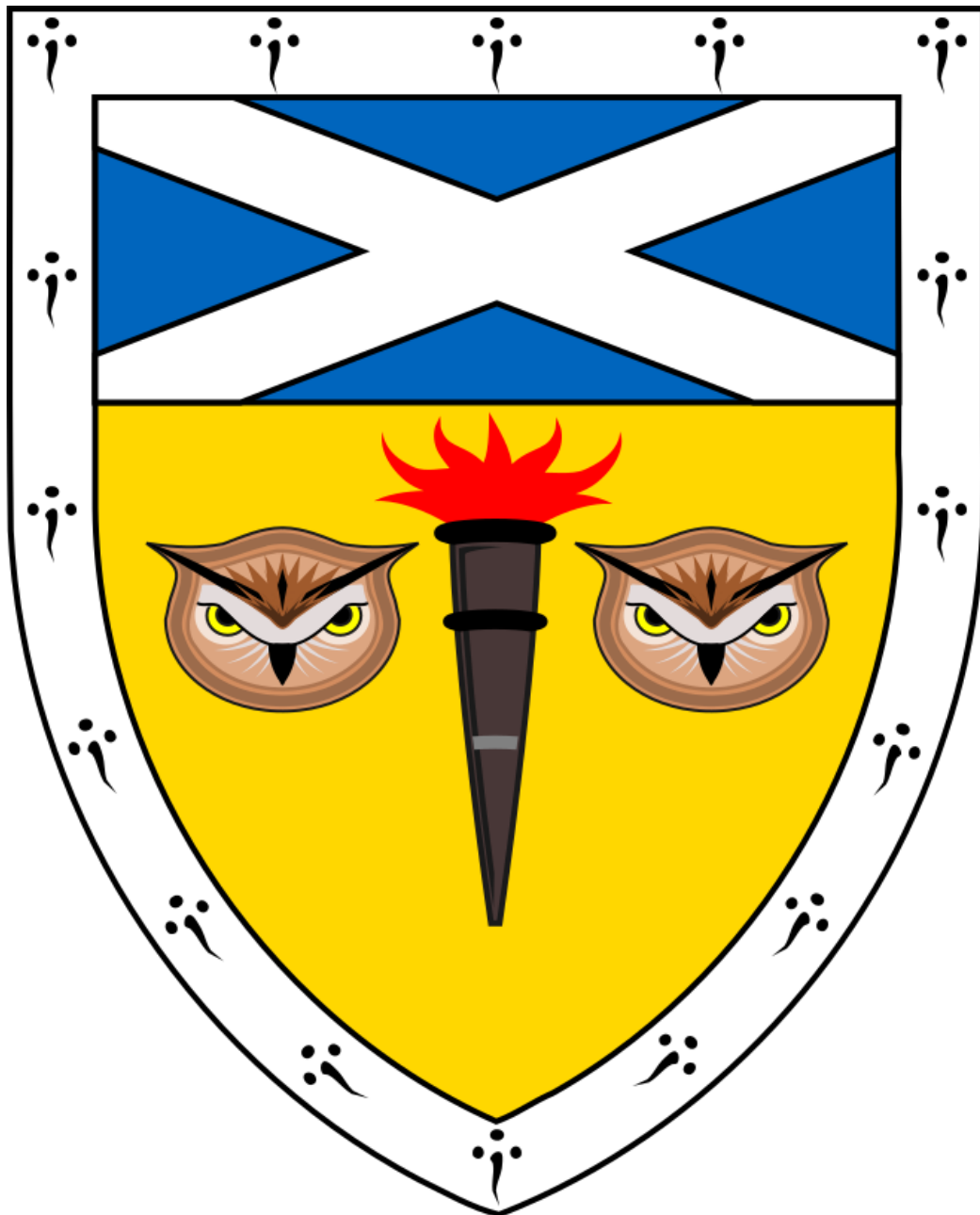


# The Royal Scottish Society of Arts

Showcasing Scotland's Science, Technology and Innovation  
203rd Session

2023-2024



Established 1821 - Incorporated by Royal Charter 1841  
Registered Scottish Charity SC015549

# The Royal Scottish Society of Arts

## Showcasing Scotland's Science, Technology and Innovation

The Royal Scottish Society of Arts was founded in 1821 as 'The Society for the Encouragement of the Useful Arts in Scotland' and incorporated by Royal Charter in 1841. It was concerned with the fields that we would now describe as science, technology, engineering and manufacture, but which were then known as the useful arts, as opposed to the fine arts.

Today the Society aims to showcase Scotland's Science, Technology and Innovation, mainly through a monthly lecture programme, excursions, promotion of Honorary Fellows, and the award of medals.

The lecture programme is given by excellent public speakers, who are distinguished in their fields of study, and the topics cover a wide range of scientific and technical issues, all pertinent to the Scotland in which we live today.

