



2022

5 Oct Trinity - the exposure and pursuit of Klaus Fuchs, the most dangerous spy in history

Prof. Frank Close *University of Oxford*

Trinity was the codename for the test explosion of the atomic bomb in New Mexico on 16 July 1945. Frank tells the story of the bomb's metaphorical father - Oxford professor, Rudolf Peierls; Peierls' intellectual son, the atomic spy Klaus Fuchs; and the ghosts of the security services in Britain, the USA and USSR. Frank has found new insights from MI5 files in the National Archives and documents of the FBI and KGB about Fuchs' treachery. These reveal that in addition to telling the Soviet Union everything about the atomic bomb, Fuchs passed key information about the H bomb much earlier than previously realised. Frank has also discovered that Fuchs was not exposed by J Edgar Hoover's FBI, as has been believed for decades, but by the cryptographers at GCHQ. The talk is based on Frank's book Trinity, published by Penguin in paperback.

16 Nov Mapping immunity to SARS-CoV-2 and its variants in COVID-19 and Long Covid

Prof. Danny Altmann *Imperial College London*

Since the start of the pandemic we have studied cohorts across several countries to evaluate immunity at the level of antibodies, neutralisation and B and T cell memory to understand differential immune patterns due to vaccination and infection. At this stage in the pandemic, immune imprinting due to different exposures - different vaccines, timings and numbers of doses overlaid by different infection episodes with diverse variant sequences - means that people have diverse immune repertoires, with associated implications for immunity to new variants. In this context it has become considerably more challenging to define true correlates of protection. A pressing, related challenge is to define immune parameters associated with the diverse symptom profiles of Long Covid.

In collaboration with the Royal Society of Biology

30 Nov A Journey Towards Artificial Antibodies

Prof. Sub Reddy *University of Central Lancashire*

Antibodies are produced by the body and can play a crucial role in the natural immune response to harmful substances such as viruses, bacteria and chemicals. Antibodies are also being used widely in diagnostics and sensors to detect infection and disease. Who hasn't taken an antibody-based lateral flow test in the last 2 years?! Their application in diagnostics presents issues related to their ethical sourcing, cost of production, temperature and pH stability. Synthetic receptors such as molecularly imprinted polymers (MIPs) are being intensively researched as stable and low-cost alternatives to biological antibodies in diagnostic and medical imaging applications. They can be rapidly produced (in a matter of hours) and these smart materials offer the promise of replacing antibodies in diagnostics and therapeutics. In this Lecture, I will introduce synthetic receptors focusing on MIPs, how they are synthesised and are being used, and speculate on what the future holds for them.

14 Dec Our Amazing Sun

Prof. Eric Priest *University of St Andrews*

Our Sun is worthy of study due to its profound influence on the Earth and its fundamental importance for astronomy as the only star that we can see closely. And yet, many of its basic properties are still a mystery, including the ways in which its atmosphere is heated to over a million degrees and huge eruptions and solar flares are produced, which can have major effects at Earth. Many of the surprises that we have discovered are due to its magnetic field, which interacts in a subtle and complex way with its atmosphere. I plan in this lecture to introduce you to the basic properties of the Sun, to share with you the excitement of a solar eclipse and to reveal some of the major puzzles that we are hoping to solve in future.

19 Oct The Science of Laughter

Prof. Sophie Scott *University College London*

Laughter is a non-verbal emotional expression: although we associated laughter with amusement, laughter has its roots in mammalian play vocalizations, and is associated with social interactions. In this talk I will explore the evolution of laughter, the ways that it is used by humans and other mammals, and some of the complexities of how our brains process laughter. I will argue that laughter is used by adult humans in a highly nuanced way, and that scientists should be paying more attention to laughter.

2 Nov Gene, Mechanism, Treatment: The Paradigm of Tuberous Sclerosis

Prof. Julian Sampson *Cardiff University*

Understanding of the relationships between genomic variation and health and disease is incomplete, but improving fast. These relationships are at their simplest in rare inherited conditions, sometimes referred to as Mendelian or monogenic diseases. In this talk, I will use the example of one of these diseases - tuberous sclerosis - to illustrate how phases of molecular genetic, biochemical, preclinical and clinical research can lead to the successful acquisition and translation of new knowledge to deliver a novel treatment.

