



2023

4 Oct Genes, Brains and Psychiatry

Prof. Sir Michael Owen *Cardiff University*

Severe psychiatric conditions, such as schizophrenia and bipolar disorder, impose huge burdens on individuals, their families and society. To address this, we need new and more effective treatments that can be targeted more precisely at those who are likely to benefit. Genetics offers a way of identifying new treatment approaches through greater understanding of underlying mechanisms as well as the potential to target treatments more precisely. Cardiff University researchers have made important advances in understanding the genetics of psychiatric conditions and are now beginning to use genetic findings and advances in neuroscience to understand the underlying brain mechanisms, develop new diagnostic approaches and discover new drug treatments.

Presidential Lecture

18 Oct Wonderful Things about Bees

Prof. Robert Pickard *Cardiff University*

Honeybees have lived in societies for some 30 million years. The pollination contracts that they hold with particular plants are much older. Human beings are some 7 million years old. We exist as herding animals aspiring to become social. We can learn a great deal from bees though we would probably not want to emulate all their achievements. Social animals regulate the size and structure of their population according to their resources. Worker bees are engineered to die when they are still fully functional which, consequently, avoids the social burden of ill health that we associate with old age. When bees are starving, they share any remaining food and die together. Only honeybees and humans can communicate navigational instructions to others of their species. The honeybee brain is a wonderful model for the study of multimodal neurons that are so important in our own decision-making processes. Bees' ability to modulate genetic expression with food molecules is legendary. Bees challenge us to reassess our concepts of individual responsibility, emotion, empathy, intelligence and mind.

1 Nov Machine Learning and Data Science

Prof. Chris Budd *University of Bath*

Data-based machine learning is one of the fastest-growing areas of modern technology, having a transformative impact on various aspects of our lives, including medicine, weather forecasting, finance, and justice. However, this explosive growth has raised concerns about the lack of understanding and trust in the way machines make decisions. Would you trust an algorithm to make a medical diagnosis or design an aircraft based solely on past data without any scientific support? In this talk I will explain (with practical examples) how machine learning works, and I will consider the power and limitations of machine learning based algorithms. Together we will consider their best use for the future of humanity.

15 Nov Clinical Trials for a changing world: Building on the success of RECOVERY

Prof. Sir Martin Landray *University of Oxford*

When COVID-19 first struck, there were no known treatments for this novel disease. Many drugs were proposed and several were widely promoted on the basis of little or no good evidence. Responding to the challenge, Martin Landray, Peter Horby and their colleagues established the world's largest and most successful trial of potential COVID treatments. The first patients were enrolled within 9 days of writing the protocol and within 100 days over 12,000 patients had taken part and the first results were available – first showing that hydroxychloroquine was ineffective and then that dexamethasone, a cheap steroid drug, reduced the risk of death for the sickest patients. But COVID-19 is just one example of a serious common disease for which better approaches are needed for prevention and treatment. Prof. Landray will reflect on the experience of leading the RECOVERY trial, consider the lessons to be learned, and describe the approach that he and others are now taking at Protas, a new not-for-profit organisation that he has established to deliver Smarter Trials for Better Public Health.

29 Nov Using nature-based solutions to tackle the climate change and biodiversity

Prof. Peter Smith *University of Aberdeen*

VIRTUAL LECTURE - members will be sent a Zoom link, do not turn up to the lecture theatre.

We are facing the twin crises of climate change and biodiversity loss. Land management emits greenhouse gases, which contributes to climate change, but certain land uses can suck carbon dioxide out of the atmosphere and lock it away. However, not all of these land based climate change options are also good for biodiversity. This talk will be about how we make sure that changes to land use and land management help tackle the twin crises, and to meet our international commitments on climate change and biodiversity.

13 Dec The Birth of a Galaxy

Prof. Stephen Eales *Cardiff University*

This lecture will describe our current understanding of how galaxies are formed and how they have evolved over the last 12 billion years. I will show observations with the James Webb Space Telescope and the Atacama Large Millimeter Array of galaxies that we are seeing during the first billion years after the big bang, which are effectively snapshots of the births of galaxies. On the theoretical side, I will show that computer simulations of the universe produce artificial galaxies that look like galaxies we see around us today, although I will argue that these simulations are not as successful as they first seem. I will finish my talk by describing the Euclid space mission (if the launch is successful) and what it is likely to tell us about the formation and evolution of galaxies.

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10 Jan Imaging, Artificial Intelligence and Robotics: The 3 weapons for the future of Surgery

Prof. Jacques Marescaux - University Hospital Strasbourg

24 Jan The Human Cell Atlas: from Cell Types to Tissues

Dr Kerstin Meyer - Wellcome Sanger Institute

Lord Phillips Memorial Lecture

7 Feb Modifying Tumour Blood Vessels to Improve Immunotherapy

Prof. Awen Gallimore - Cardiff University

21 Feb Fractals: Shape, Size and Form

Prof. Kenneth Falconer – University of St Andrews

6 Mar Battle in the seven seas: A microbe's perspective

Dr Aditee Mitra – Cardiff University

20 Mar Harnessing the power of the world's most powerful lasers

Prof. Andrew Harrison – ELI-Laser

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10 Jan Imaging, Artificial Intelligence and Robotics: The 3 weapons for the future of Surgery

Prof. Jacques Marescaux *University Hospital Strasbourg*

Technological progress applied to minimally invasive surgery will inevitably lead to the concept of automated surgery, mimicking the evolution of aeronautics and more recently the automotive industry. Three joint developments corroborate this vision: virtual 3D imaging, robotics, and artificial intelligence. The surgical revolution is underway – surgical science and science fiction are coming together.