Fellowship of the Society is open to all with an interest in science and its place in society who would like to attend our meetings. Fellows of the Society are entitled to use the letters FRSSA after their names. Applications for Fellowship must be supported by at least one Fellow of the Society to whom the applicant is personally known.

More information about applying for Fellowship is available at our meetings. Please introduce yourself to the President, Secretary or one of the members of the Society's Council at a meeting for further details.

Professor Beverly Bergman  
president@rssa.org.uk

Mr Peter Jones  
secretary@rssa.org.uk  
23 Queen's Crescent  
Edinburgh EH9 2BB

Mr Graham Rule  
treasurer@rssa.org.uk

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**Unless otherwise announced, meetings are at 7pm at the Augustine United Church, 41 George IV Bridge, Edinburgh, EH1 1EL.**

**Meetings will be simultaneously available by Zoom. Fellows on our email list will be sent details about a week before each meeting. Anyone else should email [zoom@rssa.org.uk](mailto:zoom@rssa.org.uk) if they want to attend online.**

**Please check our website for any last minute changes or updates.**

**[www.rssa.org.uk](http://www.rssa.org.uk)**

# Fusion Power: a practical energy source

**Professor Declan Diver**

**Professor of Plasma Physics**

**School of Physics & Astronomy**

**University of Glasgow**

**In the Augustine United Church**

**41 George IV Bridge**

**Edinburgh, EH1 1EL**

**On Monday 25th September 2023, at 7pm**

Recent advances in magnetic fusion research have resulted in STEP – the Spherical Tokamak for Energy Production – which will be built in the UK: the first fusion power station in the world. STEP is a unique machine, the result of a sustained UK fusion research effort, and will be delivering power by 2040. Fusion offers a consistent and reliable source of low-carbon energy that will help address the scale of the energy challenge globally: reducing fossil fuels whilst meeting the demand for significant increases in electrical power as transport, domestic heating and heavy industry transition from fossil fuels. We will explore the technology of STEP, and the prospects for the future.

*My main research theme is the role of self-consistent electric and magnetic fields in the dynamics of charged particles and neutrals for complex gaseous systems (plasmas) in mixed-phase flows (ie in the presence of dust or liquid interfaces), with recent significant emphasis on the physics of life applications of plasmas having direct and indirect interaction with living cells. I also have a continuing interest in high-energy plasmas, including fusion, relativistic pair plasmas and pulsars. I was the consortium lead for Fusion Forward Ardeer, seeking to bring the world's first fusion power station - STEP - to the Ayrshire Coast.*



**More about Professor Declan Diver from  
<https://www.gla.ac.uk/schools/physics/staff/declandiver/>**

# Remote laboratories: Tolkienian adventures in digital education

**Professor Timothy D. Drysdale SFHEA**

**Chair of Technology Enhanced Science Education  
School of Engineering  
University of Edinburgh**

**In the Augustine United Church  
41 George IV Bridge  
Edinburgh, EH1 1EL**

**On Monday 30th October 2023, at 7pm**

Tolkien's *The Hobbit* was inspired by the landscape of my heritage (Scotland) and filmed in the land of my birth (New Zealand). It's possibly even an apt metaphor for my academic journey from the familiar shire to the distant lands that I now call home, with some unexpected adventures along the way. No good story is worth telling without dragons, so there'll be tales of risk, live (remote) experiments, and maybe even some dragon sightings (no guarantees, it's an adventure after all). Along the way, I'll explain how my work evolved from insect-inspired technologies for body scanning, to digital education innovations, and remote laboratories in particular. These open up some fantastic opportunities for the future of education, as well as addressing emerging human rights concerns around open access to digital education.



*Professor Timothy Drysdale is the Chair of Technology Enhanced Science Education and Director of Strategic Digital Education in the School of Engineering at the University of Edinburgh. He leads the Practable.io remote laboratories, winners of the 2023 international award for Digital Transformation, from the Association for Learning Technology & Jisc. From 2015-2018, he was a Senior Lecturer in Engineering at the Open University, where he was the founding director and lead developer of the £3M openEngineering Laboratory which was recognised by awards including the Times Higher Education Outstanding Digital Innovation 2017, The Guardian Teaching Excellence 2018, Global Online Labs Consortium Remote Experiment Award 2018, and National Instruments Global Engineering Impact Award for Education 2018. His public engagement work has seen him exhibit at the British Science Festival, the Royal Society, and Buckingham Palace.*

