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Confessions of a Lousy Carpenter

Some Thoughts on Composing for Standard Instruments
In Just Intonation
by Larry Polansky

1. Introduction

It seems to me that we composers of the 21st century have three main areas of exploration incumbent on us. They are, in order of how interesting they are to me (right now): (1) systems of compositional and perceptual intelligence (both automata and human), (2) acoustics and psychoacoustics, and (3) human cognition and perception. These areas are not unrelated, knowledge and experimentation in each of these domains surely affects our understanding of the others, and it would be difficult indeed to build a perceptron or "compositron" (that is, a composing machine, whether abstract or corporeal) that did not utilize the enormous strides being made at present in the description and comprehension of our own methods in these fields. Nonetheless, I think that each of these is a clearly identifiable direction that we may travel. Many composers of our so-called "post-Cage" generation have expressed a kind of frustration with the fact that "it's all been done," or have felt "if anything is possible and allowable, why compose at all," and I think recognition of these almost unbelievably fecund fields of present and future compositional developments can help to bring the musical renaissance many of us dream about. It can be argued that such a renaissance is inevitable, but this fact gives little solace to the composer who cannot envision its substance.

(Note: Many conversations with my colleagues Lou Harrison and Jody Diamond have centered around the inclusion of the integration of the world's music into this triumvirate of experimentation. I do exclude it not to slight them but to honor them. I believe that their work, and those of others in this field has so remarkably and permanently altered our perception of "world" music, that, to their substantial credit, this is no longer a radical or particularly new frontier for the coming millennium. By the same token, I consider a music that does not use the cross-cultural and hybridization experiments of the latter half of this century to be guilty of the same type of naivete that would ignore the existence and preponderance of rational tunings.)

All this is by way of introduction to the rather technical essay that follows. Composition in Just Intonation, in its true sense, is a small category of that work which deals directly with acoustics and psychoacoustics. As the saying goes, we tune because we care, and because virtually every shred of perceptual, acoustical, societal, and in a less supportable manner, aesthetic evidence tells us conclusively that the way we perceive frequency relations is an integral and complex system inexorably linked to our other ratiometric perceptions of the universe. To not use rational tunings is much more of a conscious decision of
(Text continued on page 10)

"Just Intonation is the best intonation."

--Lou Harrison

(Confessions...continued from page 1)

tunings is much more of a conscious decision of avoidance, a choice to leave a particular parameter undetermined.

The history of experimentation in this area has been closely linked with instrument design, and for good reasons. Most western instruments, at least from the nineteenth century onward, are built to play in tempered tunings, and composers using Just Intonation have either had to retune and/or alter them, or build instruments of their own design. My own experience as a composer working closely for many years with rational tunings has been a bit unusual, because I am almost completely incompetent as a carpenter. In addition, I have a natural predilection and love for the instruments and musicians I grew up and learned with. Thus, my own music has had to solve the problem of how to get the intonations I need from instruments and instrumentalists who are, for various reasons, not inclined to play them.

My composition in Just Intonation has made use of three distinct methods. The first, simplest, and least satisfying, is the use of instruments constructed by others. Although I have had no qualms with the music produced this way, I have too much respect for the act of construction as an art in itself to believe that this work is mine in the way that I really want it to be. It is ironic here that I feel no such compunction about using a violin. The second method, and the one I intend to write about in the future in this space, is the use of electronics and intelligent systems. The third method, the one for which I give examples below, is to somehow coerce traditional instruments and players into doing what I want.

Strangely enough, I've had the most fun, and most experimental success, with this last, because it calls for a kind of perverse experimentation that appeals to me. For example, in my solo harp piece, Another You, I ask that the entire harp be retuned, each octave differently. The difficulty of this tuning, not to mention the piece itself, has effected a kind of "weeding out" process for prospective performers, making it almost impossible for the piece to get a lackluster performance. (In fact, only one player has been able to perform it, Alyssa Hess of New York City.) I know that to a certain extent, performers mastering complex tunings has resulted in finer

performances of works by composers like James Tenney, Ben Johnston, and others. The catch is that one has to seek long and hard for that performer or group who will work past the initial barriers of intonation to reach the music itself. This can make performances of one's work rather rare, especially if one is young and relatively unknown.

