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SPRING 2022



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STEM for BRITAIN 2022 WINNERS

BIOLOGICAL AND BIOMEDICAL SCIENCES



L-R Hamish Symington (Silver), Orla Woodward (Nutrition Society Award), Miquel Serna Pascual (Gold Medal and The Physiological Society Award), Claire Laxton (Bronze)

ENGINEERING



L-R Hayden Salway (Silver), Gor Piliposyan (Gold Medal and IEEE Communications Award), Madeleine Wyburd (Bronze), Jorge Corral Acero (Bronze).



L-R Viscount Stansgate, Vice President P&SC, Zeliang Zhang, IEEE Circuits and Systems Award, Professor Nauman Aslam, IEEE UK & Ireland Communications Society, Stephen Metcalfe MP, Chair STEM for BRITAIN.

CHEMISTRY



L-R Abigail Collins (Silver), Katherine Macfarlane (Gold Medal), John Hudson (Bronze)

MATHEMATICS



L-R Desislava Ivanova (Bronze); Matthew Tointon (Gold Medal), Teresa Bautista (Silver).

PHYSICS



L-R Ancy Anna John (Bronze), Adele Parry (Gold), Georgina Shillito (Silver)

DYSON SUSTAINABILITY AWARD

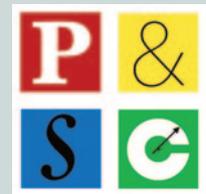


L- R Sean Polden, Design and Development Manager, Dyson Ltd, Alexandra Jones (2nd Prize) John Hudson (1st Prize) Katherine Kwa (3rd Prize), Dr Julian Rose, Senior Manager, External Research and Technology Scouting, Dyson Ltd.

THE WESTMINSTER MEDAL



L-R Viscount Stansgate, Sue Wharton, P&SC, Adele Parry, Winner, Westminster Medal, Elizabeth Rowsell, Director of Technology Centres, Johnson Matthey, Stephen Metcalfe MP



Science in Parliament has two main objectives:

1. to inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation;
2. to keep Members of Parliament abreast of scientific affairs.



Stephen Metcalfe MP
Chairman, Parliamentary & Scientific Committee (All-Party Parliamentary Group)

A warm welcome to the Spring edition of our journal.

My grateful thanks to all who contributed articles to this issue.

As you know Lord Alec Broers stepped down as our President at the end of last year and I was delighted to pay tribute to him in the previous edition.

At the recent P&SC AGM, Dr Stephen Benn, Viscount Stansgate, was elected as our President in succession to Alec. My congratulations to Stephen, who as many of you will know, has been a Vice-President for many years, and more recently Chair of Council. Stephen's contribution to science in a parliamentary setting has been immense and now he continues

to champion STEM with great passion in his relatively new role as a member of the House of Lords.

I am also delighted that Alec was elected as a Life Member of the Parliamentary & Scientific Committee at the Annual Meeting.

Paul Ridout who has contributed much to the work of P&SC over the years, not least in running our social media operation, has decided not to continue as a Vice President. Our sincere thanks to Paul for all his support and expertise.

I am pleased to say that Alfie Hoar, who writes the reports of our discussions for the website, has agreed to take on the social media role. Alfie is currently reading Physics and Philosophy at the University of Oxford.

The AGM also approved important changes to our Constitution. I should like to thank Professor Ian Haines, supported by Professor Michael Elves and Professor Narendra Ramnani, as members of the Working Group, for all their hard working efforts over many months.

They have, in my view, produced an excellent and simplified set of rules which are

relevant to the work of a modern All-Party Parliamentary Group and which also provide a sound basis for the future development of P&SC.

On 7th March, I was delighted to welcome STEM for BRITAIN back to Parliament for the first time in two years.

Congratulations to our winners and to the 124 early career-researchers who took part in this competition.

We are grateful to the Learned Societies and our sponsors for their generous support, the five judging panels, and the STEM organising team, particularly Viscount Stansgate, Dr Isabel Spence, Karen Smith, Julie Spencer, Sue Wharton, John Slater, Ben Allen and Leigh Jeffes, for helping to produce such a successful event.

You can find a photographic feature of the STEM for BRITAIN 2022 in this edition.

Finally, a warm welcome to members who have joined P&SC in recent months:

The Royal Horticultural Society, the Royal Meteorological Society, British Society of Animal Science, Science Made Simple, and Dr Andrew Bodey, who has become an Individual Member.

