Tuning and Temperament

Class 2: Early Greek and Chinese Tuning Systems

Today's Class

- Brief coverage of the reading
    - Some terminology: diesis, superparticular, other useless junk
    - Questions?
- Pythagoras vs. Aristoxenus
    - Two varying approaches in ancient Greece
    - Constructing a tetrachord
- **Analysis**: Olympos' Pentatonic
- **Analysis**: Archytas' Enharmonic

Reading

- Diesis: basically a comma
    - In the case of Barbour, it is the comma produced between an octave and three stacked 5:4 intervals.
        - Lesser diesis: 128:125 or about 41.06 cents
- Superparticular: a ratio in which the numerator is greater than the denominator by 1; i.e. 3:2, 5:4, 6:5, 8:7, etc.
    - Not really used that much outside Barbour to describe Ptolemy

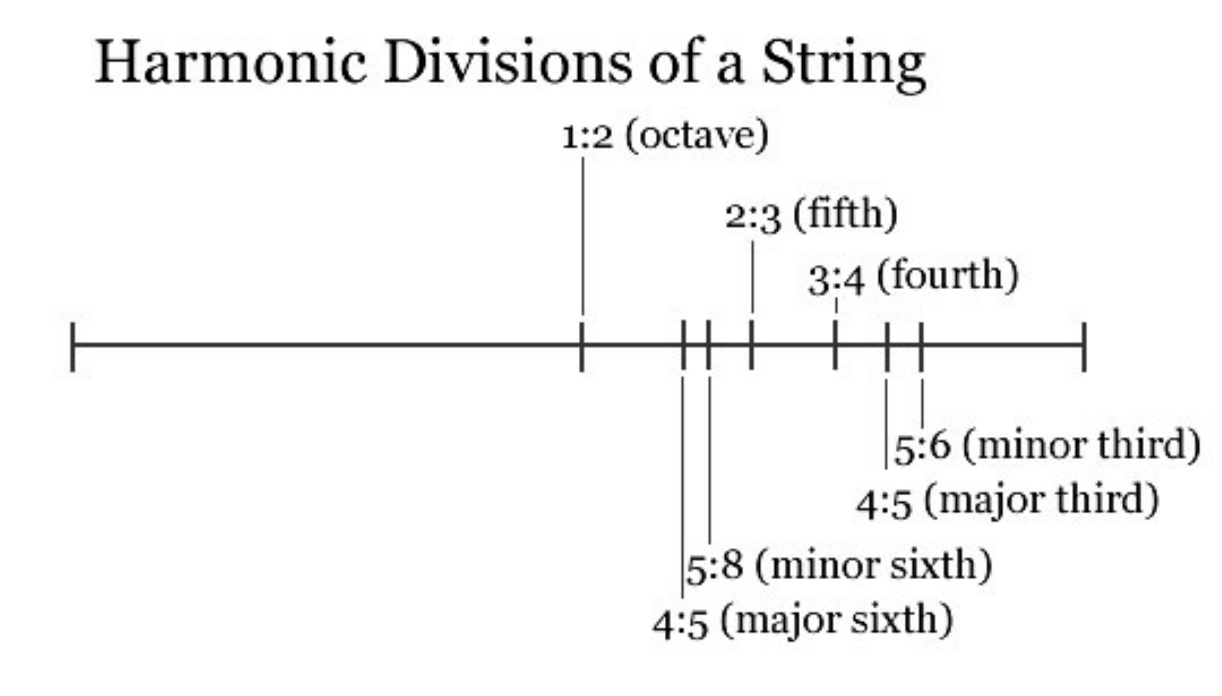
Moving up & down using ratios

- To go up, multiply. To go down, divide (i.e. multiply by the reciporical)
- You can find the interval between two ratios by dividing the larger by the smaller.

Pythagoras vs. Aristoxenus

Mathemetics vs. the Music

The Greeks creating tunings by dividing a string into equal parts.



These are the mathematical ratios for creating the intervals that Kepler finds by experiment are both consonant with respect to the whole string and with each other.

Note how this is related to the harmonic series

Constructing a Tetrachord

What is a tetrachord?

