference to several key works, notably *for jim, ben and lou; freeHorn*; and *ii-v-i*.

Larry Polansky (photo courtesy of John Seyfried)

Larry Polansky (b. 1954) writes music that is at once sophisticated, innovative and beautiful. His worklist comprises more than 200 pieces, composed over a four-decade career, not including an ongoing collection of rounds, which is growing at a rapid rate. His compositional interests include issues as diverse as rational tuning systems, vernacular music, mathematical and statistical applications, and instrumental difficulty; additionally, he contributes to the broader musical community as a performer, a scholar, an open-source content generator, and the co-founder and co-director of the composers' collective Frog Peak.[1]

[1] For the first study of a sizeable portion of Polansky's output, and a brief biographical sketch, see Giacomo Fiore, 'The Just Intonation Guitar Works of Lou Harrison, James Tenney, and Larry Polansky' (PhD diss., University of California, Santa Cruz, 2013), 135–219.

Several aesthetic and procedural threads ensure the cohesiveness of Polansky's apparently eclectic compositional output. One such thread stems from the composer's proclivity for working in series, investigating a given musical premise (or problem) from various formal, instrumental or methodological angles – the exploration of 'fertile ideas'.[2] Many of Polansky's works can be grouped and categorised as part of one or more ongoing series: for example his *Four Voice Canons*, the above-mentioned rounds, the *tooaytoods* (études designed to span no more than a few seconds), the *onceaytoods* (études in which each available note on a given instrument is played once), and several others.[3]

A unique, and perhaps unprecedented, set of pieces explores what Polansky calls *heterophonic tunings*; in these pieces, the gradual substitution of pitches from one harmonic series to another results in the simultaneous sounding of different and sometimes contrasting intonations.[4] The heterophony in the name reflects both a broad interpretation of the textural term, as well as a relaxation of historical tuning constraints (such as the avoidance of cognates, the preference for octave-replicating scales, and so forth). Dating as far back as the late 1970s, heterophonic tunings are one of Polansky's longest-running interests, as well as his most inventive contribution to the US repertoire of tuning pieces. As we will see, Polansky's heterophonic tuning pieces build upon the theoretical and practical precedents of his friends and mentors Lou Harrison, Ben Johnston and James Tenney, while also transcending them to produce an intonational framework that is flexible, powerful and surprisingly accessible.

Historical Precedents

The gradual change between different intonations exemplified in Polansky's heterophonic tuning works presupposes a tuning system with great modulatory flexibility. A common criticism of just intonation is that it restricts the possibility for modulation, since notes that are related by simple (and thus consonant) ratios to a given fundamental produce more complex intervals between themselves, unlike the same-size, transposable steps of any equal temperament.[5]

[2] 'My way of working is to come up with fertile ideas and explore them a lot, usually playfully, since that's my nature as a musician. Sometimes I feel like the conceptualist in me is a kind of wholesaler to the musician – one gives the other raw stuff, and the other makes music out of it. Sometimes these two are the same person, and that's when the pieces, to me, are the best'. Polansky, 'Answers to Questions of Paul Doornbusch; About Mapping' http://eamusic.dartmouth.edu/~larry/misc_writings/talks/about.mapping.html, accessed 30 August 2013.

[3] The majority of Polansky's works, along with several writings, computer programmes, sound recordings and photos, can be accessed on his personal website: <http://eamusic.dartmouth.edu/~larry/>. The choice of making this material publicly available (especially considering Polansky's ties with a composers' collective that publishes the same works) is a deliberate comment on publishing, accessibility and *imprimatur*.

[4] The slow, regulated change at play in these pieces makes them a specialised subset of Polansky's so-called *morphing* pieces, which explore fine parametrical changes from a 'source' to a 'target' musical item. See pieces such as *51 Melodies* (1991), *Roads to Chimacum* (1992), *The Casten Variations* (1993–4), and the *Four Voice Canon* series. For the theoretical groundwork, see Larry Polansky, 'Morphological Metrics: An Introduction to a Theory of Formal Distances', *Proceedings of the International Computer Music Conference*, Urbana, IL (San Francisco: Computer Music Association, 1987), pp. 197–205; and Larry Polansky with Richard Bassein, 'Possible and Impossible Melody: Some Formal Aspects of Contour', *Journal of Music Theory*, 36 (1992), pp. 259–84.

[5] Obviously, this criticism is predicated on the assumption that a successful modulation requires both 'keys' to have similar (or in some cases identical) degrees of intervallic consonance. In fact, there is nothing preventing modulations in just intonation systems, were one to find complex intervallic ratios acceptable or desirable. See Kyle Gann, 'Key

Although this problem can be avoided by the introduction of a higher number of notes per octave (as has been tried in several organological experiments throughout history), such solutions yield instruments that are difficult to construct and impractical for musicians to acquire and play.[6]

Nevertheless, the renewed interest in tuning theories in the twentieth century has led to a number of attempts at bridging this modulation gap in rational tuning contexts. Harry Partch's notorious 43-note scale, for example, includes some modulatory possibilities, as some of the pitches in the gamut can act both as the higher harmonics of simpler ratios and as the root or lower harmonics of more complex ones.[7] In similar guises, the extended just-intonation context favoured by Ben Johnston has become the vehicle for both conventional and novel modulatory practices, such as, for example, in his *Sonata for Microtonal Piano* (1964).[8]