11. Strings, Plates, and Pipes

For several years I have taught an orchestration class for composers and performers at Mills College, and all that time I've wanted to change the name of the course to the above -- "strings, plates and pipes." I think that one of the most interesting ways to consider instruments is in their most primitive form -- unrelated to their historical use of idiomatic developments.

Here I will focus on the strings, and the use of one of the fundamental acoustic properties of strings -- that they vibrate in infinitely many nodes whose lengths are determined harmonically (or in integral divisions of the length).

The following chart shows "finger positions" in a kind of tablature for the sounding of natural harmonics up to the ninth on a given string. The particular resultant pitches on this chart refer to the low G (IV) string of a violin, but of course a simple transposition makes this chart applicable for any string (as long as you know the harmonic series, and, in fact, even if you don't). The pitches along the center line indicate which pitch the player has to finger (as a harmonic) in order to produce the extended natural harmonic resultant pitches. Some of the fingerings, like the second B^b (with an upward arrow) are microtonally altered themselves, and players will find that the exact location differs slightly (but not significantly) from string to string and even from instrument to instrument. Most players and composers of course know and frequently make use of the 2nd, 3rd, 4th, and even 5th harmonic -- yet it is surprisingly not common knowledge that all harmonics are available on several places on the string, sounding the same pitch at each integral node. If string players were, for example, more cognizant of the fact that the 3rd and 4th harmonic (intervals of the twelfth and double octave respectively) were available at several places, it would greatly expand the

available double-stops and melodic possibilities available to composer and player. With higher harmonics, these fingerings increase geometrically. There are always, except when the harmonic is superseded by the sounding node of its lower octave, $n-1$ nodes (fingerings) for a given pitch, where n is the harmonic number.

(See Ex. 1, page 12)

The question of how far to go in the harmonic series is important for a composer, and is difficult to answer. In general, the larger the string the more harmonics are reliably available. In my piece for four string basses, Movement for Lou Harrison (1975), I use partials up to the eleventh on a given string, and I found that players had little difficulty going higher, to even the seventeenth. The main problem with the higher partials is that they simply become closer and closer together on the string, and the width and motion of a player's finger often become limiting factors. On the higher strings, like the violin and viola, I have found the seventh harmonic to be a useful limit, although this by no means seems to me to be an absolute. The extension of these kinds of boundaries is an important dynamic between performer and composer, and the players with whom I've been fortunate enough to associate have consistently surprised me with how easily they achieve these new technical demands.

The use of high natural harmonics is a common device for composers interested in harmonic series related tunings. One of the most famous, and allegedly most difficult is the 'cello solo from Ben Johnston's remarkable Fourth String Quartet (Amazing Grace) (from the variation in the middle of the piece marked 9/64).

(See Ex. 2, page 12)

In this passage, the 'cellist may, and probably should use all natural harmonics, and to preserve Johnston's intonation scheme, they should all be on the III (G) string, making them harmonics 6-12, or D to D. However, it may be more feasible to not always use adjacent nodes, and, since the high D's exist as well on the II (D) string and the high A on the I (A), there are quite a few possible fingerings for this passage, with negligible intonational change (just a few cents). (N.B. An interesting trivia question for Just

Intonation scholars is: Which Partch piece does Johnston quote from in this quartet? Answer in next issue of 1/1)

