Tuning and Temperament

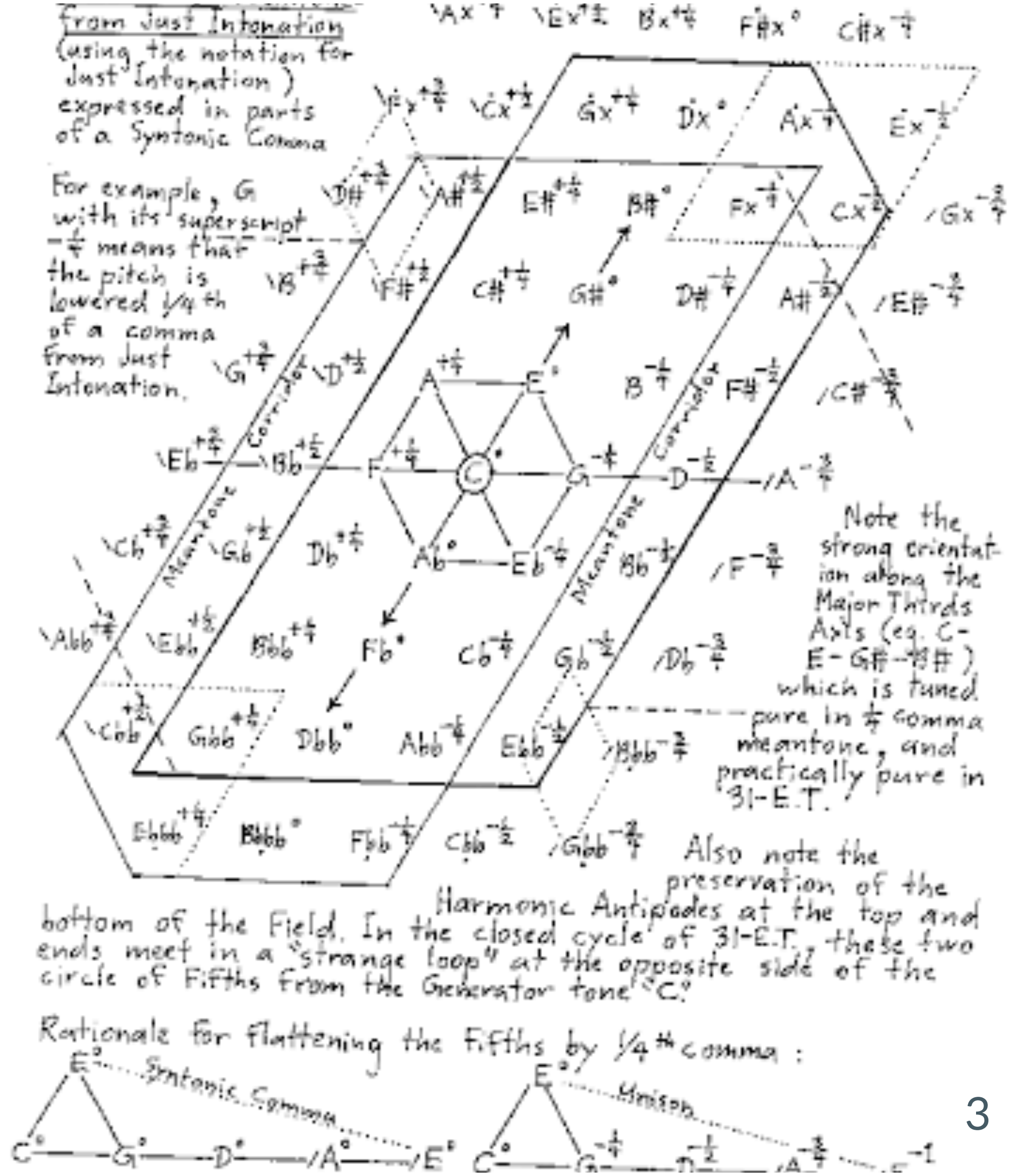
Class 3: (Extended) Just Intonation

Today's Class

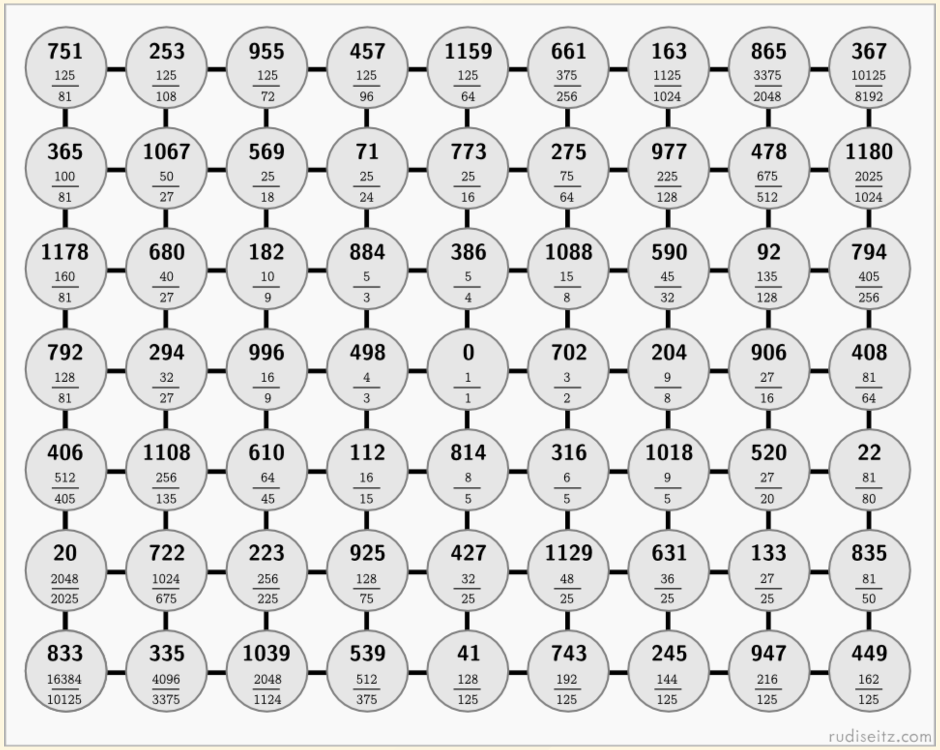
- Introduction to just intonation
  - 3-limit, 5-limit, etc
- Tone lattices: a useful tool
- **Analysis:** Ben Johnston’s Crossings: String Quartet No. 4, “Amazing Grace”
- **Analysis:** Partch: Delusion of the Fury (excerpt)