A different approach was taken by Lou Harrison, who created a freely modulatory framework for rational tunings in his so-called Free Style. In works such as *Simfony in Free Style* (1955), *At the Tomb of Charles Ives* (1963) and *A Phrase for Arion's Leap* (1974), Harrison specifies the intonation of each pitch as a rational interval, either melodically or harmonically, to a preceding one. The demands made on performers in terms of tuning accuracy are unprecedented, and have resulted in extremely few performances of these works to date. Nevertheless, from a theoretical and compositional standpoint they represent a crowning achievement, and a woefully underappreciated one.[9]

As one alternative to just tunings, higher-division equal temperaments such as 72 and 84 provide an accurate approximation of several rational intervals while also preserving the modulatory flexibility intrinsic in systems that divide the octave equally.[10] One composer who explored the practical advantages and harmonic possibilities of such systems was James Tenney: in works such as *Bridge* (1982), *Changes* (1985) and *Water on the mountain ... Fire in Heaven* (1985), the music modulates freely in the tempered harmonic space, returning to the 'home' root after a series of complex meanderings.[11]

Polansky's approach to the problem of modulation in rational tuning contexts borrows elements from each of these precedents, creating solutions that are as accurate as Johnston's, as flexible as Harrison's and as practical as Tenney's.[12] From the standpoint of compositional

Eccentricities in Ben Johnston's *Suite for Microtonal Piano*', in *Thirty-One*, 1 (2009), 42–48, for a pointed discussion of this issue.

[6] Notable examples include Nicola Vicentino's Archicembalo and Perronet Thompson's Enharmonic Guitar.

[7] Harry Partch, *Genesis of a Music* (New York: Da Capo Press, 1974), pp. 181–94.

[8] Gann, 'Key Eccentricities,' pp. 42–8.

[9] Harrison describes his Free Style method in his *Music Primer* (New York: C.F. Peters, 1971). For a broader analysis, see Leta Miller and Fredric Lieberman, *Composing a World: Lou Harrison, Musical Wayfarer* (Chicago: University of Illinois Press, 2008), pp. 116–21. In addition, a short but pointed review of the importance of Harrison's method appears in Larry Polansky, 'Item: Lou Harrison's Role as a Speculative Theorist', in *A Lou Harrison Reader* (Santa Fe: Soundings Press, 1987), 92.

[10] In fact, it is exactly because of the *tempering* that recursive intervals 'return' to their starting point, closing the spiral of fifths of Pythagorean intonation into its more famous circular counterpart.

[11] Tenney, who was not particularly inclined to write about his own pieces, made an exception for *Changes*: see 'About *Changes: 64 Studies for Six Harps*' in *Perspectives of New Music*, 25 (1987), pp. 64–87. See also Brian Belet, *An Examination of the Theories and Compositions of James Tenney* (PhD diss., University of Illinois at Urbana-Champaign, 1990); and Fiore, 'Just Intonation Guitar Works', pp. 101–23.

[12] For a historical, theoretical and aesthetic exposition of Polansky's interpretation of this subset of intonation theory, see Larry Polansky, 'Paratactical Tuning: An Agenda for the Use of Computers in Experimental Intonation', *Computer Music Journal*, 11 (1987), pp. 64–5.

aesthetics, elements that place Polansky closer to Tenney than the others include eschewing both customised instruments and the requirement of extraordinary intonational finesse from his performers; a reliance on the ratios of the harmonic series as an acoustically derived pre-compositional choice; and a preference for pieces that unfold as regimented musical processes rather than as the expression of subjectivity. In the following pages I will retrace the historical development of this segment of Polansky's repertoire and analyze its most significant stages.

The *Psaltery* Set, From its Inception to *freeHorn* (1978–2004)

Polansky's first piece to employ heterophonic tunings was *Psaltery* (1978–9, for tape); its structure and regimentation provided a blueprint for several successive works, which the composer himself has called a set of orchestrations of his original idea. In *Psaltery* Polansky generates a bewilderingly complex structure from a great economy of means, as the piece's 51 justly tuned pitches originate from a single bowed psaltery tone, manipulated with tape techniques. The pitch material is made up of harmonics 1–17 of three harmonic series, their fundamentals related by the close ratios of a just major triad (i.e. 4:5:6, or C–E–G). Consequently, all pitches in the piece belong to the harmonic series of the fundamental: the third harmonic of G equals the ninth harmonic of C; the seventeenth harmonic of E equals the eighty-fifth harmonic of C; and so forth. Note, however, that the piece's higher harmonics do not appear in their original octave: the second and third series are transposed down so that their roots are tuned 5:4 and 3:2 from C, rather than 5:1 and 3:1, respectively. Harmonic series spacing is otherwise preserved. Polansky explains the piece's unfolding in the notes for the original recording:

> After building up the initial series on the fundamental, pitches from the next series (5, or the major third) begin to replace their closest neighbors until the series on 5 is complete. This process happens twice more, moving to the perfect fifth (on 3), and then back to the fundamental. Finally, the series on the fundamental drops out.
>
> Harmonics enter according to their 'prime complexity' in this order: 17, 13, 11, 14, 7, 15, 10, 5, 9, 12, 6, 3, 16, 8, 4, 2, 1. More distantly related harmonics of a new series enter first, crossfading with close pitches from the current series so that, at first, only a 'mistuning' is heard. Gradually, closer harmonics of the new series begin to imply the new fundamental, through difference tones and our own sense of harmony. The initial buildup of the first series is the reverse of this order, and in the end, the pitches of the final series drop out in this order.[13]