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18 Jan Self-Repairing Cities

Prof. Mark Miodownik - University College London

1 Feb Can we predict how pharmaceuticals will crystallize?

Prof. Sally Price - University College London

15 Feb Catalysis with Gold

Prof. Graham Hutchings - Cardiff University

Lord Phillips Memorial Lecture

1 Mar We are made of star stuff

Dame Jocelyn Bell Burnell - University of Oxford

15 Mar The Response to COVID

Sir John Bell - University of Oxford

29 Mar Gene editing: The future of dementia treatments?

Prof. Vincent Dion - Cardiff University

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18 Jan **Self-Repairing Cities**

Prof. Mark Miodownik *University College London*

As a result of our greater understanding of matter, the distinction between animate and inanimate matter is now becoming blurred, ushering in a new materials age. Bionic people with synthetic organs, bones and even brains are becoming a reality. Just as we are becoming more synthetic, so our man-made environment is changing to become more lifelike: buildings, objects, materials that heal-themselves are being developed. This talk reviews the science behind these new animate material technologies and considers whether a particular goal, that of creating self-repairing cities to make our civilization more robust to climate change, is achievable.

1 Feb **Can we predict how pharmaceuticals will crystallize?**

Prof. Sally Price *University College London*

Crystal Structure Prediction (CSP) methods assume that an organic molecule will crystallize in its most stable structure. Implementing CSP is a challenge to computational chemistry, as shown by the Cambridge Crystallographic Data Centre's blind tests. Polymorphism adds additional challenges, as this is usually a kinetic phenomenon, with metastable polymorphs being unable to transform to the most stable structure, which may be slow to crystallise for the first time. CSP is used as an aid to polymorph screening, particularly in the pharmaceutical industry. However, the crystal energy landscape, the set of crystal structures that are thermodynamically plausible as polymorphs, usually includes more crystal structures than known polymorphs. This can be due to the approximations in the calculations, but sometimes the prediction of a putative polymorph can allow the design of a specific experiment to find it. Many pharmaceuticals and chiral compounds challenge our understanding of crystallization.

15 Feb **Catalysis with Gold**

Prof. Graham Hutchings *Cardiff University*

Catalysis is of crucial importance for the manufacture of the materials and infrastructure and underpins the way of life we enjoy today. In this way catalysis contributes towards over 25% of global domestic product. Hence designing new catalysts is a topic of intense research and economic interest. For example, the identification that gold in nanoparticulate form is an exceptionally effective redox catalyst has paved the way for a new class of active catalysts. Gold is the most active catalyst for acetylene hydrochlorination, an important reaction in the manufacture of vinyl chloride which is the monomer for PVC production. Recent research on this will be described. In particular the innovations that were required to enable its commercialization will be described. Alloying gold with other metals can enhance the activity and these catalysts are effective for the direct synthesis of hydrogen peroxide which can be used for water disinfection.

Lord Phillips Memorial Lecture

1 Mar **We are made of star stuff**

Dame Jocelyn Bell Burnell *University of Oxford*

Where did the chemical elements that are found in our bodies come from? In this talk I will describe the creation of the chemical elements in the Big Bang that started our Universe, in stars, and in stellar explosions and collisions.

15 Mar **The response to Covid**

Sir John Bell *University of Oxford*

This talk will be delivered virtually.

29 Mar **Gene editing: The future of dementia treatments?**

Prof. Vincent Dion *Cardiff University*

Dementias remain a significant societal burden and their treatment remains a major unmet medical need. Many forms of dementia are genetic in nature, meaning that they are caused by changes in the inherited DNA sequence. Recent technologies, including CRISPR-Cas9, enable changing the DNA sequence inside brain cells. It is therefore becoming possible to restore the proper function of brain cells and thereby slowing, preventing, or perhaps even reversing disease symptoms and progression. This lecture will discuss the state of this revolution and present our own work on developing a gene editing approach to treat Huntington's disease.

ORGANISING COMMITTEE

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LECTURE DETAILS

The 2022-23 programme will resume as face-to-face lectures at a venue on campus at Cardiff University.

Venue details will be shared via email prior to the start of the programme, and will also be available on the CSS website.

One lecture will be delivered virtually using Zoom on 15th March 2023 - the link will be shared with registered members in the days before the lecture.

Lectures start at 7 PM

MEMBERSHIP

Annual membership for 2022/23 is £15 giving access to all twelve lectures. Membership is free for students and under 18s.

To become a Member, please sign up on the website or send a cheque made payable to Cardiff Scientific Society, with your name and address details to:

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