  - More of a discussion of the work since even a cursory analysis would require more than we've discussed.
- **Analysis:** La Monte Young’s Well-Tuned Piano (1985) (excerpt)

Tone Lattices (or squares)

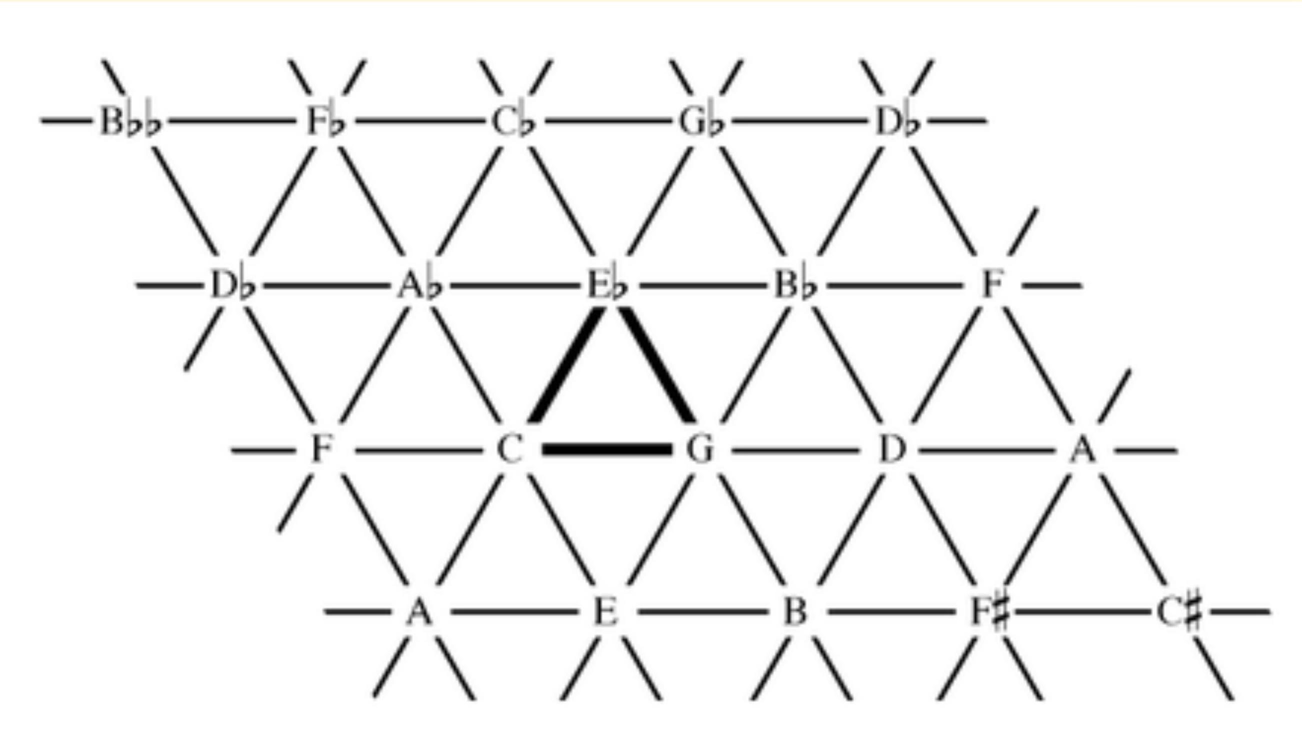
- Useful to visualize interval relationships and to build out harmonies
- Can exist in multiple dimensions (!)
- Bread and butter for extended just intonation tunings in the 20th and 21st centuries



