

The Pythagorean Lecture

During the winter and spring of 1996, we eventually arrived at the conclusion that we should try to create a project in mathematics and one in music. At a meeting at the Royal Institute of Technology (KTH) in May 96 (15/5) I proposed that we should consider the possibilities to fuse these two projects into one - centered around illuminating the connections between mathematics and music. I was asked to motivate this further by giving a 2-hour lecture on the connections between the two subjects - as well as their historical evolution.

The lecture was given at the end of May (29/5). It started from the great 'Greek dawn' at Ionia, with the birth of the 'rational project' about 600 BC, featuring such great actors as Thales, Anaximander and Anaximenes, and later a 'mystical rationalist' named Pythagoras of Samos.

"What is the basic stuff that the universe is made of?" - asked Thales - with the underlying assumption that the world can be understood from basic principles. This new belief in the reasoning power of the human brain was an electrifying spark that set the Greeks aside from earlier cultures. Soon everybody was reducing the world to basic building blocks - for Thales it was water, for Anaximander it was air, and for Anaximenes it was pneuma (the cosmic breath). The novelty lay maybe not so much in the answers, as in the fact that the questions were being asked - not to the gods, like they had always been asked before - but to 'dumb nature' itself.

As a counterpart of these substance-oriented philosophers, Pythagoras claimed that the true nature of things are hidden in their relations - which give them their form - and this nature can best be explored through the concept of number (= figure). This raised the philosophical battle between the substance-theorists ('all is matter') and the relation-theorists ('all is form') that has been going ever since - until it recently (about 1925) ended in a 'quantum-mechanical draw' expressed in the disturbing dual nature of light. The photon is neither particle nor wave, but sometimes the one, sometimes the other - depending on how we carry out the corresponding experiment. I devoted time to describe the unity (= holism) in the early quest for knowledge and discussed the Pythagorean form of interdisciplinary studies which involves connections between such diverse areas as astronomy, geometry, arithmetic, music, medicine and religion. [Figure (24)]. Within the field of music, I explained the fundamental discovery of Pythagoras concerning the connection between musical harmonies and the simplest rational numbers - such as the doubling ($2/1$) of the octave, the $3/2$ of the quint, the $4/3$ of the quart, etc. I also touched on the esoteric interpretation of the nature of numbers - such as the 'male' number 3 and the 'female' number 4 that unite in their common life-fruit 5 (representing the child) - through the mediation of the so called 'Pythagorean theorem' ($3^2+4^2=5^2$).

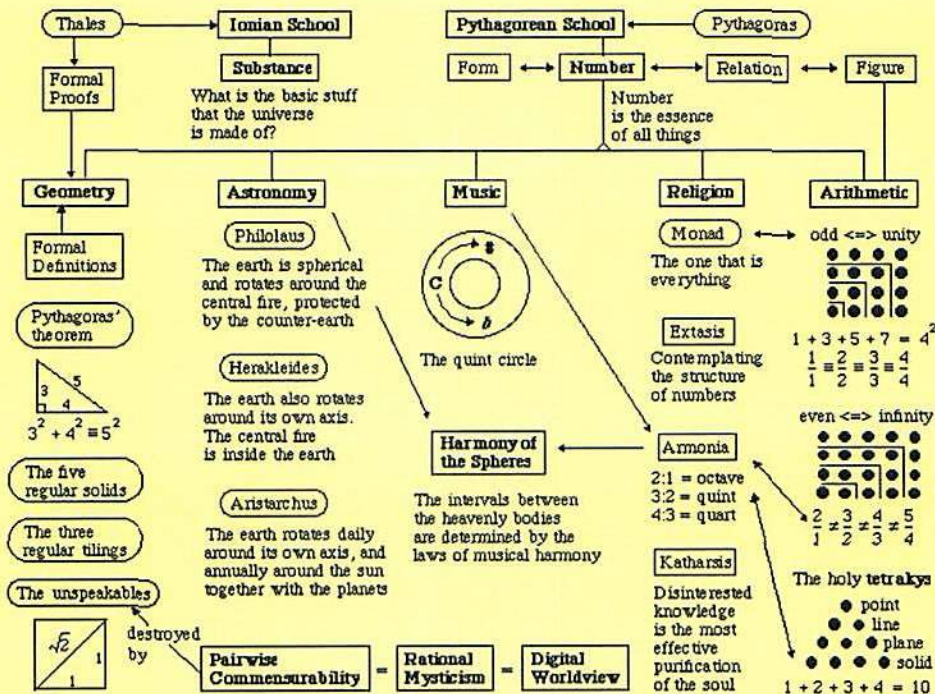
I also followed a few threads of development forward in time, and described e.g. how the geometry of the Pythagorean quint-circle $(3/2)^n$ created the prerequisites for the synthesizer, built on the uniform quint, which was achieved in the eighteenth century (during the days of Bach) by introducing the irrational compromise $2^{1/12}$ for the frequency raise of a half tone step. I continued the story of the synthesizer and described how to play tunes with constant chords by making use of the so called Fourier Transform to calculate the pressure on each individual tangent. This gives an instructive analogy to the 'material synthesizer' used by quantum mechanics itself - where such wave-interference chords are played on the Fourier transform based tangents of the Schrödinger equation [Figure (22)] - in order to create matter in the form of wave-packets. I exemplified with the so called Heisenberg's uncertainty relation - which describes the limits for the simultaneous accuracy that can be attained in measuring e.g. the position and the velocity of a particle (like an electron). With the Fourier transform, I showed how this amounts to the fact that waves of all frequencies have to cooperate in order to synthesize an infinitely sharp peak, i.e. a particle. In this context, the idea of the synthesizer as a form of time-machine - with possibilities to travel all the way from the sixth century BC of Pythagoras to the twentieth century of quantum mechanics.