In summary, then, there are two distinct processes at play. The first is the entrance of the harmonics of the series on C, which happens in prime order (meaning that all harmonics for a given prime will enter before any harmonics from the next higher prime; hence 4, 8, and 16 enter before 3). The second, and more complicated, process is the one by which the harmonics of successive series are substituted into the mix. The seventeenth harmonic of the E series is the first new pitch to enter in the second section, according to the 'prime complexity' order as defined by the composer. This note, an F defined by the ratio 85:64, is 105 cents sharper than E (5:4, 386 cents), and sounds as a slightly flat fourth (491 cents) above the nearest octave of the fundamental C. Although, generally, new tones enter in place of closely

[13] Polansky, liner notes to *The Theory of Impossible Melody*, New World Records 8064 (2009; originally issued as ART1004, 1989).

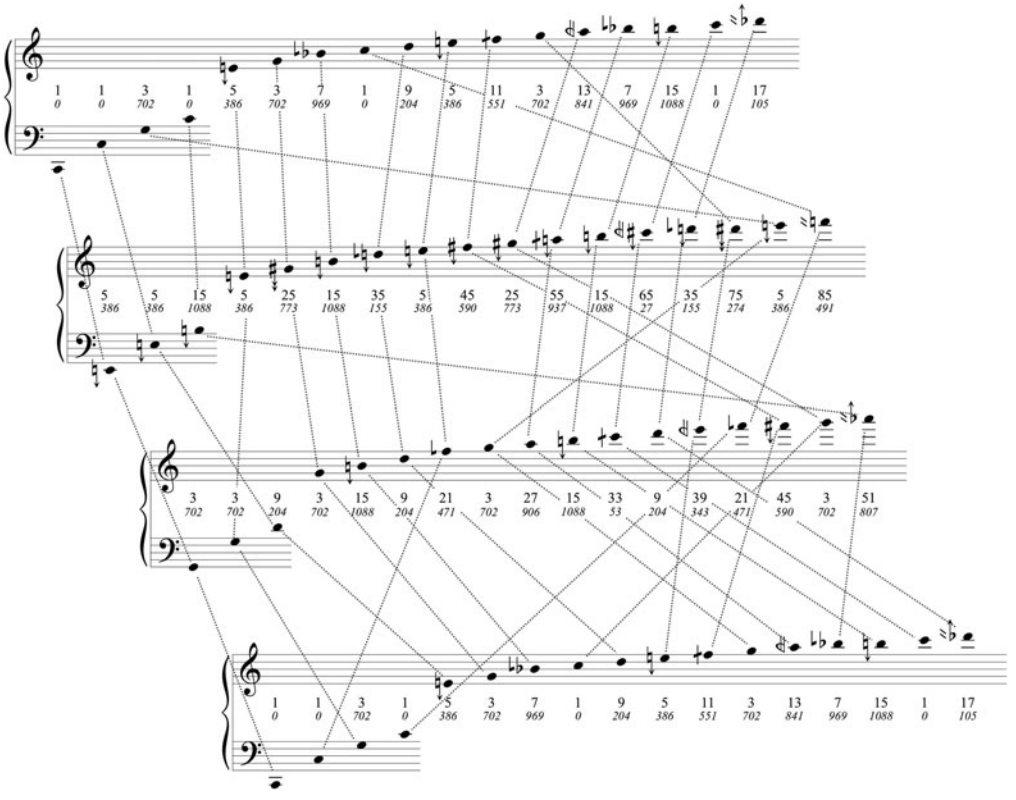

Figure 1:
Harmonic substitutions in *Psaltery*. Computer engraving by the author, from original hand drawing by Larry Polansky.

tuned ones, this new pitch substitutes a lower octave of the fundamental instead, as it is pitched higher than any note from the previous series. Figure 1, a resetting of a diagram by the composer, illustrates every pitch substitution in the piece (note that it does not show the temporal unfolding of these processes, which again occurs from higher to lower primes). Closely tuned pitch substitutions are especially apparent between harmonics 9 and 11 of the first series and 8 and 10 of the second; for example, the seventh harmonic of E (D = 35:32, 155 cents) substitutes the ninth harmonic of C (a 'different' kind of D, 9:8 or 204 cents). The 10th harmonic of C is the same as the eighth harmonic of E, and the eleventh harmonic of C (F about 50 cents sharp) exits in favour of a note 40 cents higher (the 5-limit tritone, F♯ = 45:32).[14]

As pointed out by Polansky in his notes to the piece, the introduction of pitches from each new series, from more complex to simple, causes the new pitches to sound like 'mistunings'; yet, given that any note can still be expressed rationally to the original fundamental, *Psaltery* maintains a sense of euphony beyond its heterophonic tuning surface. As more pitches belonging to the target series enter, our ears gradually recognise the simpler relationships that imply the 'new'

[14] For all examples in this article I have chosen to employ the Helmholtz-Ellis microtonal notation devised by Marc Sabat and Wolfgang von Schweinitz. The benefits of this system include precision, transposability and the reliance on intuitive and discrete symbols. For a brief introduction to the symbols and a legend, see Sabat, 'An Informal Introduction to the Helmholtz-Ellis Accidentals', http://www.marcsabat.com/pdfs/legend.pdf, accessed 30 August 2013. Each example also includes harmonic numbers, for added clarity.

fundamental, thus completing the modulation from a perceptual standpoint.