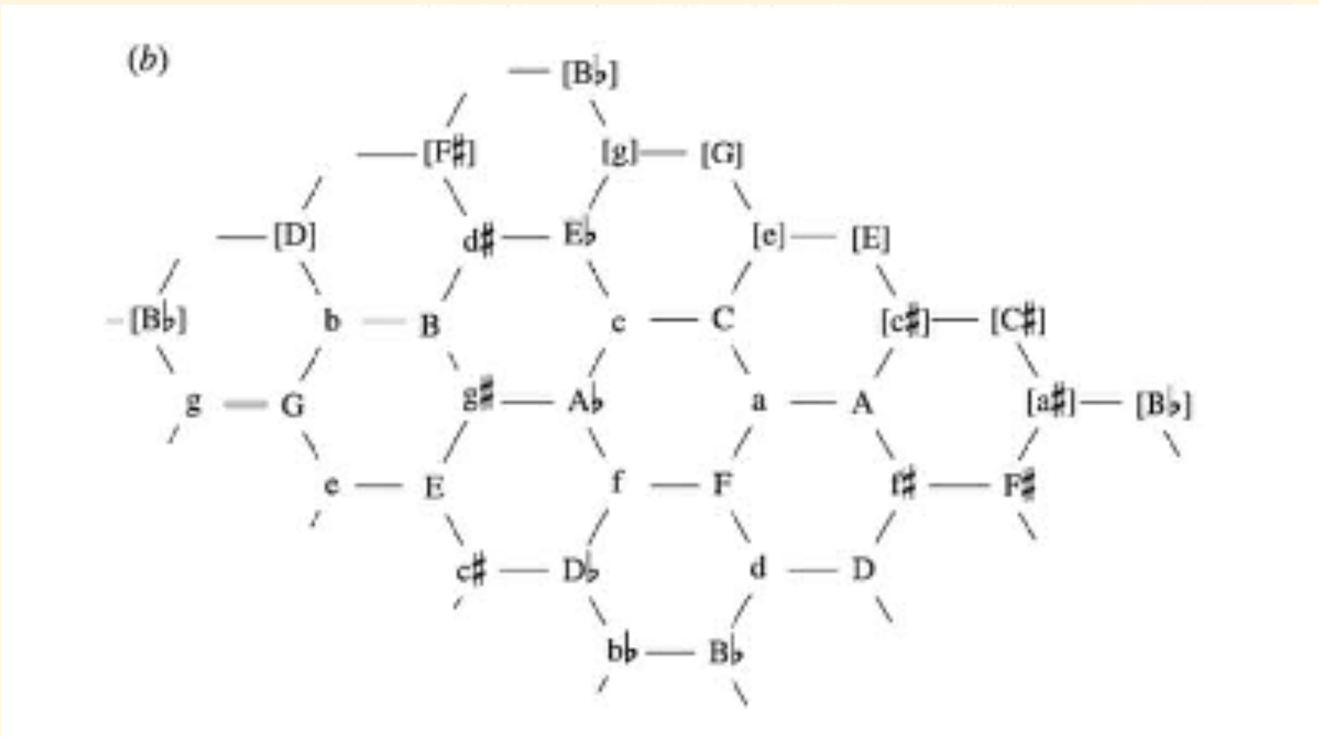
2D with square connections (5-limit in this instance)



