Scottish Affairs Committee

Science and Scotland showcase

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Science and Scotland Inquiry

On 14 June 2023 the Scottish Affairs Committee launched the Science and Scotland inquiry. This inquiry is looking at the international influence of Scottish Science, and research and development as well as how effectively UK Government money is spent on research and development within the scientific community.

As part of this inquiry, the Committee held a 'showcase' event in Edinburgh in early December 2023. During the event, some of Scotland's leading scientists told the Committee about the ground-breaking research projects they and their organisations were doing in three key areas – biomedical, environment and physics. This booklet summarises each of the projects.

Biomedical panel

Professor Charlie Gourley

Clinical Director, Cancer Research UK

Cancer Research UK Scotland Centre

Established in 2022, the Cancer Research UK Scotland Centre brings together the best in cancer research from Edinburgh and Glasgow with the unifying mission to translate cutting-edge laboratory discoveries into new treatment opportunities for Scottish cancer patients.

Our research focuses on 6 tumour-specific research themes, based on cancer types that profoundly affect the Scottish population (colorectal, hepatobiliary, pancreas, mesothelioma) and areas in which we have significant, growing expertise (brain, gynaecological).

Recent highlights include: discovery of the factors that drive early metastasis of colorectal cancer; leading the first every positive randomised clinical trial in a rare form of ovarian cancer; moving the new cancer drug NXP900 (invented in Edinburgh and out-licensed for $327M) to phase I clinical trials; and translating the discovery of a new drug combination against liver cancer from pre-clinical models into clinical trials in Scottish patients.

The CRUK Scotland Centre creates the optimal environment for cancer researchers and Scottish cancer patients.

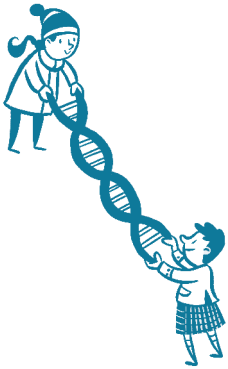
Professor Richard Hartley

Professor of Chemical Biology,
University of Glasgow,
Royal Society of Chemistry

The 3Ms: Molecules, Mitochondria and Medicines

The cells of our body have specialised compartments that do particular jobs. Mitochondria are the compartments that control the power supply. They convert the chemical energy in food into the adenosine triphosphate (ATP) that drives the biological machinery. They also communicate closely with the rest of the cell. This signalling involves small metabolites and reactive oxygen species (ROS). Sometimes mitochondria don't function properly.

There is incorrect signalling or direct damage from ROS. This can cause heart failure, sustain inflammation, harm the brain and drive ageing. Medics do not yet understand mitochondrial signalling and how to control it. Our chemistry is coming to the rescue. We design and synthesise molecules to report and control mitochondrial signalling. They are targeted to mitochondria. They report and control hydrogen peroxide, superoxide and hydrogen sulfide levels, or replace vital signals. Our most promising molecules limit damage to the heart or switch off inflammation.



Professor Heather Whalley

Generation Scotland's Chief Scientist, CLOSER, the home of longitudinal research (UCL Social Research Institute)

Generation Scotland – Scotland's largest family-based cohort study

Generation Scotland (GS) was established in 2006 for longitudinal research into physical and mental health and comprises biological, social and clinical data from 25,000 volunteers across Scotland. These data include precious measures of proteins and other molecules found in blood (that are some of the largest samples in the world) that could lead to earlier prediction and treatment of a number of common causes of death and disability.

GS has led to major discoveries in conditions such as cardiovascular disease, covid-19 and depression and led to a better understand of countless others. GS has published more than 350 peer-reviewed scientific articles in highly respected journals, enabled by Scotland's ability to link consented individuals to their electronic health records. GS has also engaged widely with the public, NHS and the Scottish Government on health research policy, including consultations on the use of neonatal blood spots in research.