The process and structure that Polansky introduced in *Psaltery* returns – in both similar and varied guises – throughout the composer's career. Even before completing the tape piece, he had begun making 'orchestrations' of *Psaltery* for live instruments (often with tape). These are *'Cello* (1978), for live cello and tape; *Canon for Flute* (1978, revised 1990), for flute and tape; *Flutes* (1978), for flute choir; *Cata/Tonic* (1978), for solo viola; and *Glass* (1979), for 11 players and 51 tuned crystal glasses.[15] Concurrently, Polansky began exploring the possibilities of live performance alongside adaptive (or 'paratactical', as he calls them) tuning systems, as exemplified by *Gauss Music* (1979, for piano and 'homebrewed' synthesiser), *B'rey'sheet* (*Cantillation Study #1,* 1986–7, for voice and live computer), and *Cocks crow, dogs bark, this all men know, but even the wisest cannot tell why cocks crow, dogs bark, when they do* (1987, for three performers, computers, and 'stuff', as the composer calls the ensemble of synthesizers, controllers, and interfaces involved).[16] The move towards live performance and the development of dynamic electronic tuning systems eventually led to another *Psaltery* orchestration, a piece for French horn and live electronics (or tape) appropriately entitled *Horn* (1989–92).

Horn was composed for Krystyna Bobrowski, a graduate student of Polansky's at Mills College, and underwent several iterations of its musical and software components; its most recent version (developed with composer, programmer and sound engineer Tom Erbe) uses a CSound programme to generate three harmonic series – tuned 1:1–5:4–3:2 above a low F – in real time. The score consists of a series of arpeggios, indicating the changing gamut of pitches with which the performer can underline the unfolding harmonic motions. Because the computer generates the part dynamically (according to the *Psaltery* guidelines, yet randomising parameters such as pitch duration, dynamic level, and so forth), the performer cannot simply memorise the accompaniment as an aid to intonation, but must react in real time to the ever-changing soundscape.

The latest derivation from the *Psaltery* set is directly related to *Horn*. *freeHorn* (2004) is a translation of the original HMSL algorithm for a more up-to-date Java programming platform, called Jsyn; the programme was developed in collaboration with Phil Burk, the creator of Jsyn and one of the original developers of HMSL. As suggested by its title, *freeHorn* loosens some of the requirements of its predecessor: there is no score, no predetermined harmonic progression, no prescribed degree of harmonic complexity and even no requirement that the performer should be in tune with the sounds produced by the programme. The performers, in fact, are in charge of some of the algorithm's parameters, a subset of which can even be changed during the course of a performance. The harmonic progression

[15] Recurrence of the number 17 and its multiples as tuning limits, titles and sectional lengths is, by Polansky's own admission, a symptom of a mild case of heptadecaphilia (Polansky, personal communication with the author, 26 July 2013).

[16] Polansky clarifies his choice of terminology in 'Paratactical Tuning', p. 68: 'I invoke the word paratact to describe a situation in which cause and effect are not unambiguously specified, but which are sometimes clarified by a larger context. A simple textual example might be the difference between "I feel so bad' cause my baby left me this morning" (syntact) and "I feel so bad, my baby left me this morning" (paratact)'. As discussed earlier in the article, the adaptive tuning is more dependent on the immediate context rather than on a pre-existing set of rules, such as the definition of a scale.

(expressed rationally in relation to the chosen fundamental), length of the piece, harmonic complexity and pitch replacement method are all 'static' variables, to be determined before the beginning of a performance; the parameters controlling the duration and dynamics of each pitch entrance, the temporal distribution of attacks (yielding a range of textures from chorale-like homorhythm to full polyphony), the probability of rests and other elements influencing the sounds produced by the programme can be adjusted in real time.

The open-endedness of *freeHorn* is exemplified by the composer's encouragement to include differently-tuned instruments in performances of the piece: players of fixed pitch, equal-tempered instruments should merely be listening and contributing what pitches they see fit, playing 'against' the tuning as much as with it. A recent performance, at the 2012 contemporary music festival, 'April in Santa Cruz' (in Santa Cruz, California) featured Polansky on fretless electric guitar, Bobrowski on horn and the author on a resophonic guitar refretted in just intonation (all instruments capable of matching the computer-generated pitches); this ensemble was joined by Amy Beal on piano, and Ma'ayan Tsadka on accordion.[17] Neither equal-tempered instrument was retuned for the occasion. To complement this oddball collection of instruments, the performance also featured three instances of the software running simultaneously. The three programmes, which shared the same fundamental (F) and overall duration, were set to describe different progressions and incorporate degrees of harmonic complexity that would accommodate the range of instruments participating. Polansky's own programme was intended to increase the complexity of the piece by using mistuned ratios, such as 1.4785 instead of 1.5 (or 3:2), and including harmonics up to the seventeenth; the programme coupled with the resophonic guitar, by contrast, matched the instrument's open string tuning and 11-limit fretboard layout.[18]

With its serene yet complex harmonic soundscape, *freeHorn* is an effective synthesis of theoretical and aesthetic concerns that resurface throughout Polansky's career. The relaxation of constraints on the performers is counterbalanced by the complex tuning processes holding the structure together; in this light, Polansky encourages the performers to signal the beginning (or completion) of a new harmonic series via a predetermined rhythmic or melodic motive.[19] Most of all, the heterophonic harmonies of *freeHorn* exemplify the composer's unique approach to tuning – one marked by the kind of open-mindedness that allows differently tuned instruments to coexist.

