The Adstock Science Club meeting on Thursday 12th June, 2014

Cheltenham Science Festival

Here is a brief synopsis of some of the talks I attended at the recent Cheltenham Science Festival.

Following this I introduced the subject of Clocks with some examples and a description of how a basic pendulum clock works. A video about John Harrison was also shown

Tuesday 3rd June – Flexible Technology – Jenny Nelson & Monica Cracium

J.N. mainly discussed development of flexible solar panels and how new materials such as Graphene were being utilised due to its flexibility, strength and conductivity.

M.C. went into more detail about Graphene and how transistors can be fabricated by using multiple layers. Flexible circuits are also being designed into wearable technology.

Wednesday 4th June – The Particle at the end of the Universe – Sean Carroll

Very interesting talk by S.C. starting with a little history of the atom, from Democritus, atoms, to Aristotle, humours.

Modern day discoveries by Chadwick, plum pudding model, to Rutherford, heavy nucleus, then on to James Clarke Maxwell and Faraday, electromagnetic force, and Newton, gravity, who's theory of gravity is still important for space travel.

Laplace refined Newton's ideas on gravity to introduce curvature of space, then on to Einstein who took this much further with Space-time.

S.C. explained, space suffused with EM and Higgs field. Because Higgs field sits at non 0 energy level it drags on some particles giving them mass.

The trials, tribulations, successes and failures of the LHC was talked about up to the discovery of the Higgs Boson.

Finally it is unlikely that the discovery of the HB will lead to new technology but the quest has led to major technological discoveries and developments.

Wednesday 4th June – The Arrow of Time – Sean Carroll

Once again a good talk by S.C. starting with the Big Bang. No definite answers about time just best guesses based on current knowledge. He discussed possible reasons why we remember yesterday but not tomorrow even though the laws of physics don't discriminate, universe began in low entropy which has been increasing. Entropy concept popularised by Ludwig Boltzman in late 19th century, closed systems would tend to disorder, S=K.logW famous equation. However order from disorder spontaneously possible leads to absurd idea of Boltzman's Brains.

Finally the Universe will end in "Big Freeze".

Thursday 5th June – Big Problems, Nano Solutions – Annela Seddon

Best talk of the festival, A.S. started by defining big to small from the Earth, person, hair, red blood cell, bacterium to nano-particle 40,000 times smaller than a human hair.

Property of matter at nano level different. Different size gold nano particles appear different colours. Butterfly wings show colour not because of dye but due to nano-structure of wings with holes.

Nano materials such as grapheme used in sport, tennis racquets etc. Human hair width carbon fibre can hold 4 tons.

View small world using microscope but nano world requires electron microscope. Two types transmission and reflection E. Microscopes. For finer detail a scanning probe microscope is used. This uses fine metal probe to closely traverse surface of subject and change of electric field is detected and converted into picture.

It was found that atoms could be manipulated with such a device as well as with "Laser Pincers". IBM created IBM logo using individual atoms and also produced "A boy and his atom", (see

https://www.youtube.com/watch?v=Dqj29lzuSIM). Laser pincer similar in operation to Ping-Pong ball held in an air stream from hairdryer.

Nano particle because of their surface to volume ratio are more effective for various purposes i.e. drug deployment. As they get smaller this increases.

Nano structures such as nano-tubes are also useful for this. By containing a drug payload and coded end stops that dissolve when in contact with say a particular cancer cell the drug can be precisely targeted.

Indian scientists have developed a cheap, £5, water filter that is capable of filtering all bacteria and viruses from dirty water and will last for a year for a family of four.

Lastly A.S. demonstrated nano-tech being used in fabrics to enable them to resist staining.

Thursday 5th June – Infinity – Jim Al-Khalili & Richard Pettigrew

1/0 ="This is not a number" being displayed by J.A. calculator. Scientists' esp. physicists hate infinities but mathematicians are not so worried. Infinity can be useful for calculations in many industries i.e. civil engineering, electronics etc.

Achilles and the Tortoise is an example of a paradox by Zeno where Achilles can never catch the tortoise up. This is based on a flaw in his logic?

By using Olber's Paradox J.A. "proved" that the universe had a beginning.

The second half of the talk, Richard Pettigrew discussed different types and sizes of infinities. He showed that infinities composed of complex numbers were bigger than those made up of normal counting numbers He also discussed Hilbert's Hotel, a 19th century mathematician, where a room could always be found for an extra guest even and infinite number of extra guests in an infinitely big but full up hotel.

Lastly he showed by "diagonalization" how one infinite series of number could be generated from another infinite series but with no overlapping sequences – I think!.

Friday 6th June – Sophie Wilson: Architect of the Modern World

Using the example of a 6502, a very old microprocessor, S.W. described the basics of this technology. The 6502 has 6000 transistors but today's *mps* have many millions. The basic construction is divided up into a number of sections, memory, registers, ALU, I/O and busses.

Moore's law is adhered to but Amdahl's law is still restricting how fast even the most parallel systems are limited in their capability.

`The latest "Firepath" processor has been shrunk to fit 4 onto a single dye with trade-offs having to be made between heat and speed. One way to mitigate this is to allow the *mp* to switch off unused circuits when not in use. Some of Intel's Pentiums approached temperatures similar to that of a nuclear reactor. RISC processors use as much complexity as others to increase their speed even though they use a limited instruction set.

Friday 6th June – The Future of Human enhancement – Dr Robert Winston

Genetically modifying embryos could resolve many heritable diseases and other issues also selecting good embryos from faulty ones may also prove beneficial, however invitro-fertilisation is still a very hit and miss affair with some clinics making aexcessive amounts of money. Another and more reliable way of producing foetuses is to stimulate a human egg either with an electric current or chemicals to start dividing and reproduce. Whether this was right or not was discussed, Francis Gaulton and the Eugenics movement was also discussed and was a popular concept in the early 20th century. Winston Churchill was one of its advocates and there was a major symposium held at London University in 1912 which endorsed these views.

Saturday 7th June – Will we ever understand the Universe? – Jim Al-Khalili, James Gates & Fay Dowler

Basically there are and will be more questions than answers.