In future, we will develop GS resources to include measures of education, employment and deprivation, enabling world-leading investigations into the wider social determinants of health and well-being. We are currently expanding the existing cohort by a further 20,000 additional volunteers between the ages of 12 and 100. This will allow us to address the growing concerns around adolescent mental health and wellbeing and allow us to address future health problems as they arise.

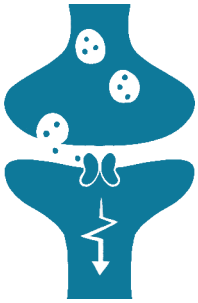
Dr Charlotte Green

Business Development Manager,
Drug Discovery Unit, University of Dundee

Effective Drug Discovery in a global pandemic

When the pandemic hit the University of Dundee's Division of Signal Transcription Therapy reacted quickly; expressing key proteins from the SARS-COV2 virus. This opened the door for drug discovery and our Drug Discovery Unit (DDU) were able to apply their expert knowledge of the human methyltransferase family of enzymes to a equivalent covid protein, nsp14. The DDU team were able to start screening chemical libraries within a month of receiving the nsp14 protein, very fast in terms of drug discovery.

The initial screening assay was published and the programme moved into its own dedicated multi-disciplinary, drug discovery programme funded by Bill and Melinda Gates Foundation, now a lead project within CARE (Corona Accelerated R&D in Europe) consortium. The focus of the drug discovery programme now is on developing drugs for future pandemic preparedness and development to deliver safe in human compounds ready for patient testing if another pandemic occurs.



Professor Tara Spires-Jones

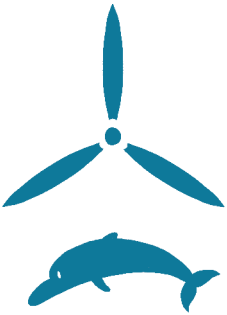
President, British Neuroscience Association

Understanding and targeting the brain changes that cause dementias

Prof Tara Spires-Jones and her group at the UK Dementia Research Institute at the University of Edinburgh are working to understand and prevent the changes in synaptic connections in the brain that contribute to cognitive decline in Alzheimer's disease and other dementias. During the progression of Alzheimer's, synapses are lost and this is strongly linked to reduced memory and thinking abilities. The group has recently discovered that pathological clumps of the protein tau – which accumulates in pathology called tangles – spread through the brains of people with Alzheimer's disease by jumping through synapses. Wherever tangles appear in the brain, synapse and neuron death follows, contributing to the decline in cognitive ability.

In their current work, the team is trying to understand mechanisms controlling this tau spread through synapses in order to develop ways to stop the spread of pathology. Stopping the spread of toxic tau is a promising strategy to stop the disease in its tracks.

Environment panel



Dr Carol Sparling

Director of the Sea Mammal Research Unit, University of St Andrews

Innovation and marine mammal research: helping to accelerate a sustainable transition to low carbon energy generation at sea

The race to achieve net zero must balance the twin crises of climate emergency and biodiversity loss. How clean energy sources can be developed without harming the marine environment is the focus of a considerable body of research being carried out at the Sea Mammal Research Unit at the University of St Andrews.

Marine mammals are an important part of the marine ecosystem, often acting as sentinels for the health of our seas. Concerns about negative effects of offshore windfarm construction and tidal stream energy developments on marine mammals have led SMRU to develop and apply novel technology (passive acoustics, active sonar, and telemetry tags) to describe and measure occurrence and behaviour around developments to evaluate impacts of offshore and marine renewable energy development on marine mammals and marine ecosystems. The research is directly informing planning, policy and decision making in the marine environment both in the UK and globally.

Professor Alasdair Nisbet

Director of Research and Innovation
and Head of Vaccines and Diagnostics,
Moredun Research Institute

Liver fluke study delivers win-wins for animal and environmental health

A season-long project on Islay involving livestock farmers aimed to reduce unnecessary flukicide treatment and strike a balance between effective fluke control and minimal environmental impact. Historically, farmers have treated their sheep and cattle for fluke – a highly pathogenic flatworm parasite of ruminants – at specific times of year. Overusing treatments has reduced the efficacy of certain products.