[17] A recording of this performance is available online at http://music.dartmouth.edu/~larry/mp3_files/freeHorn_performances/freeHorn_UCSC_April_2012.mp3 (accessed 31 August 2013). Amy Beal is Professor of Music and Ma'ayan Tsadka is a graduate student in music at U.C. Santa Cruz.

[18] A tricone resophonic guitar retuned in just intonation was the instrument envisioned by Lou Harrison for his last finished composition, *Scenes from Nek Chand* (2002); several other composers, including Polansky, have since written music for this uniquely resonating instrument. For more on the guitar and its repertoire, see Giacomo Fiore, 'Reminiscence, Reflections, and Resonance: The Just Intonation Resophonic Guitar and Lou Harrison's *Scenes from Nek Chand*', *Journal of the Society for American Music*, 6 (2012), 211–37. Although originally tuned to a G fundamental, with the open strings tuned DADGAD, the JI resophonic guitar has been used in several performances of *freeHorn*, solo and in ensemble, through the employment of simple open-string tuning modifications. For the performance in question, the strings were tuned CFCGAC, or 3–1–3–9–5–3 (in harmonic series terms).

[19] This structural device was first introduced in *Choir (Empi's Solo)* (1997), another 'orchestration' of the *Psaltery* idea co-composed with soprano Marie Pauline Esguerra. Available on Polansky, *Change*, ART1023.

Real-Time Retuning: 'Preamble'

In addition to developing a substantial body of works that feature modulation among harmonic series with the aid of taped or live electronics, Polansky has also composed music that approaches the same problem using only acoustic instruments. The earliest example of this approach is 'Preamble', the opening movement of *for jim, ben, and lou* (1995, for guitar, harp and percussion).

The use of tuning in the work as a whole is extraordinarily complex. Not only does the harp have to be extensively retuned after 'Preamble', requiring a break in performance, but the tuning of the guitar also changes *during the opening movement*, as the percussionist is instructed to retune the guitar while the guitarist is playing. The movement's structure outlines a progression identical to that of *Psaltery*: an arpeggiation of three 17-limit harmonic series, tuned to a major triad on C, followed by a return to the fundamental. At a deeper level, however, the piece unfolds in a radically different way.[20]

In order to afford the necessary harmonic range, Polansky tunes the harp and guitar using different approaches. The diatonic harp (a concert harp can be used without operating the pedals) is tuned so that each of its four-and-half octaves contains a different seven-note mixture from the three harmonic series, as shown in the top staff of Figure 2. Obviously, to avoid restringing the harp, harmonic-series spacings are not preserved in this case. Conversely, the six-string guitar morphs between four different tunings, one for each section of the piece. Figure 2 also illustrates how these tunings contain a subset of primes for each series, meaning that the remaining ones will have to be provided by the harp in performance. The gamut of pitches available to the guitar is limited to open strings and octaves, fifths, and twelfths, which can be played either fretted or as natural harmonics. This approach – a favourite of Polansky's – allows for the employment of a conventional, equal-tempered instrument, and is related to the one taken by Tenney in his writing for bowed strings (e.g. 'Spectra for Harry Partch', from *Quintext*, 1975) and guitars (*Spectrum 4*, 1995).[21]

As with the pieces from the *Psaltery* set, harmonics from a new series enter in reverse order; however in the 'Preamble' from *for jim, ben, and lou*. harmonic number, rather than prime factor, dictates the order (e.g. E15 enters before E13, and E9 enters before E7). Depending on the actual tuning at the time of its entrance, a new harmonic can be introduced either in the harp or in the guitar. This latter option requires the percussionist to retune the appropriate string (generally, but not always, one tuned within a semitone of the target pitch) immediately after the guitarist has struck it. Thus, the guitar's tuning machine-heads become, in effect, a part of the musical instrument, their manipulation an element of the performance.

The gradual change between the harmonic series on C and E is synthesised graphically in Figure 3. Filled notes represent harmonics belonging to the original C series, whereas unfilled note heads

[20] Polansky actually considers 'Preamble' to be part of the *Psaltery* set; however I have chosen to group it with other guitar pieces in which the instruments are retuned in real time for analytical purposes.

[21] For Polansky's analysis of Tenney's method, see his 'The Early Works of James Tenney', *Soundings* 13 (1984), pp. 214–18; also 'Confessions of a Lousy Carpenter', in *1/1*, 1 (1985), pp. 1, 10–14, in which Polansky explains his approach to writing for bowed strings using harmonic scordaturas, as exemplified in the early works *Movement for Lou Harrison* (1975) and *Movement for Andrea Smith* (1978). A study of Tenney's guitar writing in his *Spectrum 4* is found in Fiore, 'Just Intonation Guitar Works', pp. 124–33.