- A set of four notes tuned within the interval 4:3.
  - Pythagorean: using only 4:3 and 3:2 to get new notes (a prime factor of 3).
- Two of these sets were often separated by a "tone" to make an octave.

Definition of a "tone" in Pythagorean terms

The interval between 4:3 and 3:2.

$$\frac{3}{2} \div \frac{4}{3} = \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}$$

Let's make a scale from two tetrachords separated by a tone

Pythagorean heptatonic (Ptolemy's Diatonic Ditoniaion)

Pitches:

1/1 - 9/8 - 81/64 - 4/3 - 3/2 - 27/16 - 243/128 - 2/1

Intervals:

9/8 - 9/8 - 256/243 - **9/8** - 9/8 - 9/8 - 256/243

Cents:

0.0 - 203.91 - 407.82 - 498.04 - 701.96 - 905.87 - 1109.78 - 1200

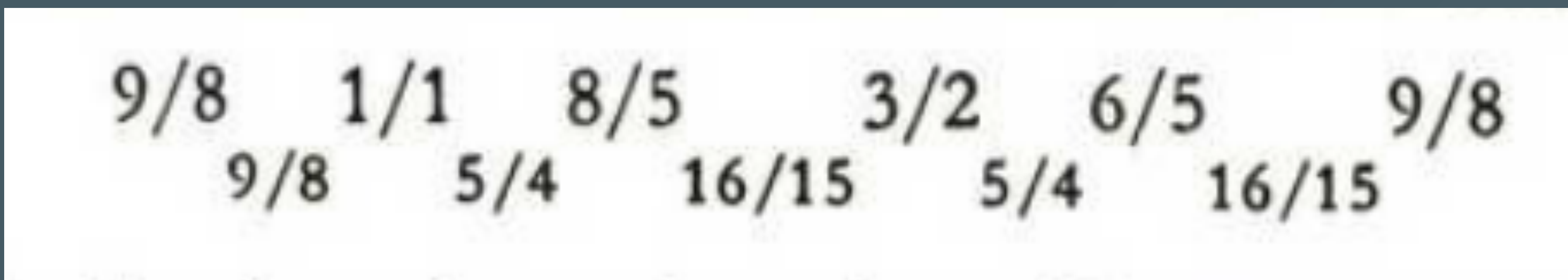
Listening

Harry Partch's Study on Olympos' Pentatonic

- Olympos was a 6th century BC flutist and lyre player.

Olympos Pentatonic

A pentatonic scale using only 3:2 and 5:4 (i.e. not Pythagorean!)



Note that the scale starts *not* on 1:1 (i.e. it's a mode). This scale also appears in koto tunings (Japanese stringed instrument).

Listening

Harry Partch's Study on Archytas' Enharmonic

- 4th Century BC

Pitches:

1/1 - 28/27 - 16/15 - 4/3 - 3/2 - 14/9 - 8/5 - 2/1

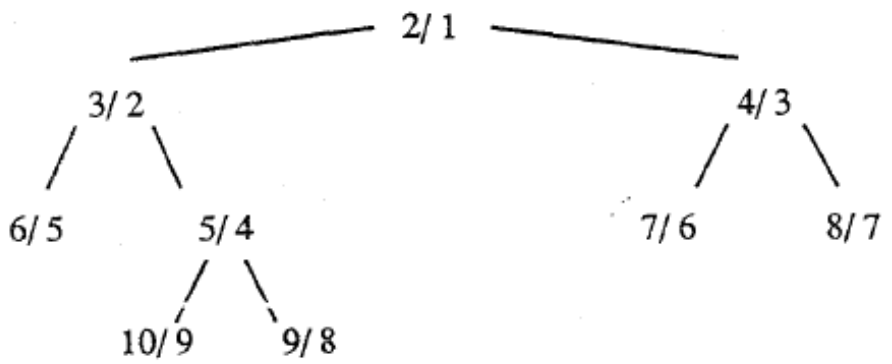
Intervals:

28/27 - 36/35 - 5/4 - **9/8** - 28/27 - 36/35 - 5/4

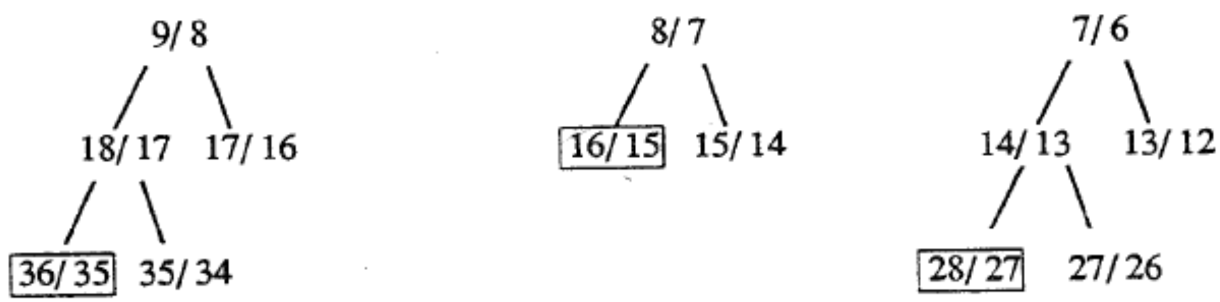
Cents:

0.0 - 203.91 - 315.64 - 701.96 - 813.69 - 1200

All of the main intervals in the Archytas system are derived through the harmonic mean. The large intervals are derived as follows [16]:



The small intervals are also a result of manipulation of the harmonic mean:



Three Greek Genera

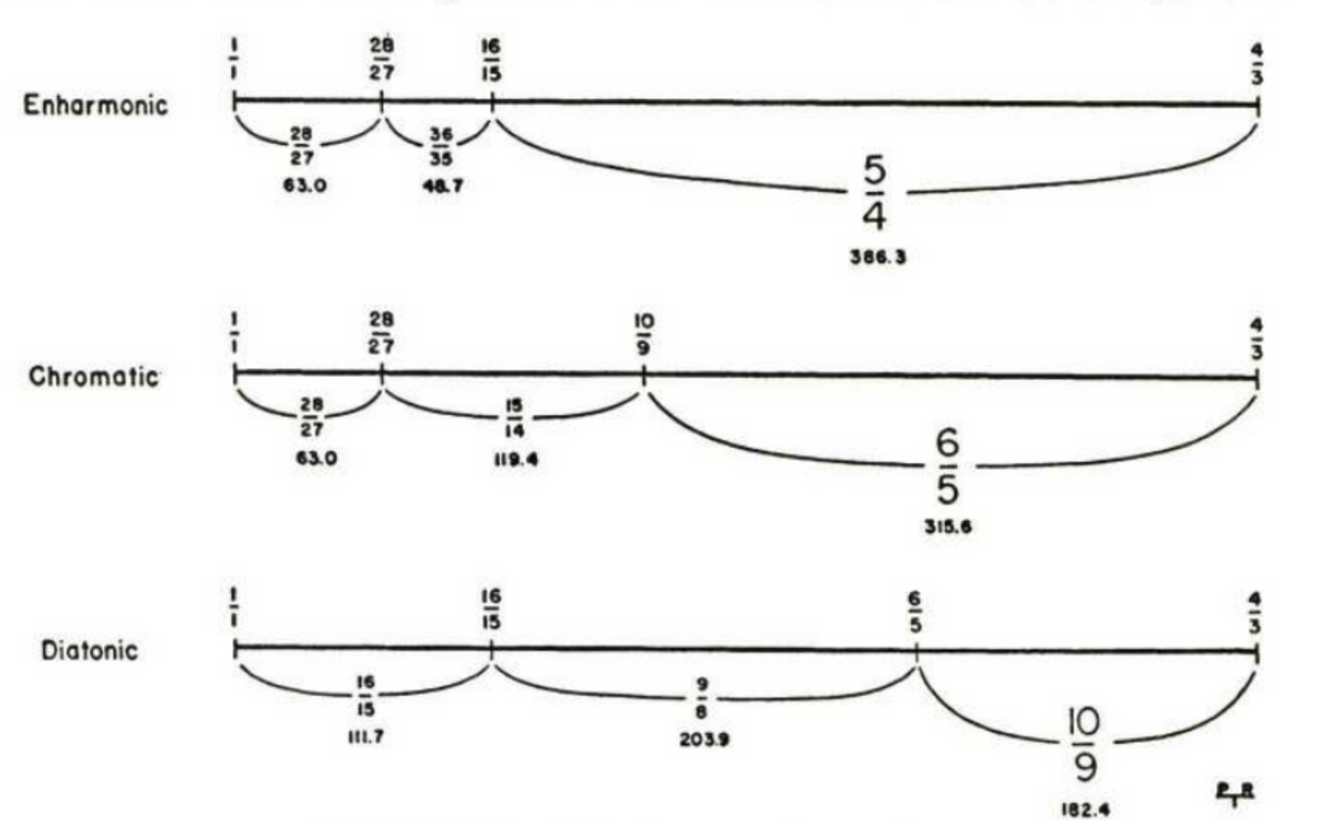


DIAGRAM 10.—THE ANCIENT GREEK GENERA

Ling Lun: Chinese Tuning using 3-limit

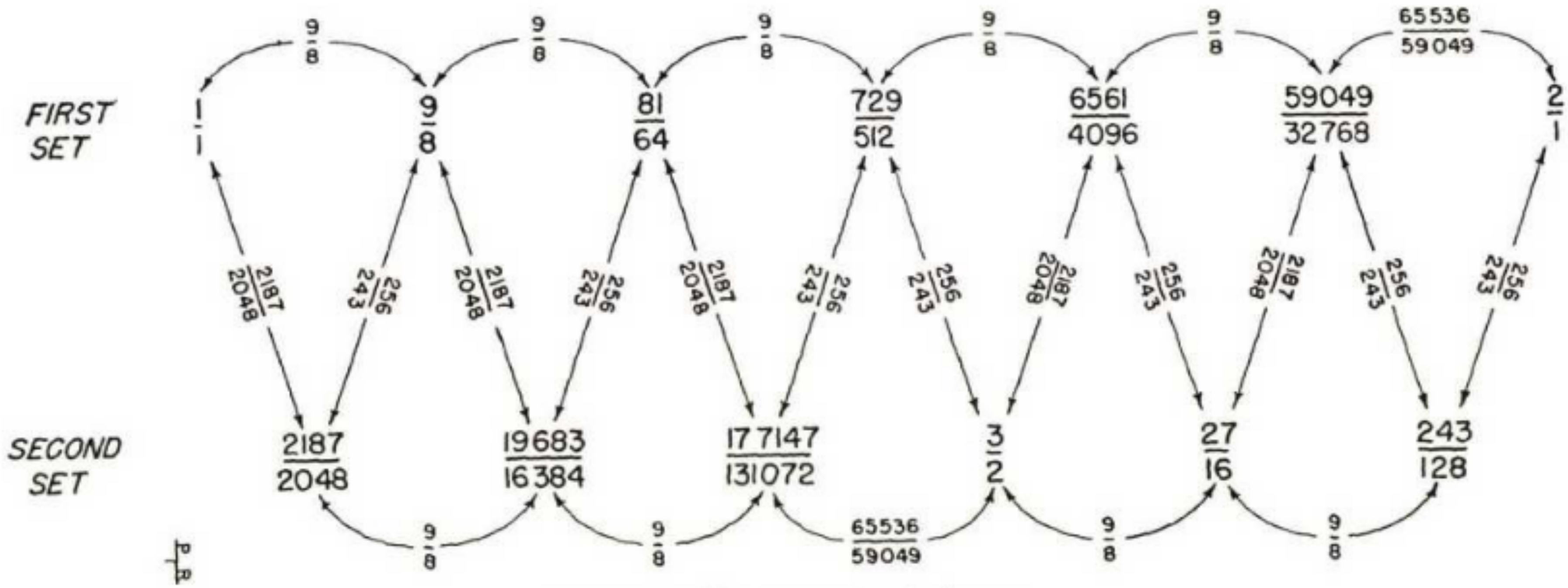


DIAGRAM 22.—LING LUN'S SCALE