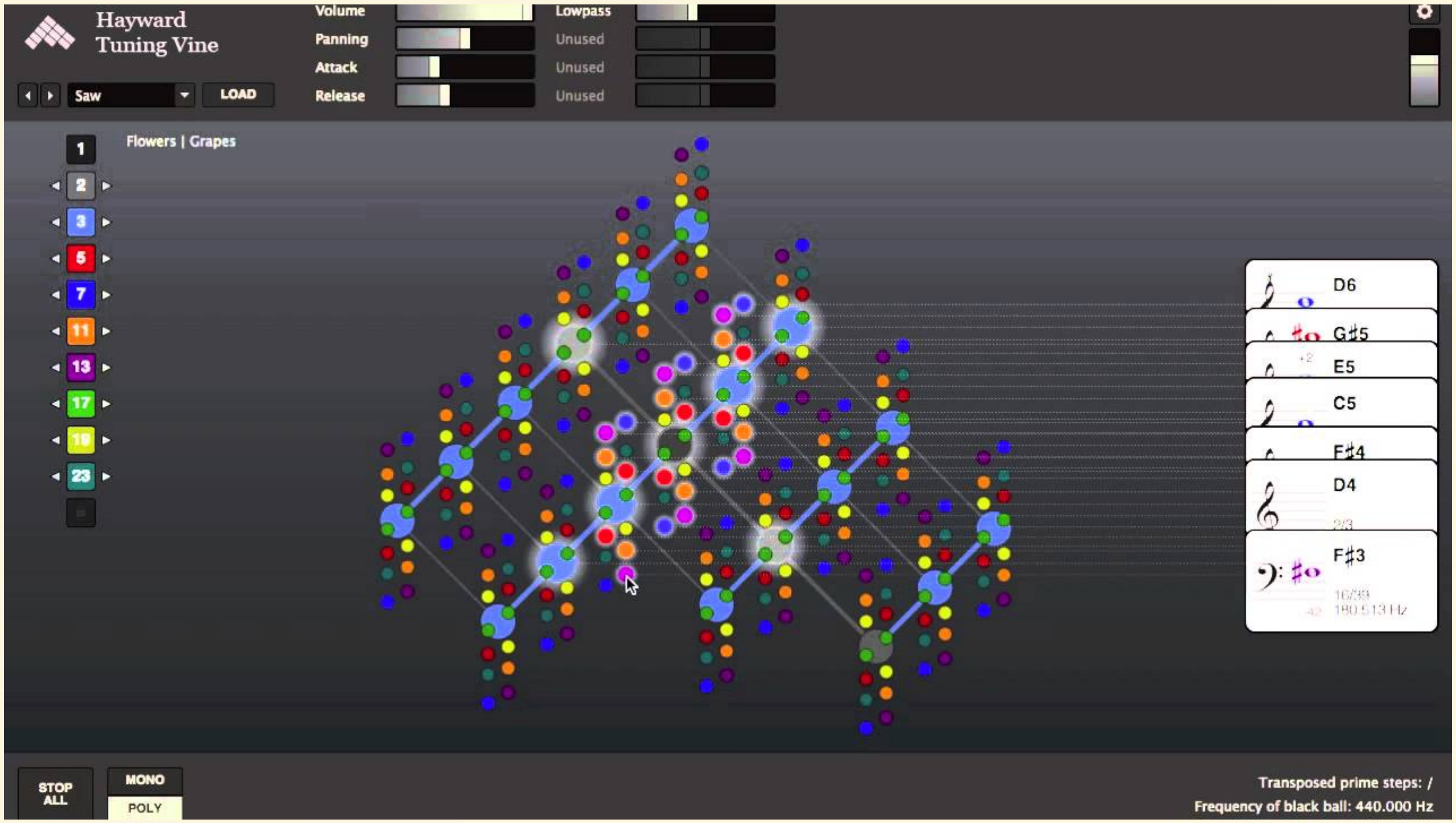
2D with triangular connections



2D with hexogonal connections



3D


Hayward
Tuning Vine
Volume
Panning
Attack
Release
Lowpass
Unused
Unused
Unused
Saw
LOAD
Flowers | Grapes
1
2
3
5
7
11
13
17
19
23
D6
G♯5
E5
C5
F♯4
D4
F♯3
STOP ALL
MONO
POLY
Transposed prime steps: /
Frequency of black ball: 440.000 Hz