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SUSTAINABILITY IN THE 21ST CENTURY



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INTRODUCTION

The UN World Commission on Environment and Development define sustainable development as follows: “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The recent experiences with COVID have helped the global community to recognise that major threats to our global survival exist and these are transnational in nature and in consequence. Anthropomorphic climate change is an existential threat to life on a global scale. However, unlike viral infections, and as eloquently summarised by Dr Jen Vanderhoven, Vice Principal, Engagement - University of the Highlands and Islands “there is no vaccine for climate change”¹.

Before COP26, we were on course for 2.7°C of global warming. Based on new announcements made during the Conference, experts estimate that we are now on a path to between 1.8°C and 2.4°C of warming², however this must be placed in the context of estimates of global growth. According to the International Monetary Fund “Global growth is expected to moderate from 5.9 in 2021 to 4.4 percent in 2022 – half a percentage point lower for 2022 than in the October World Economic Outlook (WEO)”³. Sustainable development, therefore, is not simply meeting the needs of the current generation within global climate constraints, it must include management of the consequences of the growth in global economies. Emissions management is a case in point. The global methane pledge, a joint EU-US initiative has mobilised over 100 countries to cut their collective methane emissions by at least 30% by 2030⁴. Such significant initiatives will be crucial for our future. At the same time, economic expansion will require an increase in industrial activity. At face value, these courses of action appear contradictory. They



are, however, not mutually exclusive. The European Union cut its greenhouse gas emissions by over 30% since 1990, while growing its economy by over 60%. To maintain and, indeed, improve on this record of progress, governments and industry must work together. Simply using the conventional indices of economic growth (GDP, manufacturing output) will not reflect the true position with respect to global environmental health and wellness. For example, the OECD⁵ have estimated that inflation will be between 3% at the end of 2022 in some advanced economies (UK and US) and 0.5% (Japan). In emerging economies, the spread is perhaps more pronounced with low rates predicted for China (2.2%) and higher rates in India and Russia (5.8%). Global economic

homeostasis is an illusion and there will continue to be a need to maintain economic growth and to eradicate poverty by ‘levelling up’ on a global basis.

In addition to these macroeconomic trends, there is also pressure caused by high demand for and exhaustion of limited resources – including fossil fuels. A study by MIT in 1972 predicted an economic collapse in the 21st century due to overexploitation of planetary resources. This has not (yet) come to pass. A recent independent study by Gaya Herrington⁶, a director at KPMG concluded that, if business “continued as usual”, economic and industrial growth could stagnate as early as 2040. The prospects are not irretrievably gloomy. In a newspaper interview⁷, Herrington said:

“There is a sustainable way of creating value and prosperity that also has immense economic potential. Doing good can still yield a profit”.

The UN International Resource Panel (UN-IRP), in their 2019 report, stated: “the extraction and processing of natural resources account for more than 90 per cent of global biodiversity loss and water stress impacts and for approximately half of global greenhouse gas emissions.”⁸ The IRP and others have pointed out the link between natural resource utilisation and the environment – “an estimated 23% of total anthropogenic GHG emissions in the last decade were from agriculture, forestry, or other land use”. The immediate challenges of the next 30 years are therefore to develop ways to more effectively and efficiently make use of natural resources

- a) so that there is less pressure on them and
- b) to proactively mitigate the deleterious consequences of human activity.

Both of these will require the development and application of joined up and coherent science and technology and both must be carried out in partnership so that the potential benefits can be realised. As the UN-IRP noted, “Increasing material efficiency is a key opportunity to achieve the aspirations of the Paris Agreement. Materials are vital to modern society, but their production is an important source of greenhouse gases. Emissions from material production are now comparable to those from agriculture, forestry, and land use change combined, yet they have received much less attention from the climate policy community. As shown by IRP estimates, it is time to look beyond energy efficiency to reduce global carbon footprint.”⁸

INCREASED EFFICIENCY IN THE USE OF NATURAL RESOURCES

The development of better methods of making use of natural resources does not just mean elimination all use of petrochemical-derived feedstocks. The increased use of solar and wind power has been extensively promoted (together with the use of nuclear plants). A major issue is that of energy storage. There have been two major approaches – the optimisation of current technologies (particularly those based around lithium) and the development of new concepts in battery production and use (for example flow batteries that use externally stored electrolytes). As the cost of batteries has reduced from \$1,100/kWh in 2010 to \$156/kWh in 2020, their use has expanded. What is clear, however, is that different applications will require batteries with different characteristics and application-driven research, underpinned by theoretical and small-scale application models, will continue to have a crucial role to play.⁹