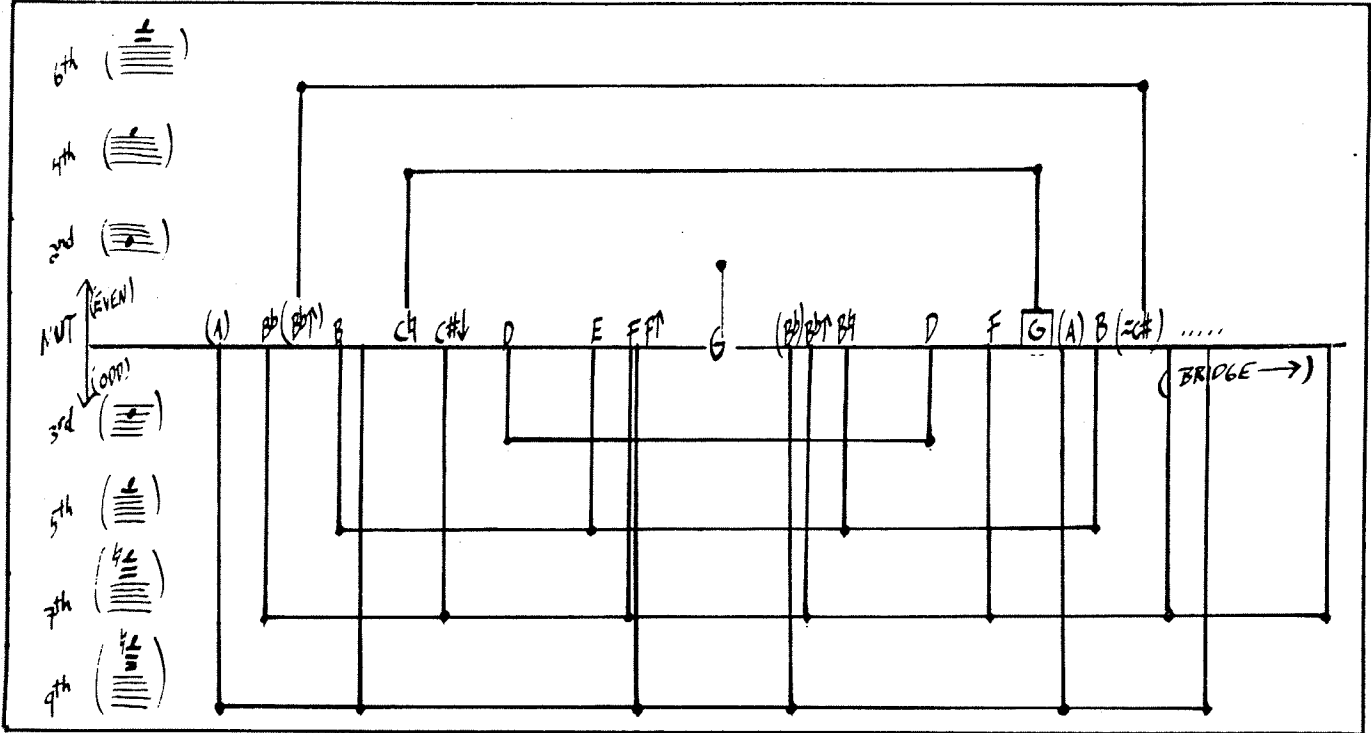
The music of James Tenney has also made use of natural harmonics, particularly to achieve Tenney's experiments in harmonic series related structures and sonorities. One of the more extended, and beautiful examples, is his Spectra for Harry Partch, the fifth of his Quintext for string quintet. Since I have analysed this piece at some length in my book The Early Works of James Tenney (available from Soundings Press), I will refrain from doing so here, other than to introduce one of the more important aspects of the use of natural harmonics. Tenney calls for a scordatura, or retuning of all the instruments to pitches that are themselves harmonic series ratios, so that all higher nodes on each of the strings constitute what Partch might call "otonalities." In this way, one can achieve a surprisingly wide palette of intonations without the player ever touching the string to the neck of the instrument. For example, if a given string is tuned to the seventh harmonic (say the violin III (D) in relation to the bass IV (E), an adjustment of only 31 cents, and easily done using the actual harmonic from the bass), successive natural harmonics (up to the seventh) on the string will produce the ratios, in octave reduced form, 7/4, 21/16, 7/4, 35/32, 21/16, and 49/32.

I have used this same technique, almost exclusively, in two works, and have evolved notations and methods for achieving it. The following example is the scordatura and pitches used from my Movement for Andrea Smith (My Funny Valentine) for Just String Quartet, for two violins and two violas.