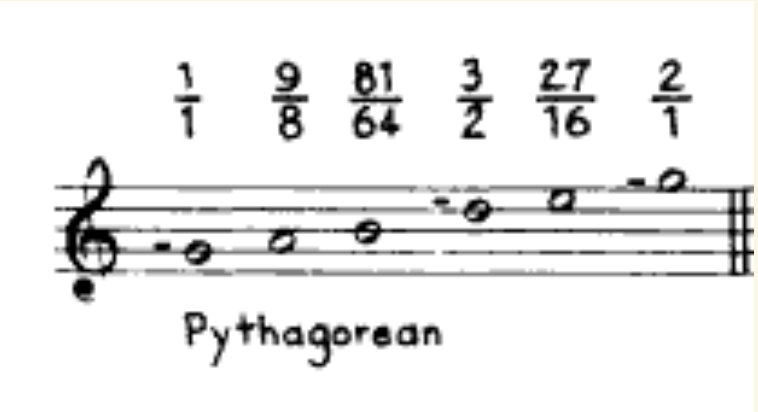
Analysis

Ben Johnston's Crossings: String Quartet No. 4, "Amazing Grace"

Progressively more compelx tuning for each variation

I and II: Pythagorean pentatonic

$$\frac{1}{1} - \frac{9}{8} - \frac{81}{64} - \frac{3}{2} - \frac{27}{16} - \frac{2}{1}$$



III: 5-limit Just Intonation

$$\frac{1}{1} - \frac{9}{8} - \frac{5}{4} - \frac{4}{3} - \frac{3}{2} - \frac{5}{3} - \frac{15}{8} - \frac{2}{1}$$

The scale ratios multiplied by 1/2 =

$\frac{1}{2}$ $\frac{9}{16}$ $\frac{5}{8}$ $\frac{2}{3}$ $\frac{3}{4}$ $\frac{5}{6}$ $\frac{15}{16}$ $\frac{1}{1}$

The above fractions subtracted from 1/1 =

$\frac{1}{2}$ $\frac{7}{16}$ $\frac{3}{8}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{6}$ $\frac{1}{16}$ $\frac{0}{0}$

The above series of fractions from 0/0 to 1/1 times 48 =

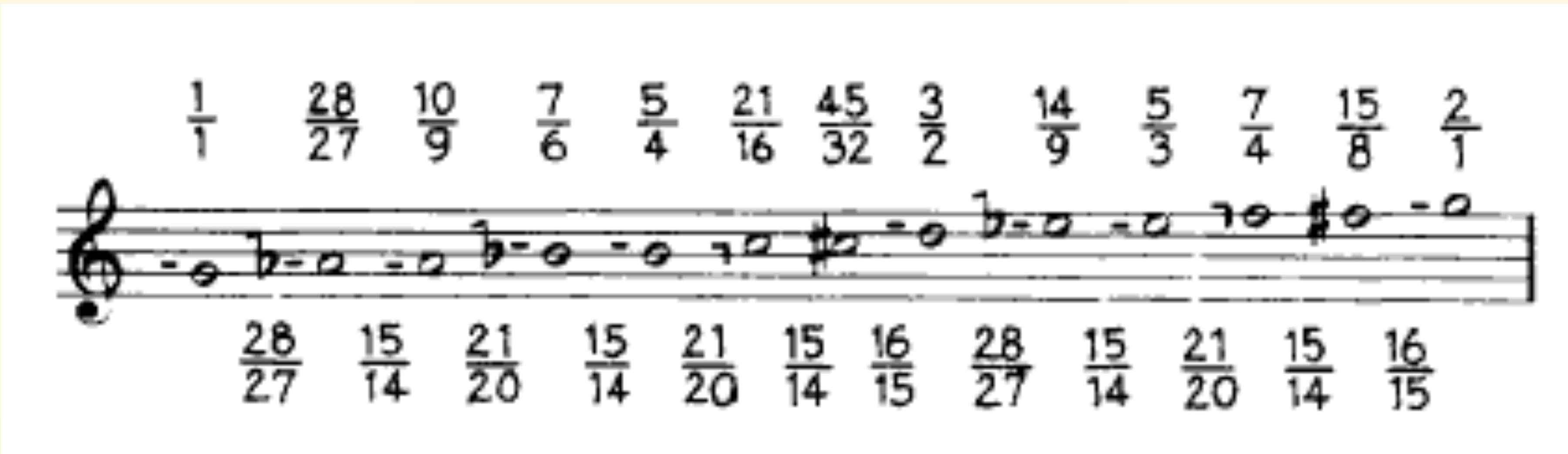
0 3 8 12 16 18 21 24 27 30 32 36 40 45 48