A number of attempts have been made to improve the utilisation of feedstocks – particularly in the production of high value products such as pharmaceuticals, flavour compounds and cosmetics – by using bio-approaches. This can involve areas as disparate as the bulk (1,000 tonnes per annum) production of biosurfactants in bioreactors to the production of biopharmaceuticals and biosimilars¹⁰. These can include small molecules such as terpenoids¹¹ or large biologics. The FDA approval of Aduhelm (Aducanumab) for the treatment of Alzheimer’s disease was a major biopharmaceutical success and a significant achievement in the use of antibody-based therapies. These types of

molecules would either be very expensive to make by standard synthetic chemistry or, in the case of large biomolecules such as antibodies, would not be achievable.

MITIGATION OF THE EFFECTS OF HUMAN ACTIVITY

The 3Rs (reduce, reuse and recycle) is a crucial aspect of sustainability. A number of (bio) technological approaches are currently attracting attention. These include the production of bioplastics, microbial degradation of polymers and the recycling of rare and precious metals. There have also been significant attempts to replace metal-based catalysts such as palladium however many of these have failed¹² and the more effective reclamation of valuable “waste” products from reactions remains an important goal.

CONCLUSION

Biotechnology in all its forms offers an as yet untapped resource for re-engineering some of the large and complex challenges around using natural resources more efficiently and mitigating the effects of human activity. It holds substantial promise to meet our current needs without compromising the ability of future generations to meet their own needs, offering hope for a more resilient ecosystem of people, planet and profit. This will be a key aspect of current and future sustainability. It will require substantial technological and scientific insights and a determination by governments to be bold, imaginative and innovative.

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DEMENTIA – CAN THE UK RISE TO THE CHALLENGE?



Dr Caroline Wood, Oxford Population Health

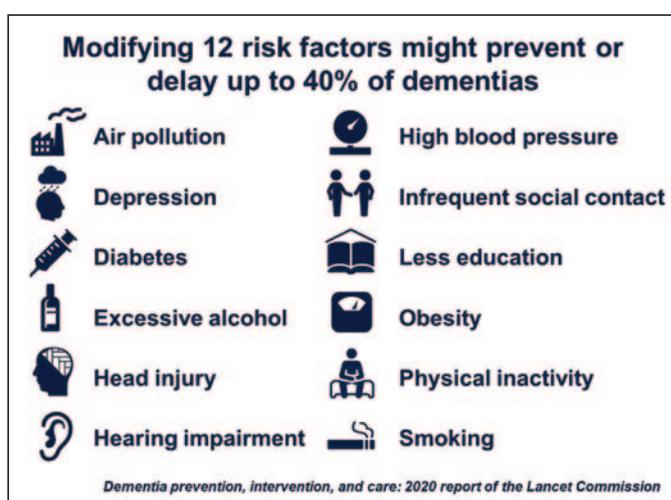
Nobody likes to talk about dementia but we really need to: nearly one million people have dementia in the UK, and this is expected to grow to 1.6 million by 2050 (Alzheimer’s Research UK). Caused by brain diseases such as Alzheimer’s, dementia has devastating consequences for affected individuals, their families and friends, besides costing the UK economy £26 billion each year. As the experts tell us here, the challenge facing policy makers is clear: rapid and strategic investment into both dementia research and holistic social care.



David Thomas, Head of Policy at Alzheimer’s Research UK

PREVENTION: CAN WE REDUCE OUR RISK OF DEMENTIA?

According to a 2020 Lancet Commission report, up to 40% of dementia cases may be caused by modifiable risk factors (see infographic right). And since many of these factors also affect general health and the risks of other diseases, this makes them ideal targets for Government action, as David Thomas, Head of Policy at Alzheimer’s Research UK, says. “While there are things that individuals can do to address many of these factors, Government has a vital role to play in developing policies to tackle them and improving public awareness, for instance through supporting our Think Brain Health campaign.”



Dr Thomas Littlejohns Oxford Population Health

generalised hearing impairment had already been linked to dementia, speech-in-noise hearing is a specific subtype not usually tested in standard hearing assessments, so it was unknown whether it was associated with increased dementia risk.