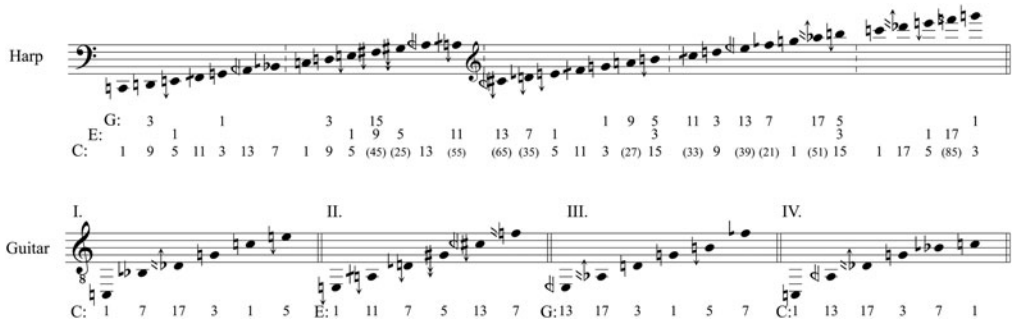

Figure 2:
Tuning of the harp and guitar (by section) in the 'Preamble' from Polansky's *for jim, ben, and lou*. Numbers in parentheses indicate harmonic numbers in relation to C.

stand for their E-series counterparts. Note, once again, that in strictly acoustical terms all notes in the piece belong to the harmonic series on C; however, the intervallic relationship and close spacing of the newly entering pitches lead our ears towards assuming a change in the fundamental from C to E. The interim stages of this process perfectly illustrate the 'heterophony' of tunings, as two incomplete series are present at once and thus perceived at the same time (one exiting, the other coalescing). These moments of ambiguous intonation represent Polansky's attempt to expose the naturally occurring relationships of the harmonic series, laying them bare for the listener's ears to pick up.

Unlike the semi-improvisatory contexts of other pieces in the *Psaltery* set, 'Preamble' is fully notated. The morphing between harmonic series happens in prescribed rhythmic and melodic contexts, as opposed to the droning, rhythmically loose atmosphere found in other works in this series. Although the eighth-note pulse stays constant throughout the piece, the metre is irregular, with odd groupings that match the number of the newest harmonic in a given measure. In section III, as the series modulates from E to G, the harp and guitar/percussion parts become metrically independent: their measures grow in counts from (9/8 and 6/8, respectively, to 11/8, yet their metrical climaxes are staggered. Both parts then reverse the process, finally rejoining their bar lines three measures before the end of the section, just as the guitar completes retuning to the new G series. Figure 4

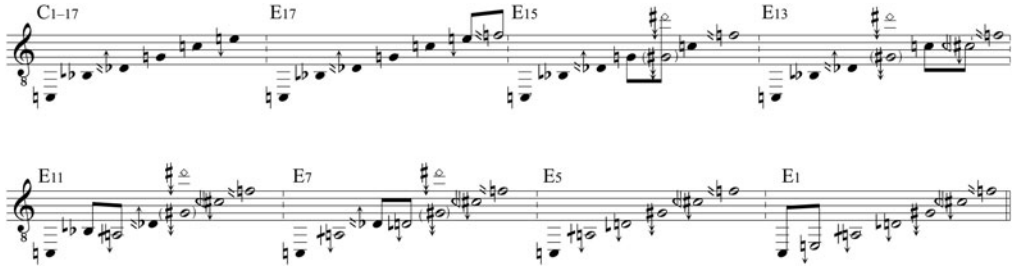

Figure 3:
Reduction showing 'morphing' between C (black note heads) and E (white note heads) harmonic series. Beamed notes indicate changing pitches.