Moredun Research Institute, and its partners, regularly monitored sheep and cattle faecal samples and found the timing of peak fluke infection was much later than expected, due to recent changes in weather patterns. Evidence-based decision-making allowed farmers to optimise treatments and improve animal health while saving money whilst reducing the risk of developing flukicide resistance. Reduced chemical use also provides benefits for biodiversity, as it leaves the dung and soil invertebrate population much stronger, a sign of a healthy farm ecosystem.

Dr Antje Ahrends

Head of Genetics and Conservation,
Royal Botanic Garden Edinburgh

Impact of natural rubber plantations on tropical forests measured for the first time

Over 90% of tropical deforestation is linked to global commodity production. Understanding the impacts of commodities is thus of fundamental importance to underpin sustainability policies. However, for most crops, impacts can only be estimated – there is no direct evidence linking commodities to deforestation. Natural rubber – used in billions of tyres annually – is one major commodity for which deforestation impacts have been highly uncertain. We harnessed satellite data and cloud computing to produce the first high-resolution maps of rubber-associated deforestation for Southeast Asia (source of 97% of the world's rubber).

Our maps show that rubber-related forest loss has been underestimated at least two – to threefold in figures widely used for setting policy. With over 4 million hectares of forest lost to rubber since the 1990s, the impacts on biodiversity and ecosystem services are extensive. Our research highlights the importance of rubber, and contributes crucial evidence for incoming due-diligence legislation.

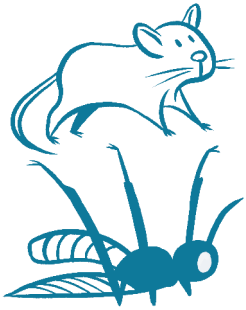
Professor Robbie Waugh

Director, International Barley Hub (IBH),
James Hutton Institute

Accelerated evolution of wild-to-domesticated barley

Narrowing of the germplasm base of modern crops has revealed a pressing need to address emerging vulnerabilities by exploiting natural genetic diversity. There are many examples of how using 'crop wild relatives' can enhance the performance of our major crops, but the enhancements achieved have generally involved simple traits, often conferring resistance to disease. There has been limited success for traits under complex genetic control.

One reason for this is that established germplasm exploitation approaches generally focus on moving small segments of a wild genome controlling a target trait into a well-adapted domesticated line by breeding and selection. However, advances in our understanding of the genes involved in crop domestication have prompted us to test whether reversing this improvement strategy by moving small segments of domesticated genomes into wild genetic backgrounds may overcome the barriers of manipulating complex traits. The outcome will be plants that have 'crop wild relative' genomes that have been rapidly domesticated by introducing well known and understood domestication genes.



Professor Sarah Reece

Chair of Evolutionary Parasitology,
University of Edinburgh

The private life of parasites: sophisticated strategies for survival and reproduction

The Reece lab provides a unique perspective on parasites, examining their world within hosts and vectors (insects that transmit parasites). Working at the intersection of parasitology, chronobiology, and evolutionary ecology, our research asks: “what makes a successful parasite” and “what are their evolutionary limits”? Unlike most infection research, that focuses solely on genetics and molecular aspects, our approach considers parasites in their ecological and evolutionary contexts.

This has enabled us to uncover the sophisticated strategies that malaria parasites possess, such as optimizing the balance between transmission and replication, strategic investment in each sex of transmission stages, and scheduling activities according to the time of day. By understanding how parasites navigate their challenging lifestyles and seize opportunities, we contribute to interventions that can outsmart parasites and reduce the risk of resistance evolution. Our findings extend beyond the laboratory, showcasing the potential of environmental research to curb the impact of parasitic infections, whether in humans, wildlife, livestock, or agriculture, and helping to protect ecosystems.