UNDERSTANDING THE GENETIC ELEMENT

Big data approaches will also have a critical role in uncovering the genetic components of dementia, including the over 60 gene variants that have been associated with Alzheimer’s disease so far ². Although the exact role of many of these is currently unclear, they are already revealing new insights about the origins of disease and potential targets for treatments. “We have learned so much from both rare gene variants with large effects, and more common ones with smaller effects” says Professor of Epidemiology Cornelia van Duijn (Oxford Population Health). “For instance, genetic studies brought to the surface how many other cells besides neurones are involved, including astrocytes



Cornelia van Duijn, Professor of Epidemiology, Oxford Population Health

However, there is still a lot we don’t understand about why some individuals develop dementia, and why others don’t. Answering this will require continued investment in large-scale, population-level studies that have the statistical power to separate true associations from chance. Just last year for instance, researchers from Oxford Population Health (based at the University of Oxford) uncovered a potential new risk factor for dementia: difficulty hearing speech in noisy environments ¹. Whilst

Lead researcher Dr Thomas Littlejohns says: “Our analysis used data from over 82,000 participants in the UK Biobank, who were followed over 11 years. The results showed that insufficient and poor speech-in-noise hearing were associated with a 61% and 91% increased risk of developing dementia, compared to normal speech-in-noise hearing, respectively. This presents the possibility of specifically targeting speech-in-noise hearing impairment as a strategy to prevent dementia.”



Naomi Allen, Professor of Epidemiology at Oxford Population Health and Chief Scientist for UK Biobank

and microglia, besides major pathways such as lipid metabolism and the innate immune system.”

The challenge now facing researchers is to unpick how these genetic factors interact with environmental and lifestyle factors. According to Professor van Duijn, it’s a numbers game: “Studies need to be four to ten-fold larger to study the interaction between two factors compared with studying the factors by themselves” she says. However, as genetic sequencing technologies continually

EARLY DETECTION

It can currently take up to ten years from the first symptoms for an individual to be diagnosed with dementia, by which point the damage is untreatable. But again, research is yielding valuable new approaches, as Professor van Duijn says: “An exciting development is the arrival of blood-based biomarkers for the hallmarks of Alzheimer’s disease, including amyloid plaques and neurodegeneration. These biomarkers are continuous, like your blood pressure or blood



Neurodegenerative diseases can begin in the brain up to two decades before symptoms start to show. Digital technology and machine learning hold enormous potential to help identify digital ‘fingerprints’ to detect the brain diseases that cause dementia much earlier than we currently can. Photo credit: Pixabay.

improve, more large-scale cohort studies are adding whole-genome sequencing (WGS) information to their databases.

This includes UK Biobank’s ambition to add WGS data for all 500,000 participants. Naomi Allen, Professor of Epidemiology at Oxford Population Health and Chief Scientist for UK Biobank, says “These data, combined with the lifestyle, environmental and health outcome data already available in the resource, will significantly enhance our understanding of the role of genetic factors in the development of dementia (and a wide range of other health outcomes) and will advance drug discovery and development”

cholesterol level, and could predict disease risk up to ten years in advance, perhaps longer” she says.

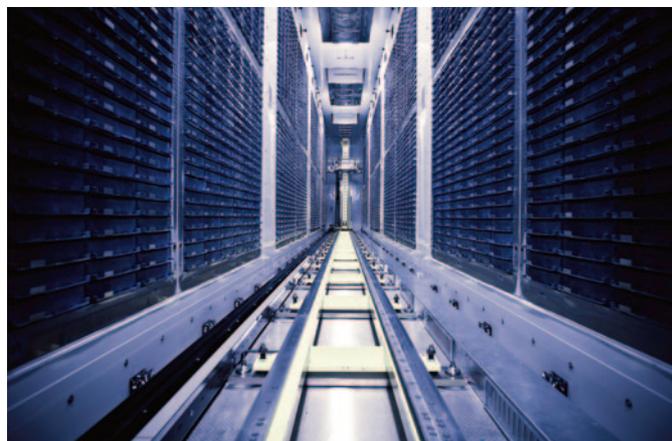
Mr Thomas adds that digital technologies and big data could also help to spot early cognitive decline. “Projects like the Early Detection of Neurodegenerative diseases (EDoN) initiative, spearheaded by Alzheimer’s Research UK, are collecting, sharing and analysing digital health data to detect diseases like Alzheimer’s earlier than we can today. With efforts like this, we will be able to get treatments to people sooner when they’re likely to have most benefit”

Oxford Population Health is also active in this area, through its involvement in the

GameChanger and Digital Biomarkers for Dementia projects. In GameChanger, a smartphone App called Mezurio is helping to establish what healthy cognitive change looks like by asking users to complete simple activities requiring learning, memory and thinking skills. Meanwhile, Digital Biomarkers for Dementia aims to combine clinical and neuropsychological data with virtual reality simulations into a predictive model to identify patterns of cognitive and motor change.