I have a vivid memory of this lecture, since it was my first one on this subject - the early evolution of western knowledge with an emphasis on the areas of mathematics and music. I also found the time to talk a bit about my educational project with First Class Mathematics [see chapter (7)], where I have

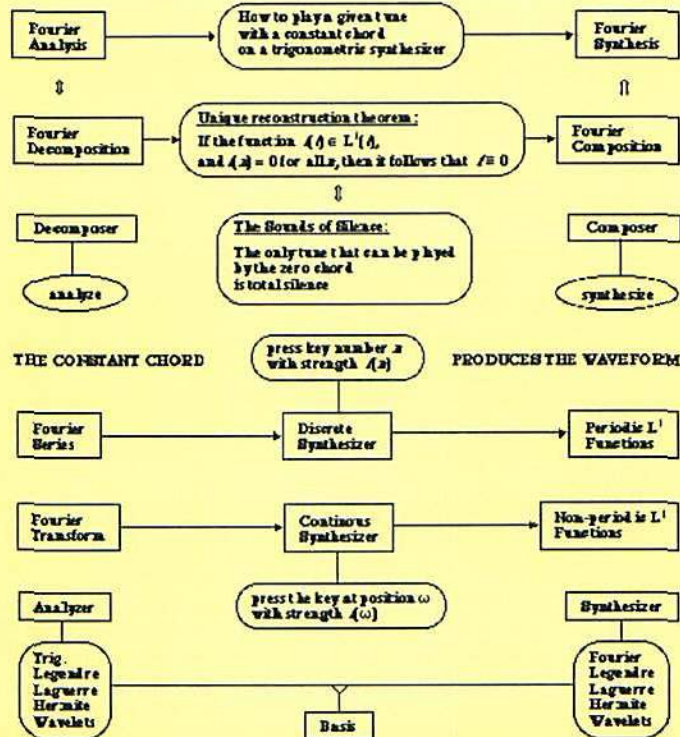
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experimented with trying to convey some carefully selected mathematical insights to the pupils of my daughter Ylva's class. As I have described above, this project is based on viewing mathematical truths as a sort of logically tested fantasies - where the right brain is fantasizing and the left brain does the logical testing. Only the fantasies that survive the logical tests are elevated to the status of mathematical truths. To encourage such a view of mathematics it is vital that the children are confronted with interesting structures at an early age - structures that can encourage them to foster their own mathematical fantasies. An example of such rich and interesting structures is provided by symmetrical patterns, such as rosettes, bands, and wallpapers. In the lecture, I showed examples of the experimental exploration of some wallpaper-patterns that was carried out in this spirit by a group of 9-year olds - using the program MacWallpaper - within the First Class Mathematics project. It felt like I managed to convey some of the mathemagical power of the structural exploration work of the kids!

Indeed, it was a very special lecture. Five of the six persons present were Rikard, Katarina, Klara, Kristina and Mattias - who all later became co-workers in the GOK-project in various ways. I interpret this as a sign that I managed to infect them with a substantial part of my enthusiasm for this holistically inspired knowledge project.



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