24 Jan The Human Cell Atlas: from Cell Types to Tissues

Dr Kerstin Meyer *Wellcome Sanger Institute*

The human body is made up of approximately 37 trillion cells, which belong to various types and form our organs. The Human Cell Atlas is an international group aiming to identify and understand all these cell types, their functioning in health, and their abnormalities in diseases. With the help of single cell biology, particularly single cell RNA sequencing, we can now study millions of cells simultaneously and use computational tools like machine learning to analyze the data we gather. By combining this extensive knowledge with spatial information, our goal is to create a comprehensive "Google Map" of the human body. I will describe our work in identifying new cell types and states, as well as uncovering tissue structures that support organ function. In the future, we hope to utilise this knowledge to engineer "designer cells" and develop new approaches to treat disease.

Lord Phillips Memorial Lecture

7 Feb Modifying Tumour Blood Vessels to Improve Immunotherapy

Prof. Awen Gallimore *Cardiff University*

Cancer immunotherapy is viewed as one of the most significant scientific breakthroughs of recent years. This is due in part to therapies which seek to rejuvenate immune cells, most notably T cells, which once activated can recognize and kill cancer cells. Indeed, targeting T cells can drive destruction of previously incurable cancers. However, despite massive benefits to some patients, most people do not exhibit objective responses. One key reason for the limited success may be the failure of activated T cells to effectively get inside solid tumours where they are needed to wreak their destructive effects. We have found ways of creating in-roads for T cells by making alterations to the blood vessels inside tumours and our findings show that the presence of these altered blood vessels profoundly enhances the ability of T cells to eliminate cancer cells. These findings have led to new ideas for therapeutic approaches, combining immunotherapy with regimes designed to alter tumour vasculature.

21 Feb Fractals: Shape, Size and Form

Prof. Kenneth Falconer *University of St Andrews*

Fractals are geometrical objects that have detail at arbitrarily small scales: zooming in on them reveals an ever more irregular structure, in contrast to classical geometrical shapes such as squares or ellipses. Fractals may appear intricate and complex, but on the other hand they can often be constructed or described in a very simple manner, perhaps by repeating a basic operation many times. The branch of mathematics now known as 'fractal geometry' has developed as a framework in which fractals can be represented, measured, and their geometrical properties examined. This illustrated talk will present a wide variety of fractals which are often visually attractive, consider some of their properties, and show how their form and irregularity may be described using simple mathematical or geometrical ideas. We will also see examples of how fractals can model phenomena that arise in science, social science or nature.

6 Mar Battle in the seven seas: A microbe's perspective

Dr Aditee Mitra *Cardiff University*

For over a century, our understanding of marine ecology has been dominated by a plant-animal dichotomy similar to that on land. Thus, single-celled marine microalgae are considered to be plant-like producers, which are consumed by microscopic animals supporting larger animals on up to fish and whales. Marine research, management and monitoring are all based on this interpretation. However, over the last decade, we have found that this plant-animal interpretation is not correct. Microalgae are not plants; many also eat bacteria or other microalgae. To feed they variously smother or entrap their prey in snot, harpoon them, poison, explode, dissolve, or envelope them; some microalgae even insert drinking straws to suck out the contents of their prey. Various microalgae cannot even photosynthesise alone but must steal body parts or enslave other microalgae in order to acquire 'factories' for carbon fixation. This talk, with videos, will showcase the fascinating methods that microalgae exploit to fight for survival and proliferate across the sunlit oceans.

20 Mar Harnessing the power of the world's most powerful lasers

Prof. Andrew Harrison *ELI-Laser*

The Extreme Light Infrastructure (ELI) facility is a new institute established in Central Europe, distributed over three sites in Czech Republic, Hungary and Romania, with the objective of providing the scientific community in Europe as a whole with access to the highest-performance lasers in the world. These offer some of the highest-peak intensity light pulses ever produced, which can be used to generate and study matter under extreme conditions, for example plasmas and, ultimately perhaps matter and antimatter from a vacuum. Such plasmas have the potential to provide clean energy through nuclear fusion and are already offering new means of creating high-energy particle beams, which in turn offer new diagnostics and therapies for cancer or methods of imaging materials. The facility also provides probes of extremely fast processes, at the scale of motion of electrons during chemical and electronic processes, giving new insights into catalysis and biological processes at the most fundamental level.

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LECTURE DETAILS

The 2023-24 programme will take place in the Main Building on Cardiff University campus. If arriving by car, parking is available on Park Place and Musuem Avenue (Cardiff Council Pay and Display). If arriving by train, Cathays train station is opposite Main Building.

One lecture will be delivered virtually using Zoom on 29th November 2023 - the link will be shared with registered members in the days before the lecture.

Lectures start at 7 PM

MEMBERSHIP

Annual membership for 2023/24 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:

Cardiff Scientific Society, 18 Hollybush Road,
Cyncoed, Cardiff, CF23 6TA
email: members@cardiffscientificsociety.org

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