Math and music

par ??? des
Lycées danois de Hillerød et de Brønderslev

enseignants : Mme Kirsten Bangsø Jensen et M. Gert Schomaker.

The golden section has always been considered as a principle of dividing things into harmonic proportions. It has been used by painters and architects through centuries, and a number of theories have been advanced with the purpose of explaining the golden section, which seems to be a law of nature.

As arts seem to be influenced by the golden section, we wondered if music was also influenced. Our group consisted of two persons, who both work with music every day. Therefore it was obvious that we found this particular subject interesting. Unfortunately, we were given much too little time to work thoroughly with it.

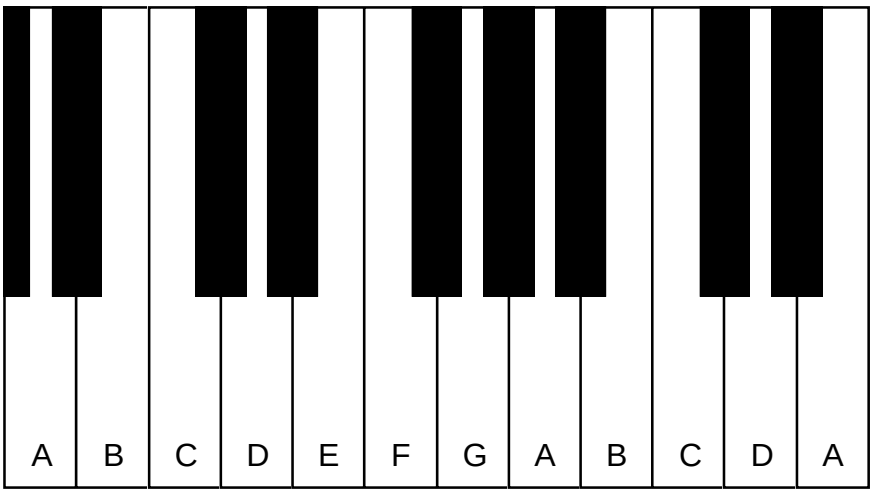
There are many ways of approaching this subject, but it was obvious that our basis should be the Fibonacci series, because it has got much relevance to this, and because the series has been examined by another group (which is why it will not be further explained in this article).

Only a few centuries ago, the keyboard on the piano had been divided into octaves, each with twelve tones. By examining the twelve-tone octave (see below), we can see that the simply harmony, a triad major follows the principle of the Fibonacci-series. Either we can count the tone intervals in half or in whole tones, but we end up with the Fibonacci-series anyway. However, this does not tell us, that the frequency ratios between these tones are the same as the frequency ratios between the Fibonacci-series. The conclusion to this is, that the golden section is not mathematical in this case, but the principle functions individually in the tone system.

If we look at the opposite part of the problem above, namely where two tones are divided into the golden section by their frequency ratios, i.e. a frequency ratio of approximatively 1.618 (= φ), we see that this ratio is almost obtained between a tone and its sixth.

For instance a c = 261 Hz and its sixth a = 440 Hz. 440/261 = 1.6875. As a musician, you can tell, that this interval (a sixth) does not sound harmonic compared to a third or a fifth. Anyway, several composers use this interval on purpose in their works.

A final conclusion to all this must be, that the principle of the golden section cannot be regarded as being strictly mathematical.



Interval counted in :

whole steps	1	3	5	8
half steps	1	5	8	13