

Committee 6
Science and Music: A Unifying Concept

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Musical Patterns at the Various Levels of Complexity in Nature

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Musical patterns at the various levels of complexity in Nature

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Abstract

Connections between science and music (and philosophy) go back to remote periods of history, when they did not exist as such but were parts of magic rituals. Pythagoras was the first recorded thinker in the western world to introduce explicitly physical and mathematical (and mystical) considerations into musicology: he devised a music scale that prevailed until the 17th century and on which our modern scales are still based. Numerous mathematicians and physicists (from Descartes and Euler to Huygens and Helmholtz) wrote memoirs on arithmetic, acoustics and music. It has been said that mathematical physics stems from the theory of music.

Relations between science and music are of various kinds: 1) physics and mathematics, as well as physiology and neurology, may help to understand the theory of music (for instance, Fourier expansions of musical sounds provide a background for the understanding of harmony, and the analysis of biological rhythms that of melody, rhythm and tempo); 2) technical developments based on scientific progress (as the building of the organ or the advent of the computer) can be influential in the development of music (as in the 'stochastic music' of Iannis Xenakis); 3) cultural changes induced by scientific progress may set the background for novel musical trends (for instance, geocentric cosmology can be related to modal music in Ancient Greece and Einstein's relativistic cosmology to Schönberg's atonal music); 4) Science, technology and culture motives can be used (as are folk, military or religious motives) as a source of inspiration for music composers (as in 'Impressions of two space travellers' by Marja Rantanen); 5) On the other hand, the practice of music may help develop emotional intelligence (many philosophers and scientists, from Plato through Feynman, were fond of music) and even have psychotherapeutic effects (from David healing Saul's melancholy with a lyra through modern techniques of musicotherapy).

However, the deepest connection between science and music is in the existence of musical patterns at the various levels of complexity. Everything in Nature, from elementary particles to galaxy clusters through atomic and molecular spectra, crystal and polymer structures, biological and geological rhythms, or the songs of birds and dolphins, is made of waves, periodicities, vibrations, and resonances. From Plato to Kepler one spoke of a 'music of the spheres'. In the 19th century Weiss found a similarity between music scales and crystal symmetries, introducing a 'music of the depths'. More recently Sternheimer has shown that the masses of stable elementary particles follow the tempered scale. Basic properties of nuclei and atoms through the periodic table can be put in the form of musical scores. Several authors have shown that the amino acids in proteins and nucleotidic bases in nucleic acids can be used as music notes to form meaningful musical scores. One may wonder whether the great works of music composers do not reflect the deep aperiodic crystalline structure (to use Schrödinger's words) of their brain. It has been said that a scientist is someone who deciphers God's score in Nature, while a composer is someone who deciphers God's score within Man.

1. - Introduction

Why a Science and Music Committee ? Elaborate on the main contents of the abstract.

2. - Science, Music and their Relationships

- 2.1. What is Science ?

- Traditional (subjective) Science and Contemporary (objective) Science. Information and Formation; Knowledge and Know-how. Magic and Technique.

- Classification of the sciences according to the levels of abstraction of the Mind and to the levels of complexity in Nature.

- 2.2. What is Music ?

- 1D, 2D and 3D vibrations in solids, liquids, and gases.

- Acoustic and electromagnetic waves. Audible sounds and visible colors: frequency, intensity, tone, duration.

- Musical patterns: monophony and polyphony; harmony, melody, rhythm; tempo, loudness, and their modulations.

- 2.3. What are the relationships between Science and Music ?

- What can Science do for Music (refer e.g. to Pr Daudel's and Pr Emery's papers).

- What can Music do for Science (refer e.g. to Sternheimer, Ohno, Leach, and others).

3. - Musical Patterns at the Successive Levels of Complexity in Nature

one transparent, no music

- 3.1. The music of the masses of stable elementary particles.

four transparents, no music

- 3.2. The music of the masses and spins of stable nuclei.

eight transparents, four pieces

- 3.3. The music of ionization energies and electron affinities, electronegativities and chemical hardnesses, and valence numbers of atoms through the periodic table.

fifteen transparents, five pieces

- 3.4. *The music of various kinds of atomic, molecular and cluster spectra (give example of calcium, and refer to Pr Lefebvre's paper).*

two transparents, two pieces

- 3.5. *The music of biomolecular structures: proteins, nucleic acids, etc. (give example of score concordance, and refer to Pr Lefebvre's paper).*

no transparent, two pieces (start of Ohno's composition and start of 'My promise').

- 3.6. *The music of the cells, organs, organisms, and ecosystems: inner biological rhythms, etc. (refer to Dr Gaudeau's paper).*

four transparents, songs of birds

- 3.7. *Musical characterology and ethnology (Leone Bourdel).*

four transparents, some music (harmony, melody, rhythm, ...)

- 3.8. *Music and psychology (Laurent Dukan), sociology (Jean-Louis de Lannoy), ethnology (Demetrios Moraitis, Guy Buchholtzer), and philosophy (Georges Koussanellos).*

no transparent, no music

- 3.9. *Music therapy (Edith Lecourt).*

no transparent, one piece from JoSt (inhibitor ACE)

- 3.10. *From the 'Music of the Depths' to the 'Music of the Spheres': Music of the Solar system, star galaxies, and the Universe (refer to Dr Lekkas' paper).*

four transparents (galaxies), two pieces ('Constellation' and 'Black Hole') - half transferred to Pr Daudel's paper.

4. - Conclusion

Non-linear effects and quasi-chaotic phenomena: could music help distinguish real from apparent chaos, and help extract implicit order out of apparent chaos ? Give examples from quasi-symmetries, shell effects, and molecular staggering. The Holy Scripture and transcendant numbers.

four then two transparents, no music

Quote again Ohno, Leach: music may be used to memorize more easily complex patterns or to discriminate real effects from artefacts.

Philosophical aspects of pattern recognition through musical transcription.

Transparents of color pictures

Gnossienne from Satie / Libera me from Verdi

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