(3 + 5 + 4 + 4 + 2 + 3 + 3 + 3 + 3 + 2 + 4 + 4 + 5 + 3)

The meters used are then:

$\frac{3}{4}$ $\frac{5}{4}$ $\frac{4}{4}$ $\frac{4}{4}$ $\frac{2}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{3}{4}$ $\frac{2}{4}$ $\frac{4}{4}$ $\frac{4}{4}$ $\frac{5}{4}$ $\frac{3}{4}$

IV and V: 7-limit justly intoned "blues"



Notice the different "flavors" of intervals. There are even more when accounting for those not against $\frac{1}{1}$.

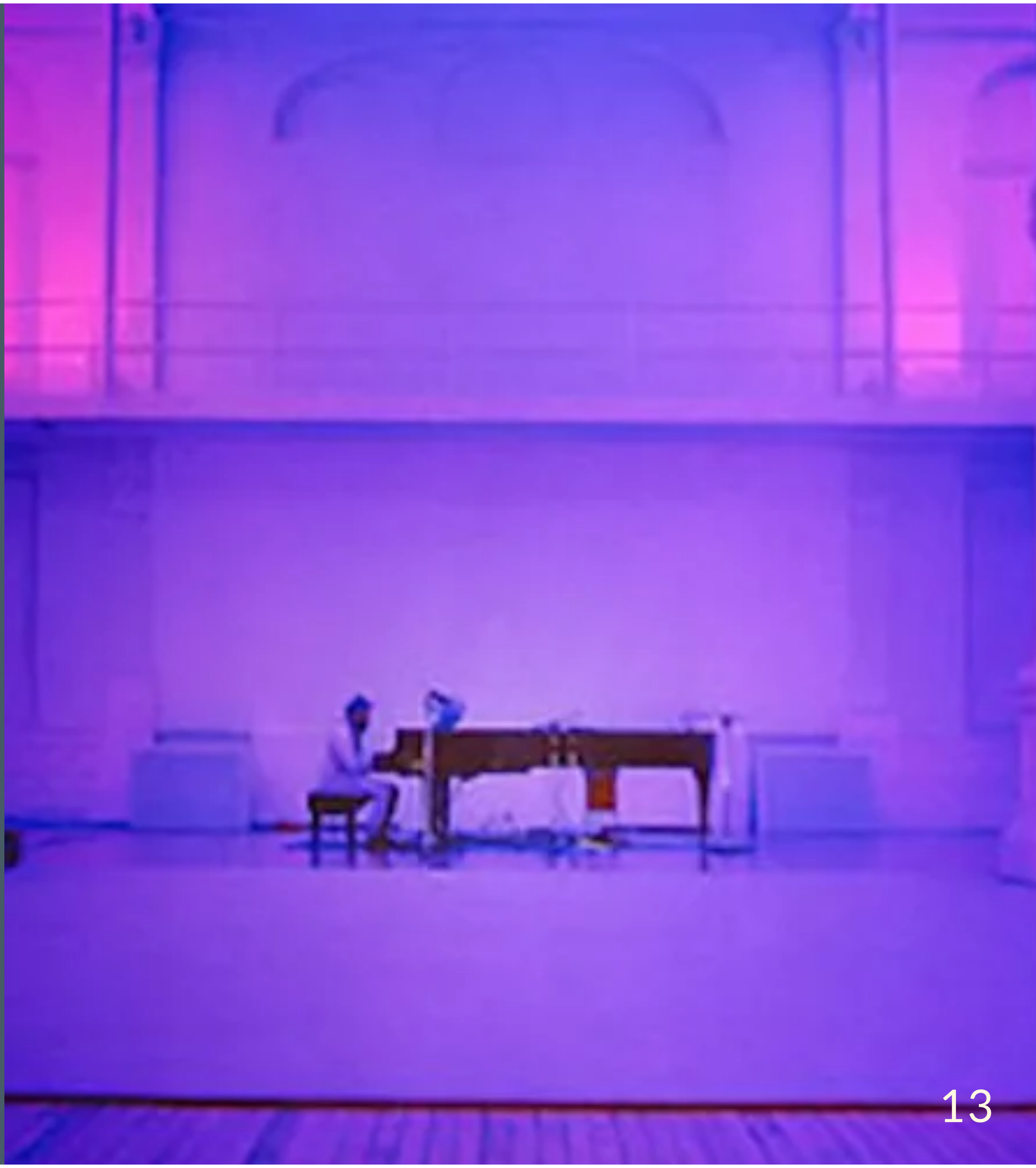
Analysis

[Harry Partch: Delusion of the Fury (1969)]

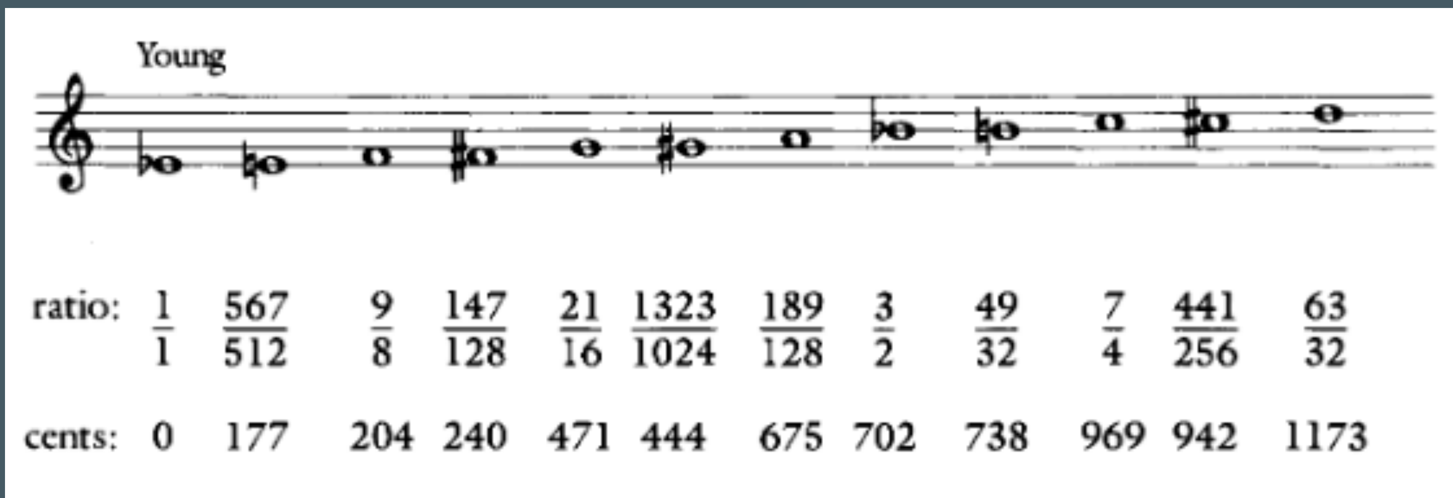
Analysis

La Monte Young: the Well-Tuned Piano

(Yes, it's 5 hours long)



Since it's on a piano, Young fixed the pitches:



$\frac{1}{1}$ is an Eb. What do you notice about these pitches? (Hint: think about their prime factors). How did he get this tuning?

× 3/2

	$\frac{49}{32}$ B	$\frac{147}{128}$ F♯	$\frac{441}{256}$ C♯	$\frac{1323}{1024}$ G♯	
× 7/4	$\frac{7}{4}$ C	$\frac{21}{16}$ G	$\frac{63}{32}$ D	$\frac{189}{128}$ A	$\frac{567}{512}$ E
	$\frac{1}{1}$ E♭	$\frac{3}{2}$ B♭	$\frac{9}{8}$ F		

The opening chord of *Well-Tuned Piano*:

$\frac{1}{1}$ - $\frac{3}{2}$ - $\frac{7}{4}$ - $\frac{9}{8}$