(See Ex. 3, pages 12 and 13)

The white notes with roman numerals are the initial tunings of the given strings, and the successive pitches are the resultant ratios and nearest staff line neighbors in conventional notation. Note that certain strings are tuned at least one pitch class away from their origin, and this tuning chart gives both a tablature for the player (the string "fingerings" before retuning) and the resultant pitches. (Below the string tunings I have written out the available pitches for the piece in a linear fashion, irrespective of which instrument or string they appear on.)

Ex. 1. Excerpt from Larry Polansky: Contemporary Instrumentation and Orchestration Syllabus
 (Mills College Class) Fingering chart for natural harmonics of the low G violin string



Ex. 2. Excerpt from 'cello solo, Ben Johnston: Fourth String Quartet (Amazing Grace)

Ex. 3. Tuning chart and scale for Movement for Andrea Smith (My Funny Valentine) for Just String Quartet

I use this notation in the score itself, from which the following example is an excerpt and even go so far as to give the cents values (in deviations from nearest tempered tunings) for each pitch. The arabic numbers next to the roman ones indicate which harmonic is being played, while the noteheads tell the player what the sounding pitch is to be. There is not ambiguity in this notation, although there is quite a lot of redundancy, the result of trying to make the score useful for both player and composer. (See Ex. 4, page 13)

Although this piece looks daunting at first, it proves to be quite easy to play, and has been performed by undergraduate musicians. I have only had to coach the tuning, and show them where the nodes are, and no more.

An earlier and much longer piece (20 minutes as compared to 4) is the already mentioned Movement for Lou Harrison, for four contrabasses. The notation and "scordatura" procedures for this work are similar to the string quartet, except that in the bass piece I was chiefly concerned with the evolution of tonality from highest prime ratios (121/64) down to the simplest (3/2), and the structure of the piece is based purely on this chorale-like tonal evolution. Movement for Andrea Smith (My Funny Valentine) for Just String Quartet on the other hand, uses the extended ratios in a much more melodic context, since the piece is based on the jazz standard. The bass piece is also a kind of homage to my friend Lou Harrison, who used a similar technique with string basses in one of his symphonic works. Lou offered an invaluable performance suggestion at one of the rehearsals of this work. The piece calls for harmonics up to the eleventh, and it was a problem for the players to find them quickly, without roaming around through the adjacent partials. Lou's idea was to use grease pencil in various colors to indicate the nodes -- in this case we used them only ascending towards the bridge. The grease proved to do no damage to the strings or the bow, and came off easily afterwards. Once we did this, a virtually unplayable piece became nearly sight-readable.

It is interesting to note that I had earlier experimented with a different notation for this same piece, in a version for two violins. The idea in this version was to make no reference to

stave notation at all (there is a version of the string quartet in this form as well). Although this notation is far more difficult for the players, I find it more interesting and integral to my ideas, and certainly less cumbersome to write. Here the players are simply given the number of the harmonic, the resultant ratio, and the duration of the pitch in a graphic manner. (See Ex. 5, page 13)

III. Some Afterthoughts

Although strings seem to be those instruments most easily manipulated in this intonational/acoustic fashion, I should stress in closing that many other instruments are amenable to experimentation. The harp, if one avoids the pedals, is simply a large "kanon," and can offer the composer opportunities both with open strings and harmonics up to the seventh (on many strings, with select harpists). Pianos, both electric and acoustic, are easily retuned, although the particular configuration of the keyboard, and its relationship to the hands is not particularly amenable to any experimentation with more sophisticated tuning or acoustical structures. All of the winds are in essence just resonating pipes, and if you ignore the valves, or embrace the older traditions of "natural" playing, extended harmonic possibilities are both possible and facile.

In fact, the valves, pedals, keys, frets, and all other weapons of temperament seem to me to be only slightly worse than similar mechanisms of Just Intonation and extended equal temperament. As David Mahler has so nicely put it, our objective as composers is to let the instruments sound, and I think that we should consider carefully the artifices of interference with the natural acoustics of vibrating bodies. I often wish that we, as composers sincerely interested in choosing our pitch(es), would be less willing to simply fix a tuning on a vibrational system. These systems need to be either intelligent, as with a computer or player that may make dynamic intonational adjustments, or organic, as are the harmonic nodes of a pipe or string. ④

