

Christians in Science Lecture 5 at St Peter's, Farnborough 28th February 2017

Nanoscience: A New Aspect of God's Creation

Russell Cowburn FRS, Professor of Experimental Physics at The Cavendish Laboratory, University of Cambridge, gave an audience of about 120 a stunning introduction into the world of Nanoscience (NS) and Nanotechnology (NT). He prefaced his talk by saying he was both a 'serious scientist' and a 'serious Christian' and had been since student days some 27 years ago. Russell defined this relatively new science as being the study and manipulation of atoms, molecules or objects with dimensions in the 1-100 nanometre range, where a nanometre (Nm) is one billionth of a metre or one millionth of a millimetre. For comparison, a paperclip is about 1mm in diameter, a human hair about 0.05mm (50,000Nm), a red blood cell about 10 microns or 10,000Nm, and at one end of the scale, a single atom about 0.1Nm. NS and NT have been made possible by the development of very powerful vacuum pumps, which can remove all the air from stainless steel vessels, and extremely sensitive new microscopes some of which like the Scanning Tunnel and Atomic Force microscopes enable us both to 'see' and 'touch' individual atoms, as exemplified by his slide of a piece of silicon. Amongst the many new nanoscale materials that have been made are 3 new forms of carbon (alongside the familiar diamond and graphite) – a C60 fullerene molecule (so-called Buckyball, first detected in outer space), carbon nanotubes and grapheme, a single layer of linked carbon atoms which is immensely strong.

So 'what's exciting about working at the nano level?' The answer to this question has nothing to do with miniaturisation per se but is all to do with materials having totally different physical and chemical properties at the nano scale – the so-called 'Nano Advantage'. These different properties enable scientists to make entirely new, better and cleaner materials which are only available via NT. The current most obvious example is the enormously powerful chips found in today's computers and smartphones, where the transistors are now only a few tens of Nm across. NT has also helped chemists pinpoint the source of antibiotic resistance exhibited by some recent hospital-acquired infections – which turns out to be a single missing hydrogen atom – and to create colourless nanoparticles of titanium dioxide (normally white as used in paints), which are used in sunscreens to block ultraviolet light without leaving a white skin deposit. There is hope too that NS will lead to the production of new materials which will be much more efficient at capturing sunlight and converting the energy into electricity, and so help to provide affordable renewable power generation even in cloudy Britain.

Professor Cowburn also posed the question 'What's terrifying about NT?' The answer - as with most new technologies - is very little provided it is used responsibly and ethically. However, two recent books by Drexler and Crichton have led to the quite unfounded fear of a self-replicating 'Drexler (NT) machine' relentlessly consuming all living species on the planet and turning them into a 'Gray Goo'! Again, as with every technology, there has to be a balance struck between the risks and the benefits – Russell referred to this as a 'proportionality of risk'. Where nanoparticles are firmly bound to a surface as in smartphones there is probably little or no risk but there might be where relatively large amounts are freely dispersed. This is where we would need to do proper toxicological studies. For example, the widespread use of sunscreens containing nanoparticles of titanium oxide could potentially lead to sea water being contaminated, with the risk of the particles catalysing ozone production which would in turn be toxic for the microorganisms on which fish rely. On the other hand, if NT can be harnessed for efficient renewable power generation, to increase the supply of drinking water, or to improve the efficiency of MRI scanners in searching for cancer cells, there would clearly be enormous benefit for mankind. The truth is, of course, that nanoparticles have always been around even in materials long thought to be quite harmless. Research has also shown the widespread presence of nanoparticles in nature. The morpho butterfly, for example, appears blue not because of some pigment in its wings but because of the presence of rows of nanoparticles which break up the incident sunlight. All living species also depend on the enzyme ATP synthase for the production of ATP from ADP (plus energy), ATP being the molecule that powers the metabolism of all life as we know it. This enzyme can be regarded as a little 'nano-machine' or 'nano-box' and has been around in nature for about 4 billion years or so.

Russell then turned to the ‘theology’ of NT which could, of course, be applied to any (new) technology. Is technology a ‘good thing’ from a Christian point of view and where might God fit into the development of NT? He cited Genesis chapter I where man is described as being created ‘in the image of God’ to ‘rule over every living creature’, and to Psalms 19 and 139, where King David praises God for the wonder of His creation both materially in what David could observe (the heavens and the earth) and for his own existence as he realised that he was ‘fearfully and wonderfully made’. Russell also referred to Revelation chapter 4 and 5 - ‘You are worthy .. to receive honour and glory ... for you created all things’ and to the revelation of God in the redemption of mankind through the sacrifice of Jesus Christ (the Lamb). In a similar way, he saw present day advances in scientific knowledge such as NS as another part of the continuing revelation of God’s creation and not in any sense as ‘diminishing’ God – quite the reverse. It was right that scientists should develop technology but in the ‘right’ way, for the benefit of mankind and safely. He referred to the topic of abiogenesis (the study of the origin of life from inanimate molecules) and to the as yet poorly understood (‘missing’) steps in the generally accepted chain of events (evolution) that leads from the Big Bang through to present-day life. In particular, scientists have yet to figure out the mechanism by which small molecules are converted into large complicated molecules such as RNA and DNA. Some people see these poorly understood steps as ‘God’ ie as examples where God effects the transformation. Professor Cowburn felt this was quite erroneous thinking which has the effect of diminishing God, whom he saw as being involved in the whole of creation and not just in the parts we don’t fully understand. He speculated that some kind of nano ‘self assembly’ might have been involved in these transformations several billion years ago.

In conclusion, Professor Cowburn said that NT had considerable potential for good and was on track to underpin the next industrial revolution, but that it had to be developed with safety in mind. He claimed also that ‘God had got there first’ in that nature was ‘full’ of nanotechnology!

In a stimulating Q and A session Russell answered a number of thoughtful questions. In terms of where NT was heading in the short term he felt that the production of entirely new materials was high on the agenda due to the possibility of combining many different elements at the nanoscale level. Britain was unlikely to be the leader of the next industrial revolution but could be ‘smart’ in the research it carried out, witness the dominance of British-made (ARM) chips in mobile devices. In response to a question relating to evolution being driven by genetic mutation (GM), he said he did subscribe to GM and evolution as being part of God’s creation and pointed out how wonderful it was that species could adapt to their often hostile environments. He did not think NT would be directly involved in the development of new drugs but nanoparticles might be used as tools to eradicate disease such as cancer. Similarly, NT would not be involved directly in editing human DNA but might provide better tools for sequencing it. Russell agreed that historically defence and warfare had been important drivers of research and that it was still true today. However, new ‘drivers’ were the need to counteract Global Warming and concerns over environmental problems such as pollution. Did he find it difficult being a Christian within the scientific community? Perhaps surprisingly, the answer to this was generally ‘no’ as he had many Christian colleagues and there has always been a significant minority of Christians within science with a profound faith, Boyle and Faraday amongst many others. In answer to questions on research funding and support, Russell did regret the UK government’s attitude to funding and the dearth of scientists amongst politicians, but felt that, nevertheless, politicians and certainly many within the Civil Service were often quite supportive of science as a wealth-generator..

The next CIS meeting dealing with Science and Faith issues is on Tuesday 27th June 2017 at 7.30 pm at St Paul’s Church, Camberley and will be given by Dr Denis Alexander, Emeritus Director of the Faraday Institute for Science and Religion, St Edmund’s College, Cambridge. His subject will be:

‘Can a Christian believe in Evolution’

John Wood