



## 2021

### 6 Oct **The Problem of finding Longitude, from the Phoenicians and the Vikings to the Board of Longitude and John Harrison**

**Dr John C. Taylor** *Inventor*

Dr Taylor became interested in finding his own longitude whilst trying to fly a small Aztec twin piston engine plane from Manchester to Tokyo in 1976. His route took him over the North Magnetic Pole so that for a long period even his magnetic compass was useless. He turned this interest to practical effect by studying all the examination grades of the Royal Yachting Association - Competent Crew, Day Skipper, YachtMaster and finally YachtMaster Ocean Instructor. Of course, all ocean navigation comes back to knowing Greenwich Mean Time wherever you are in the world. This then sparked Dr Taylor's interest in the development of clocks compensated for extremes of temperature from the Polar regions to the Tropics and capable of withstanding the violent motion of a ship in a storm. He has made some 30 transatlantic flights using the wonders of GPS which equally uses time to find position.

### 20 Oct **Is Life Quantum Mechanical? The emerging science of quantum biology**

**Prof. Jim Al-Khalili** *University of Surrey*

Physicists are used to dealing with quantum mechanics, but biologists have thus far got away without having to worry about this strange yet powerful theory of the subatomic world. However, times are changing. There is now solid evidence that enzymes use quantum tunnelling to accelerate chemical reactions, plants send quantum lumps of energy in many directions at once to calculate the most efficient route for sunlight to get to their photosynthetic cells. More intriguingly, it appears that some birds might use quantum entanglement - what Einstein called "spooky action at a distance" - to 'see' the earth's magnetic field for navigation. This lecture introduces the exciting new field of Quantum Biology. And if life does make use of quantum mechanics, how exciting and important is this field likely to become?

### 3 Nov **Biomimetic colour engineering from nature to applications**

**Prof. Silvia Vignolini** *University of Cambridge*

The most brilliant colours in nature are obtained by structuring transparent materials on the scale of the wavelength of visible light. By designing the dimensions of such nanostructures, it is possible to achieve extremely intense colourations over the entire visible spectrum without using pigments or colorants. Colour obtained through structure, namely structural colour, is widespread in the animal and plant kingdom. Such natural photonic nanostructures are generally synthesised in ambient conditions using a limited range of biopolymers. Given these limitations, an amazing range of optical structures exists: from very ordered photonic structures, to partially disordered, to completely random ones. In this talk, I will introduce some striking examples of natural photonic structures and share some insight on their development, and review our recent advances to fabricate bio-mimetic photonic structures using the same material as nature. Developing biomimetic structures with cellulose enables us to fabricate novel photonic materials using low-cost polymers in ambient conditions. Importantly, it also allows us to understand the biological processes at work during the growth of these structures in plants.

### 17 Nov **Everything from nothing: how our universe was made**

**Prof. Carlos Frenk** *Durham University*

Cosmology addresses some of the most fundamental questions in science. How and when did our universe begin? What is it made of? How did galaxies form? There has been enormous progress towards answering these questions. For example, recent observations have established that our universe contains an unexpected mix of components: ordinary atoms, exotic dark matter and a new form of energy called dark energy. Gigantic surveys of galaxies reveal how the universe is structured. Large supercomputer simulations recreate the evolution of the universe in astonishing detail and provide the means to relate processes occurring near the beginning with observations of the universe today. A coherent picture of cosmic evolution, going back to a tiny fraction of a second after the Big Bang, is beginning to emerge. However, fundamental issues, like the identity of the dark matter and the nature of the dark energy, remain unresolved.

*In collaboration with the Institute of Physics*

### 1 Dec **Listening to Shells: what can molluscs tell us?**

**Prof. Liz Harper** *University of Cambridge*

Shells are a familiar sight on any visit to the seaside or even the garden or allotment. Molluscs have been making shells for 540 million years and the sheer range and diversity of them (different sizes, shapes, colours etc) is truly amazing. But what can such familiar objects tell us? I will explore a range of tales from those concerning life and death in the fossil record, to the construction of superior materials we might learn from to considering the challenges they face in future acidifying oceans.

### 15 Dec **Kidney Transplantation in the 21st Century**

**Dr Sian Griffin** *University Hospital Wales, Cardiff*

The UK organ transplantation programme is a remarkable achievement. Thanks to the generosity of donors and their families, the lives of nearly 4,000 recipients are transformed each year. Every transplant requires the complex integration of logistics, laboratory science and clinicians, built on a strong legal and ethical framework. Despite progressive advances in immunology and therapeutics, significant challenges remain, in particular the management of patients who have become sensitised following previous blood transfusion, pregnancy or a prior transplant. My talk will review the current landscape of kidney transplantation in the UK, with a focus on immunological challenges and how these can be overcome.

