Fraction Frontier

By Kyle Gann

Tuning Ratios

A new statistic is cropping up in CD liner notes: tuning ratios. As violinists and organists specify manufacturers and diapasons, composers now give us strings of fractions representing the scales they use. Most impressively, in his *New Band* disc (Mode) Dean Drummond lists the scale tuning of his 31-pitch zoomoozophone: 1/1, 16/15, 12/11, 11/10, 10/9, 9/8, 8/7, 11/9, and so on. Erling Wold, in a rock quartet from his *Music of Love* disc (Spooky Pooch), provides tunings for two scales used at once bitonally: 1/1, 27/25, 7/6, 4/3, 3/2, and 9/5 for one, and another tuned to a pitch 6/5 lower. What can we calculus dropouts do with these fractions?

To start with, we can try to interpret them, for they give us structural hints about the music. Such ratios were the musical currency of ancient Greek, Arabic, and Indian cultures, and they look to be the future language of the avant-garde. I'm enchanted with the intervals I'm learning to recognize from alternative-tuning discs. I find the twanging 9/7 major third luxuriantly larger, sexier, and somehow more serious than the blandly cheerful 5/4 we're used to. The 7/6 minor third is cozier than the more common 6/5. I've even warmed to businesslike 81/64. These are not intervals to miss, so here's a hopefully not-too-technical listener's guide to tuning ratios.

SANDRA-LEE PHIPPS

Atonal freedom: Dean Drummond and his zoomoozophone

The fractions represent ratios between the pitch frequencies of two notes. For example, if A 440 is your starting point (given as 1/1), a 9/8 B vibrates at 495 (9/8 x 495). If you listen closely, it sounds less buzzy and more in tune than the equal-tempered 493.883 to which the B on your piano is currently tuned. The smaller the numbers, the more consonant the interval, and the more related the notes sound. 3/2 is a perfect fifth (C to G), 4/3 a perfect fourth (C to F), 5/4 a major third (C to E). A fraction that divides to near 1.25 will be about a major third.

Numbers over 16 usually denote intervals less consonant with the home note, or tonic, than with other notes of the scale. For example, the 64/45 in Terry Riley's *The Harp of New Albion* (Celestial Harmonies) dissonates with the tonic C sharp, but creates a perfect fourth with the 16/15 D: 64/45 divided by 16/15 is 4/3. Factor out large fractions, or divide them by the other fractions to find what notes they're related to, and the most frightening tunings usually boil down to something simple. The 256/243 in Lou Harrison's Serenade for gamelan (CRI) looks like a hair-raising half step; it only fills the 81/64 below it into a 4/3, and the piece couldn't sound sweeter.

How does that translate into structure? Generally, large numbers indicate flexibility in re-creating the same chords in different keys, while smaller-number tunings gravitate toward a central key. That doesn't mean a tuning locks a composer into staying in one key. Part of *Harp of New Albion*'s charm is that the movements are in different keys *despite* the tuning's being in C sharp, so that every key has a different flavor. Drummond's numbers all have small ratios to the tonic G, but his music writhes chromatically and leaps with atonal freedom. Wold's simple scales remain in one dronelike key throughout, so he compensates by setting conflicting scales against one another. Some composers follow where the tuning goes naturally, others work against the grain.

La Monte Young's unpublished tuning for *The Well-Tuned Piano* (Gramavision) is more complex and highly original. He limits the number of pitches heard at once for the sake of greater key-changing possibilities. Follow along at your piano, and you'll notice that over the tonic E flat there are no pitches in the G or A areas. Instead, some tones are tuned extremely close together, not only for modulation, but to create tiny, shimmering pitch shifts. One of the most revealing passages is the recurring one entitled "Sunlight Filtering Through the Leaves": what almost sounds like a single note repeated within the melody is actually two pitches only a fourth of a half step apart. The vibrant ambiguity of those shifts keeps the piece from palling over five hours.

Ben Johnston can't easily supply the ratios in his *Sonata for Microtonal Piano* (New World), for he tunes his 88 keys to 81 different pitches, from 1875/1024 to 1280/729. The numbers melt down, though, to a series of 4:5:6 ratios—perfect major triads—so that notes close together in range tend to be consonant, those far apart dissonant. In his String Quartet No. 6 (CRI), Johnston's notation allows him an open pitch field with hundreds of potential pitches per octave, but at any given moment he limits himself to the lower overtones (or undertones) of one pitch.

When the scale isn't given, more general info can suggest what to listen for. Pythagorean, or 3-limit tuning, means that all the numbers are expressible by multiples of powers of 2 and 3 (for example, 81/64). In 3-limit tuning, fifths, fourths, and seconds will be in tune for a spare, open sound. Five-limit tuning (all numbers factorable to 2, 3, and 5, as in *Harp of New Albion*) allows for tuned thirds, and often indicates a desire for major and minor triads. Seven-limit tuning is a delicious frontier; intervals based on 7 tend to be about a sixth-tone flat, like the arresting 7/4 interval that opens *The Well-Tuned Piano*. Larry Polansky's *B'rey'sheet* on his new CD (Artifact) starts at 17-limit and reduces gradually to 7-, 5-, and 3-limits; the music grows simpler as tones are filtered out.

You don't need to read the numbers to appreciate these works; good tuning is to clarify, not obfuscate. Learning what the fractions mean is like learning the differences between Steinway and Bosendorfer pianos, or the rules of sonata form: it deepens subtlety of enjoyment. But that's an understatement. When a major third is no longer just a major third but a certain *color* of major third, whose relation to the scale gives it a different meaning from some other major third in the piece, music opens up from black and white to a wonderful spectrum of forgotten hues. ■

The second half of Kyle Gann's Consumer Guide will appear in two weeks.