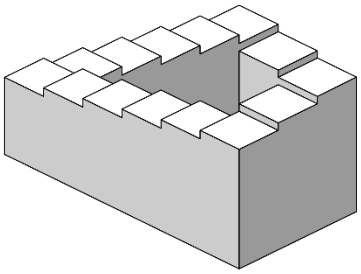
TASC Talk 17th January 2019

Paradoxes - by Dr Felix Flicker, Astor Junior Research Fellow of Physics, New College, Oxford University.

January's Science Club talk was given by Dr Felix Flicker from Oxford University and was on Paradoxes, jokes, riddles, Zen Buddhist Koans, and some ideas in modern theoretical physics. He began by presenting us with some definitions of the word "Paradox" –

1) *A seemingly absurd or contradictory statement or proposition which, when investigated may prove to be well founded or true.*
2) *A statement or proposition which, despite sounding reasonable and drawn from acceptable premises, leads to a conclusion that seems logically unacceptable or self-contradictory.*

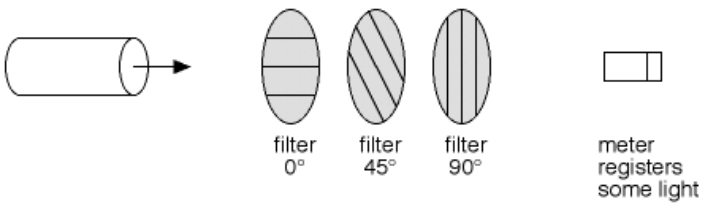


After showing us some famous examples of paintings by M. C. Escher depicting paradoxical situations such as an infinite staircase and waterfall he played us sounds which seemed to be continuously increasing or decreasing in pitch but never actually becoming inaudible. As a matter of interest some of these audio techniques have been used in a number of films to accentuate the action sequences. If you get a chance to watch any recent Batman movie where the Batmobile is in action, listen carefully and you may notice this effect being used.

We took a look at a number of paradoxes such as David Hilbert's Grand Hotel paradox and Zeno's paradox. Look them up on the Internet if you're interested.

Other examples of paradoxes were discussed after which Dr Flicker introduced the concept of quantum uncertainty, the uncertainty principle leads to all sorts of paradoxes, like particles being in two places at once. He used Schrodinger's Cat to illustrate that at very small scales the world does not seem to operate in a common sense way. Particles, for instance, which have been "entangled" during a quantum process can be separated by any distance but still seem to be in instant contact with each other defying one of Einstein's cherished laws, that states that nothing not even information can travel faster than the speed of light. He explained this in relation to their "Spin". The "Spin" of subatomic particle such as an electron is equivalent to their angular momentum. When considering entangled particles their "Spin" can vary unpredictably depending on how they are being observed, which seems to indicate that consciousness may also play a part in quantum processes.

To try and show how "spin" can be used to explain some seemingly paradoxical events, Dr Flicker used an experimental apparatus consisting of a base with a lamp shining through three polarising filters. All these were set-up to allow light through to a screen. He showed that by rotating the last filter by 90º the light was stopped from getting to the screen, however if the middle filter was then rotated by 45º some of the light was again visible on the screen. This in theory should be impossible but obviously wasn't. This affect was explained in terms of "Spin" and the quantum uncertainty principle.



Many other paradoxical things were discussed, but unfortunately I am not able to mention them here, so till next time I will leave you with a question, When you look at yourself in a mirror you will notice your left and right sides are swapped over so why then isn't your up and down? Interestingly this question is discussed in one of Professor Eric Laithwaite's now famous Royal Institute lectures, "Looking Glass House". Here's the link if you want to watch it –
http://www.rigb.org/christmas-lectures/watch/1974/the-engineer-through-the-looking-glass/looking-glass-house

Marius Stuart