# The past, present and possible future of bird flu

**Professor Paul Digard**

**Chair of Virology and Deputy  
Director**

**Roslin Institute**

**University of Edinburgh**

**In the Augustine United Church  
41 George IV Bridge  
Edinburgh, EH1 1EL**

**On Monday 27th November 2023, at 7pm**



The oldest living humans on the planet have lived through seven viral pandemics; of which, six have been caused by influenza A virus, all descended at greater or lesser remove from avian influenza, or "bird flu". Currently, much of the world is afflicted by the largest known epizootic outbreak of H5N1 bird flu. Spread across at least 5 continents, the virus is killing large numbers of wild birds, domestic poultry and spilling over into wild and domesticated mammals, often fatally. Thankfully, it currently is not infecting humans in any appreciable numbers but nevertheless, presents a serious threat for causing another pandemic. This talk will attempt to explain the evolution and ecology of bird flu and thus why it poses such a threat to human and animal health, as well as assessing the current situation and describing interventions and possible outcomes.

*Paul Digard is a career virologist, trained at Cambridge and Harvard Universities before setting up his own research group in Cambridge in the 1990s and then moving to Edinburgh in 2012. He has studied a variety of viruses, but specialises in influenza, where his research into molecular aspects of the virus has led to rewritten text books, patents on antivirals and vaccine technology and advice to the NHS and government bodies. The aspect of his career that he is proudest of though, is the training of a substantial body of future scientists – over 50 PhD students and a sizable cohort of the next generation of independent researchers.*

**Professor Paul Digard's website:  
<https://www.ed.ac.uk/profile/paul-digard>**



# A series of fortuitous events: Capture of carbon dioxide by milling of silicate minerals

**Professor Zoe Shipton OBE FRSE**

**Professor of Geological  
Engineering  
University of Strathclyde**

**In the Augustine United Church  
41 George IV Bridge  
Edinburgh, EH1 1EL**

**On Monday 29th January 2024, at 7pm**



Milling minerals rich in magnesium and iron within CO<sub>2</sub> gas has been proposed to capture carbon as metal-carbonates. Through a series of fortuitous events, we discovered that not only are rocks much better than trapping CO<sub>2</sub> than individual minerals, but that this process can occur on all common silicate minerals. Polymineralic rocks are crushed worldwide to produce construction aggregate. If crushing processes could be conducted within a stream of effluent CO<sub>2</sub> gas (such as produced from cement manufacture) our findings suggest that for every 100 Mt of hard rock aggregate sold, 0.4-0.5 MtCO<sub>2</sub> could be captured as a by-product.

*Professor Zoe Shipton is a geologist who researches the structural and permeability architecture of fault zones, geological processes of earthquake rupture propagation and constraining uncertainty in geological models.*

*Zoe is Professor of Geological Engineering at the University of Strathclyde, where she collaborates with scientists, engineers and social scientists to deliver subsurface solutions for the energy transition.*

*Stillings M., Shipton Z. K., Lunn R. J.. 2023.*

***Mechanochemical processing of silicate rocks to trap CO<sub>2</sub>.***

*Nature Sustainability, 10.1038/s41893-023-01083-y <https://rdcu.be/c7vQK>*

# Avoiding Killer Asteroids

**Professor Colin Snodgrass FRAS**

**Professor of Planetary Astronomy**

**The University of Edinburgh**

**In the Augustine United Church**

**41 George IV Bridge**

**Edinburgh, EH1 1EL**

**On Monday 26th February 2024, at 7pm**



I will describe the NASA DART mission, which successfully performed the first test of the technology to deflect an asteroid from its trajectory in September 2022. This was a 'planetary defence' mission rather than a science one, designed to practice (on a harmless asteroid) what we would do if we discovered an asteroid on a collision course with the Earth. The University of Edinburgh team supported the mission with observations of the asteroid before and after the impact, from telescopes in Chile and in Kenya, where we established a new observatory for this purpose.

*Colin Snodgrass joined the University of Edinburgh as a Chancellor's Fellow in 2018, having previously worked at The Open University, the Max Planck Institute for Solar System Research in Germany, and the European Southern Observatory in Chile. His PhD studies were at Queen's University Belfast. He is involved with a number of space missions, including the ESA Rosetta, Hera and Comet Interceptor missions, but his background is in observational astronomy, and in particular studying comets and asteroids with large optical telescopes.*

**More about the DART mission <http://dart.jhuapl.edu/>**

# Inside the brain of a bee

**Professor Barbara Webb FRSE**

**School of Informatics  
University of Edinburgh**

**In the Augustine United Church  
41 George IV Bridge  
Edinburgh, EH1 1EL**

**On Monday 25th March 2024, at 7pm**

Bees and other insects are able to perform impressive feats of navigation. They can track their location relative to their nest during long foraging excursions and take the bee-line home. They also remember the location of food and can

communicate this to their nest-mates by dancing on the honeycomb. Although these behaviours have been studied for many years, we have only recently discovered the brain circuits involved. It appears the insect brain has evolved to perform the trigonometric functions needed for navigation. This lecture will explain what we now know about how it works.