Physics panel

Professor Alkistis Pourtsidou

Professor (Personal Chair)
of Theoretical Astrophysics,
University of Edinburgh

The Euclid satellite mission: exploring and understanding the dark Universe

The Euclid space telescope, launched in July 2023, will map our Universe by observing billions of galaxies across a third of the sky and covering 10 billion years of cosmic history. Led by the European Space Agency (ESA) and a consortium of 2,000 scientists across 16 countries, with major Scottish involvement, Euclid will spend six years venturing through space. Euclid will provide the largest and best 3D map of the Universe ever made, a remarkable achievement combining state-of-the-art science and engineering.

We aim to extract the maximum amount of information from this map to figure out how Nature works at the most fundamental level. We will pin down how dark matter and dark energy evolve with exquisite precision, understand the behaviour of gravity at the largest cosmological scales, and measure the mass of the neutrinos.

Professor Daniele Faccio

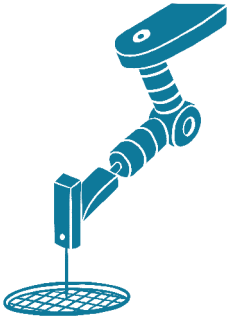
Professor of Quantum Technologies (School of Physics & Astronomy), University of Glasgow

Scotland's Role in Driving the Quantum Revolution

The discovery of the quantum nature of subatomic particles led to a revolution in physics. Scotland is now driving this revolution internationally, benefitting from more than 20% of the £1bn UK National Quantum Technologies Programme, including for the development of superconducting single photon cameras; developing quantum computing technology, to support a decade of QuantIC (Quantum Hub for Imaging), and leadership in single photon lidar and quantum position, navigation and timing (PNT) technologies.

The University of Glasgow lies at the heart of this research and will discuss how we can leverage Scottish excellence through direct application of quantum entanglement, as well as the opportunities for spinout applications.

Members will hear about brain imaging and heart diagnostics; sensing for Net Zero applications; imaging for surveillance and national security through detection of gravitational anomalies, and the detection of hidden weapons and cameras made from an optical fibre the width of a human hair.



Professor Jennifer Hastie

Director of the Institute of Photonics, University of Strathclyde

Photonics Research Under-Pinning Next Generation Quantum Technologies

Professor Jennifer Hastie (Director of the Institute of Photonics at the University of Strathclyde) will offer an introduction on why quantum technology is at the forefront of innovation in science, and a key area of investment and interest for the UK government.

Prof Hastie will give a flavour of the breadth of quantum research undertaken at the University of Strathclyde, which ranges from the development of key photonics devices to enable technological advancement to next generation cold-atom-based quantum science, leading to Strathclyde's involvement in all 4 National Hubs of Phases 1 & 2 of the UK Quantum Technology Programme.

As part of her presentation, Prof Hastie will also share some of the laser systems her own team are developing, including those for cooling strontium atoms to within a millionth of a degree above absolute zero for quantum timing applications.

Professor Mehul Malik

Royal Academy of Engineering
Chair in Emerging Technologies,
Heriot-Watt University

Programming quantum circuits for light inside an optical fibre

Optical fibres are used to transport information encoded in light across the globe, serving as the backbone of the internet. In parallel, photonic circuits that compute with light are seen as the next big leap in computing technology. However, as these circuits become more complex, challenges related to fabrication and control inhibit their performance. When light enters an optical fibre, it gets scattered and mixed in complex ways. By gaining exquisite control over this complex scattering process, we have found a way to programme optical circuits for light inside a commercial optical fibre.

We use a technique called "inverse-design," that lets us reverse-engineer a desired operation by embedding it inside the larger, complex process represented by the fibre. Our method serves as an alternative yet powerful approach for realising precise control over quantum states of light, with clear applications in next-generation quantum technologies for unconditionally secure communication and ultrafast computing. (Accepted in Nature Physics).

Thank you from the Chair

On the behalf of the Committee I would like to thank everyone who took the time to come and share their fantastic work at this showcase event. The research taking place in Scotland is truly exceptional and world leading. This booklet is a testament to the ingenuity of researchers in Scotland.

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