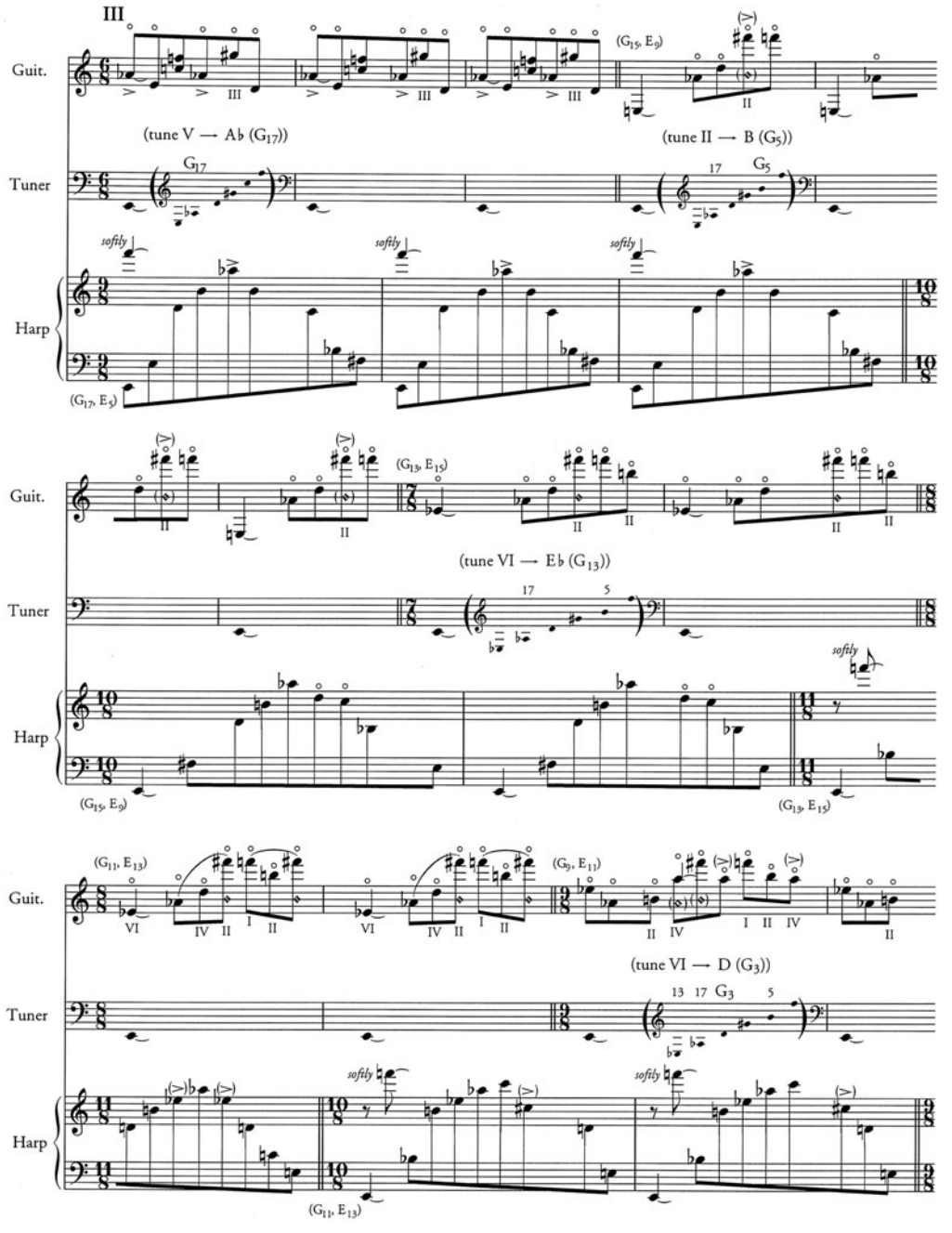

Figure 4:
Complex rhythmic interplay in Polansky, 'Preamble' from *for jim, ben and lou*, Section 3. © Larry Polansky, 1995; used by permission

shows the complex rhythmic nature of the writing concurrent with the ongoing tuning modifications.

The combination of its novel tuning requirements and intricate ensemble writing make 'Preamble' a movement that poses an unprecedented set of challenges to its performers. The remainder of the work is also difficult, requiring the guitarist to sing and play in the second movement, 'Rue Platz', and unfolding an extremely complex

hocket in the final movement, 'The World's Longest Melody'. As a result, it took almost 15 years for the work to given a premiere, a fate similar to that of several other pieces by Polansky; the premiere was given by guitarist Toon Callier, harpist Jutta Troch and Jeroen Stevens on 14 April 2009 at the contemporary music venue Logos in Ghent, Belgium.[22] The following year Callier, Troch and Stevens recorded the work for New World Records, and at least one additional group has presented a complete performance of the piece.[23] As the musicianship and technical abilities of performers keeps rising, and musical demands once considered unpractical (some would say unreasonable!) are met, we should expect to hear more and more performances of this and other seminal pieces.

More Real-Time Tuning: *ii-v-i* and *toovviivfor*

Considering Polansky's instrumental background, the implementation and eventual expansion of the idea of manipulating the guitar's machine heads in performance should not come as a surprise. He had already used real-time retuning in earlier pieces such as '*. . .getting rid of the glue. . .*' (1978) and *34 Chords* (1995). In neither case, however, does the real-time retuning play as integrated a role as in 'Preamble': in '*. . .getting rid of the glue. . .*' the retuning is used as a microtonal effect, and in *34 Chords* it is used to expand the range of the guitar for chord voicing purposes. Retuning in these pieces is therefore just another example of an extended technique, as employed in pieces like Tristan Murail's *Tellur* (1978), Peter Sculthorpe's concerto *Nourlangie* (1988) and his guitar solo *From Kakadu* (1993). Polansky, however, was not yet finished with machine heads.

In August 1997 pianist Thomas Bächli organised a series of performances at La Mama Galleria in New York City, as a memorial for the late pianist Wladziu Liberace (1919–1987), and invited Polansky to participate. Polansky, who had been thinking of building a piece entirely upon retuning, recruited guitarist/composer and frequent collaborator Nick Didkovsky and decided to demonstrate the common classical and jazz progression ii-V-I for this performance. The piece's success (after a single rehearsal) led Polansky to formalise its workings into a set of instructions, which in turn outline three possible versions.

In a nutshell, *ii-v-i* is a study on the modulating sections of 'Preamble': the guitarists are instructed to retune gradually, waiting before fully tuning any given string in order to create a 'smooth, reverberant cloud of moving intonation', and thus accomplishing the same musical effect that had been painstakingly notated in the earlier piece. *ii-v-i* exists in a version for two guitars (in C), and two alternatives for solo performer (in A♭ and D); these fundamentals are chosen to keep all notes within a reasonable range of the standard pitch for each string (the lower strings offering some more flexibility in terms of down-tuning, due to their thicker gauge). As in the later piece *freeHorn*, Polansky asks the performers to highlight the structure of the piece by signalling the completion of a tuning sequence with

[22] The second movement had had its premiere shortly after its completion, by dedicatee John Schneider's ensemble Just Strings at the Japan–USA co-sponsored Interlink Festival in fall 1995.

[23] Polansky, Callier, Troch, et al. *The World's Longest Melody* (New World Records 80700, 2010). For a video of 'Preamble' being performed by Estelle Costanzo (harp), Julien Mégroz (tuning) and Flavio Virzi (guitar) in Basel on 18 October 2011, see http://www.youtube.com/watch?v=TuZlnjK8x7o, accessed 31 August 2013.