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### 12 Jan **COVID-19: From the beginning to the end**

*Prof. Jonathan Ball - University of Nottingham*

Lord Phillips Lecture

### 26 Jan **Science as Revolution**

*Prof. Sir Paul Nurse - The Francis Crick Institute*

RSB Lecture

### 9 Feb **Folding a Protein: Nature's Origami**

*Prof. Sheena Radford - University of Leeds*

### 23 Feb **Sustainable Transport: What does it mean for me?**

*Prof. Carol Featherston – Cardiff University*

Presidential and Sir Martin Evans Lecture

### 9 Mar **Building models with high performance computing**

*Prof. Sir Richard Catlow – Cardiff University*

### 23 Mar **Elucidation of Cellular Oxygen Sensing Mechanisms**

*Prof. Sir Peter Ratcliffe – University of Oxford*

2022

12 Jan **COVID-19: From the beginning to the end**

**Prof. Jonathan Ball** *University of Nottingham*

During this session we will explore the history of virus spillover events and the environmental, economic and social factors that influence them. We will then look at the emergence of coronavirus as human pathogens, with particular focus on SARS and SARS2, and why the latter resulted in one of the largest pandemics in recent history. Finally, we will cover disease manifestation and the rapid deployment of treatments and vaccines to control the likelihood and severity of future outbreaks.

**Lord Phillips Memorial Lecture**

26 Jan **Science as Revolution**

**Prof. Sir Paul Nurse** *The Francis Crick Institute*

Science has brought about revolutionary changes in our understanding of ourselves and the natural world, which have acted as major drivers of our culture and civilisation. This scientific knowledge has in turn brought about revolutions in the ways that we live and in the technologies that support society. A case can be made that science is the most revolutionary activity of human-kind.

9 Feb **Folding a Protein: Nature's Origami**

**Prof. Sheena Radford** *University of Leeds*

Proteins are amazing three-dimensional machines that carry out life's essential processes. Modern methods in structural biology are enabling us to see these structures at work in ever-increasing molecular detail. Yet the most fundamental process of all, how proteins fold and assemble into these complex machines, remains a mystery. Understanding the rules of protein folding would not only enable new protein structures with new functions to be made, but would also enable us to understand how, and why, errors of protein folding give rise to disease, and why these errors become more common as we age. Given the enormous burden of diseases associated with protein misfolding, typified by Alzheimer's and Parkinson's diseases and type II diabetes, cracking the folding code has never been more important. Fortunately, progress is being made at a rapid pace, kindling hopes that therapies to combat protein folding diseases will soon be within our grasp.

*In collaboration with the Royal Society of Biology*

23 Feb **Sustainable Transport: What does it mean for me?**

**Prof. Carol Featherston** *Cardiff University*

Transport systems are essential to our communities, connecting people and businesses in their everyday activities. However, as we have all become more mobile, the carbon footprint of our transport activities has grown. Transport currently accounts for a quarter of greenhouse gas emissions in Europe and this figure continues to rise as demand grows. The Paris agreement aims to substantially reduce global greenhouse gas emissions in an effort to limit the global temperature increase in this century to 2 degrees Celsius above preindustrial levels, while pursuing the means to limit the increase to 1.5 degrees. An essential part of achieving this requires us to move to a more sustainable transport system putting users first and providing them with more affordable, accessible, healthier and cleaner alternatives. In this talk we will explore what this means to us as users and the ways in which we can contribute to decarbonising the transport system.

**Presidential and Sir Martin Evans Lecture**

9 Mar **Building models with high performance computing**

**Prof. Sir Richard Catlow** *Cardiff University*

Model building is one of the oldest human and scientific activities. Scientists have always built and used models to help us understand our world and our universe. Models can help us comprehend things that are unimaginably large, such as galaxies and unimaginably small such as atoms and molecules; and models can help us make predictions and test out theories. Over the last few decades, the growth of high performance computing has resulted in an exceptionally powerful range of model building tools and computer modelling is now used in almost all scientific disciplines. The lecture will highlight some of the key application areas, including cosmological modelling, simulating the formation of galaxies and stars; global modelling including climate and ocean circulation; modelling in Engineering and in Medicine; and modelling at the atomic and molecular scale including some of the work of the lecturer's team on modelling of materials and catalysts. The lecture will conclude by looking forward to the future of this exciting and rapidly developing field.

23 Mar **Elucidation of Cellular Oxygen Sensing Mechanisms**

**Prof. Sir Peter Ratcliffe** *University of Oxford*

TBC

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**LECTURE DETAILS**

The 2021-22 programme will be delivered virtually via Zoom. It is free to download on most PCs, laptops, tablets and smartphones. The features of the platform will allow for the audience to ask the speaker questions in a similar fashion to a traditional lecture, and we will also be able to record the session allowing members to catch-up if they are unable to watch live.

The joining details to access the session will be provided in the week prior to the lecture to only those members that have registered.

**MEMBERSHIP**

**Annual membership for 2021/22 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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