*Barbara Webb obtained her B.Sc. (in Psychology) from the University of Sydney in 1988 and her Ph.D. (in Artificial Intelligence) from the University of Edinburgh in 1993. Following lecturer positions in Nottingham and Stirling, she joined the School of Informatics at the University of Edinburgh in May 2003. Her main research interest is in biological perceptual systems for the control of behaviour, which she studies by building computational and physical (robot) models of the hypothesised mechanisms. In particular, she focuses on insect behaviours, as their smaller nervous systems may be easier to understand. She was elected a fellow of the Royal Society of Edinburgh in 2022.*

**More about Professor Barbara Webb from  
<https://blogs.ed.ac.uk/insectrobotics/>**



# The Effect of Nanoparticles on Workers and Health

**Dr Rodger Duffin BSc PhD MRCPATH FRSB**  
**Reader in Respiratory Medicine**  
**Centre for Inflammation Research**  
**The University of Edinburgh**



**In the Augustine United Church**  
**41 George IV Bridge**  
**Edinburgh, EH1 1EL**

**On Monday 29th April 2024, at 7pm**

When compared to chemicals, exposure to particulates, unless at extreme levels, can be hard to recognise yet are well known in the toxicology field to harm your health. For good reason, a great deal of attention is given to understanding how air pollution can effect ones health however workplace exposures have historically and continue today to have a huge impact on health. In Scotland, there is a long history of exposure and subsequently, disease associated with these exposures such as coal dust, asbestos and silica (mainly from stone dust). Whilst coal mining and in particular asbestos use has seen a massive decline, there has been increases in new (nano) materials which may pose similar risks. Work in my lab is focused on the mechanisms controlling inflammatory processes from their initiation to resolution and also understanding the potential toxicology surrounding environmental and occupational nanoparticle exposures. The rise of the nanotechnologies and the production of novel nanoparticles has raised concern that new hazards are being produced which need to be better understood in toxicological terms. A better understanding of the hazard of any particle and determination of the true biologically effective dose offers the prospect of an improved metric for risk management and the prospect of rational intervention in disease progression following exposure.

*Dr Duffin is a Reader in Respiratory Medicine and Head of the Particle and Fibre Research Laboratory within the Centre for Inflammation Research at the University of Edinburgh. His research interests are focused on the mechanisms controlling the processes of inflammation, from initiation to resolution and also understanding the potential toxicology surrounding environmental and occupational (nano)particle exposures. He trained in Edinburgh with Professor Ken Donaldson as a Colt Foundation PhD student. He undertook a 3 year post-doctoral training position in Dusseldorf where he then returned to Edinburgh in 2005. He is currently one of the Scientific Advisors to the Colt Foundation Trustees.*

**[https://www.ed.ac.uk/inflammation-research/people/  
principal-investigators/dr-rodger-duffin](https://www.ed.ac.uk/inflammation-research/people/principal-investigators/dr-rodger-duffin)**

## Annual General Meeting

**The Society's AGM will be held in the Augustine United Church  
41 George IV Bridge  
Edinburgh, EH1 1EL  
On Monday 3rd June 2024, at 7pm**

The President, Professor Beverly Bergman, will be in the Chair.

Agenda will be circulated before the meeting.

Following the Annual General Meeting, there will be a short talk to the society. Details will be published later.

The evening will conclude with a reception with a light buffet, wine and soft drinks to which all Fellows and their guests are warmly invited.

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## Honorary Fellows

The Society's Rules allow for the election of up to 10 people "*Distinguished in the Science of the Applied Arts*" as Honorary Fellows. Current Honorary Fellows are:

Professor Dame Anne Glover DBE FRS FRSE FASM

Professor Catherine Heymans MPhys DPhil FRSE, Astronomer Royal for Scotland

Professor Peter Higgs CH BSc MSc PhD FInstP FRSE FRS, Nobel Laureate

Professor Sir James Hough OBE FRS FRSE FInstP FRAS

Professor Malcolm Longair CBE FRS FRSE

Professor Stephen Salter MBE FRSE



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**2023-2024**

## **President**

Professor Beverly Bergman MB ChB PhD FFPH FCMI FSAScot  
president@rssa.org.uk

## **Vice-Presidents**

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Dr Carol Marsh OBE CEng FIET

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Miss Sophie Goggins BSc  
Dr Patrick Hickey BSc PhD  
Professor Stuart Monro OBE DUniv FRSE FGS  
Professor Ian Robson BSc PhD FRAS FInstP CPhys

## **Secretary**

Mr Peter Jones BPharm MSc FRPharmS  
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## **Treasurer**

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## **Programme Secretary**

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## **Excursion Organiser**

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## **Archivist**

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Mr Graham Rule