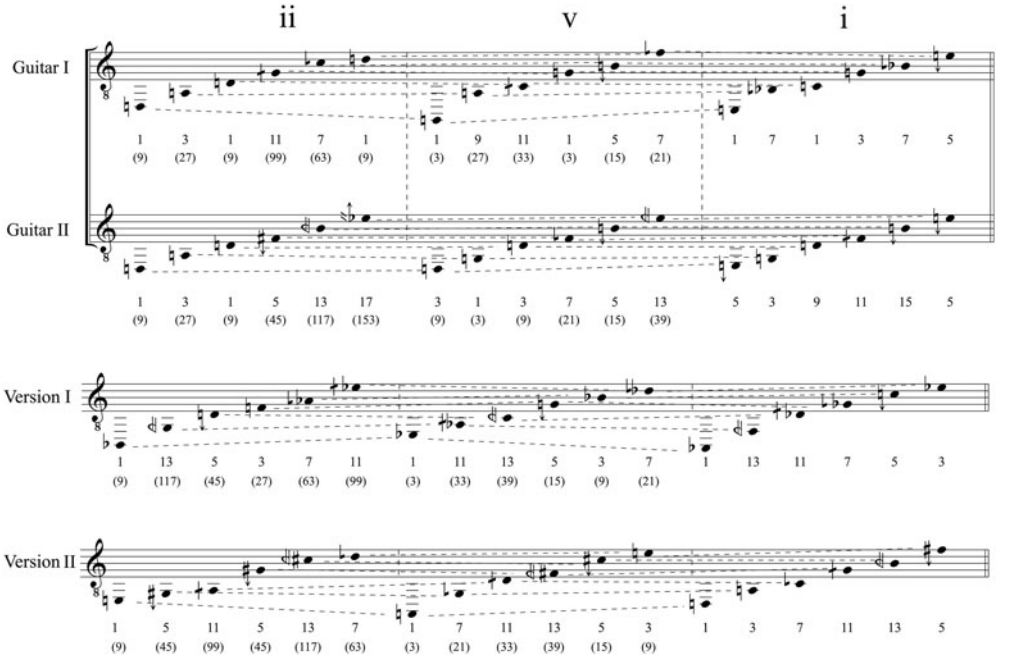

Figure 5:
Tuning sequence for (a) the duo and (b) two solo versions of Polansky's *ii-v-i*.

the execution of a predetermined 'cadential' rhythmic or melodic pattern. Figure 5 outlines the tunings of the two guitars for (a) the duo and (b) two solo versions. The main differences between the duo and solo versions are the gradual harmonic simplification that happens in the duo version (from a 17-limit, through a 13-limit, to the final 11-limit harmony), and conversely the more compact set of primes employed in the solo versions—a result of the lower number of strings available. The duo version has been performed on numerous occasions by Polansky (with several partners) and Callier; in 1998 Argentinian guitarist Claudio Calmens premiered the solo version in Buenos Aires.

Another example of real-time retuning – one we could call an 'orchestration' of *ii-v-i* – is *toovviivfor*, pronounced 'two–five–six for four'. As its title cryptically implies, this piece describes a ii-V-vi interrupted cadence for four players; it was originally composed in 2002 and later re-dedicated to Callier's ZWERM guitar quartet upon the piece's premiere in 2009.[24] The 24 total strings of *toovviivfor* provide the players with additional tuning support, as there are a higher number of perfect fifths and octaves across the instruments to guide the retuning process. *toovviivfor* also features a nod to the Picardy third of common-practice theory: the final series, built over A, is initially tuned as an A minor chord, before a final twist of the machine head changes the C natural to a 5:4 major third.

Conclusion: Pushing Boundaries, Moving Forward

Polansky's music in heterophonic tunings creates harmonic soundscapes of unprecedented complexity and mesmerising beauty; though

[24] *toovviivfor* can also be heard on New World Records 80700.

it certainly requires diligence and dedication from performers, it also maintains a high degree of accessibility by not requiring dedicated or modified instruments, and it even serves as a tutorial of sorts from technical and musical standpoints. The clearest example of this synthesis between pedagogy and difficulty is found in 'Twickenham Stomp', the middle movement of the set *3 Cello Tunes* (1998). While each movement of the work offers its own set of intonational challenges, 'Twickenham Stomp' effectively replicates the morphing harmonic series of *Psaltery* not only without the aid of taped or live electronics, but using a single performer. By retuning the open strings of the cello to a just G major chord (B–G–D–G, or 5:1:3:1), and introducing each new partial as a natural harmonic on the appropriate low string, Polansky builds in a tuning guide for the performer to learn the intonation of fingered pitches, while also 'announcing' them to the audience. Perhaps the most challenging of his pieces in this guise, 'Twickenham Stomp' completes the composer's translation of the *Psaltery* concept to a live, entirely acoustic context; its bare-bones instrumentation, however, has led to a long wait for a premiere.[25] Nevertheless, the interest of perfomers in these pieces – and their continuing willingness in attempting to conquer their challenges – is the most eloquent endorsement of their merit.

[25] Cellist and composer William Raynovich premiered the first movement of *3 Cello Tunes* on 14 July 2013 at the Frequency new music series in Chicago, Illinois; he is currently preparing the remaining two movements for performance.