Lecture 1 - The Science of Sound

1. Simple Tones

- **Harmonic oscillation**

   Description and demonstration

   Terminology

   > Amplitude, Phase, Period (cf. Pierce p.40)
   > Frequency, Wavelength, Cycles (Hertz)
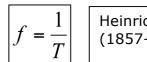   > Pitch
   > Nomenclature

$$f = \frac{1}{T}$$

Heinrich Hertz (1857-1894)

- **The Harmonic Series**

   Definition

   > [📄 1 - Harmonics]
   > [SC demonstration]

   Terminology

   > Ratio, Cent, Hertz, Pitch name

Cents are a logarithmic measure of interval ratios based on the powers of two:

cents = (log$_2$ a:b) x 1200

The sum of two intervals may be found by multiplying their ratios or adding their cent values:

4th + 5th = octave
4/3 x 3/2 = 12/6 = 2/1 = octave
498 + 702 = 1200 = octave

2. Tuning and Temperament

- **Pythagoras**

   History

   > Samos, c.580b.c. - c.500b.c.
   > Secondary sources and first accounts (Plato = Timaeus and Critias)
   > Pythagoreans and number theory

   Pythagorean tuning

   > [📄 1 - Harmonics]
   > [📄 2 - Tuning and Temperaments]
   > Definition
   > Benefits and limitations
   > Ubiquity of use until C14th
   > Influence of use on music practice
   > [📄 3 - Musica Enchiriadis][💿 1 – Léonin & Pérotin – C12th-C13th]
   > [💿 2 – Organum – C12th]
   > Legacy of string tunings

   The Pythagorean comma

   > [📄 1 - Harmonics]

   'Natural' tuning

   > [💿 3 – Minuetto: Louis-François Dauprat – early C19th]
   > [💿 4 – Serenade: Britten – C20th]
   > [💿 5 – Kalmoukie. Khöömii]
   > [💿 6 & 7 – Fujara]

- **Meantone temperament**
  - [🗎 2 - Tuning and Temperaments]
  - Definition
  - The syntonic comma
  - Importance of tuned thirds on the development of harmony

- **Equal temperament**
  - [🗎 2 - Tuning and Temperaments]
  - Definition
  - First use
  - Advantages and disadvantages

- **Just intonation**
  - [🗎 2 - Tuning and Temperaments]
  - Definition
  - Advantages and disadvantages

- **Octave equivalence**
  - Only non-cultural construct in music

3. Concepts of Consonance and Dissonance

- **Perception**
  - Ratios

- **Diads, triads and other -ads**
  - Helmholtz
  - [🗎 4 - Major and minor chords]
  - Beat frequencies
  - Combination tones (difference and summation)
    - [cf. translator's note, pp. 214-215]
  - Fourier

> Hermann Helmholtz (1821-1894)
>
> *On the sensations of tone as a physiological basis for the theory of music* (1863)

> Jean Baptiste Joseph Fourier (1768-1830)
>
> *The Analytical Theory of Heat* (1822)

4. Conclusions

- **Music of the Spheres?**
  - Relationship of vibrations and musical tones to numbers and physical phenomena. Perception mediated through context.

- **What about timbre?**
  - Arnold Schönberg – Theory of Harmony
  - Trevor Wishart – On Sonic Art (chapter 3)
  - [♫ 8 & 9 – Shephard Tones]