Alzheimer’s disease, besides pioneering stem cell techniques that allow scientists to turn adult cells such as skin cells into nerve cells, creating an invaluable tool for testing potential new treatments.”

Professor van Duijn adds that integrating clinical trials with genetics could accelerate the discovery of effective treatments: “Combining studies of high genetic risk groups, blood based biomarkers and targeted intervention may prove to be a very powerful approach. If we can show effects on biomarkers



Population-level biobanks are an invaluable resource to help researchers understand who is most at risk of developing dementia. This shows one of the UK Biobank’s large freezer stores containing biological samples from some of the 500,000 participants. Photo credit: Tim Ainsworth, UK Biobank.

TREATMENTS

Although dementia treatments do exist, these have a limited effect and only treat the symptoms rather than the underlying diseases. What we urgently need are therapies capable of stopping or slowing the diseases that cause dementia. “We should now take advantage of our world-leading expertise in life sciences to establish a network of high-performing clinical trial sites for late-stage research” David Thomas says. “UK researchers are among those making significant progress in this area. For instance, Alzheimer’s Research UK is also supporting research to explore the role inflammation may play in driving

at a ‘younger age’ in those genetically at high risk, we can move the field forward.”

But keeping up this momentum requires an urgent funding boost, Mr Thomas says. “At the December 2019 election, the Conservatives promised to double research funding into dementia as part of their ‘moonshot’ campaign to find a cure – equivalent to £1.6 billion over the next decade. But this promise has not been delivered. The Government must use its forthcoming Dementia Strategy to outline how this funding pledge will be met so we can deliver life-changing breakthroughs to the people who desperately need them.”



SOCIAL SUPPORT

“Dementia has significant impacts on individuals’ physical, social and psychological wellbeing, but since the austerity cuts came in, many services from the council to support these people and their carers have been withdrawn. It’s typically left to voluntary organisations and charities to step into the gulf” says Elizabeth Hays, Fundraising Manager for Daybreak, an Oxford-based network of Dementia Day Clubs (<https://daybreak-oxford.org.uk/>). Daybreak aims to maintain skills and abilities in clients, by providing stimulation, enjoyment and companionship through creative and social activities. Daybreak also allows family carers much needed respite from their responsibilities as full-time carers.

The critical importance of such services became even clearer as a result of the COVID-19 lockdowns. “From March 2020 until clubs re-opened in May 2021, nearly three times the number of clients died or went into care than would be typical in the same time span pre-COVID” Ms Hays says. “Roughly 90% of the deaths were in clients who never contracted COVID. Anecdotally, they declined due to social isolation and lack of stimulation.”

With voluntary and charity-led services struggling more than ever for funding, the entire UK social care model needs to be addressed, she adds. “Caring for those with dementia is highly labour intensive; you can’t replace people with booklets and information flyers. We



Alzheimer’s Research UK is funding ground-breaking research that is transforming our understanding of dementia, and could lead to innovative treatments. Photo credit: Alzheimer’s Research UK.

urgently need to address how society collectively is responsible for the costs of social care. Tweaking round the edges is not going to work – there has to be a radical overhaul.”

Nevertheless, we can all play a part in helping people with dementia lead high-quality lives for as long as possible. In 2013, Alzheimer’s Society set up Dementia Friends to combat stigma and misunderstanding about the condition, and help shape more inclusive

environments for people with dementia (<https://www.dementiafriends.org.uk/>). “People with dementia have the right to live the life they want and continue to do the things they enjoy, but often feel excluded and isolated from their communities” says Mary

social care system we want to grow old in, now and for future generations.”

Ultimately, we will all grow old, and many of us will experience cognitive decline to at least some extent. We may not like talking about dementia, but if we want to shape a society where individuals can have the best cognitive health for as long as possible, we really need to start – now.

Oxford Population Health, based at the University of Oxford, is a world-leading research institute that uses large-scale studies to investigate the causes of disease and the most effective treatments. <https://www.ndph.ox.ac.uk/>

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Organisations such as Daybreak provide valuable opportunities for mental and social stimulation for people living with dementia. Photo credit: Daybreak.



Dementia Friends raise awareness about how dementia affects people, and the ways that we can all help to create more inclusive communities. Photo credit: Dementia Friends.

PUTTING HEALTH AT THE HEART OF THE UK'S RESPONSE TO THE CLIMATE EMERGENCY



Professor Madeleine Thomson, Wellcome



Professor Mike Tipton, The Physiological Society/ University of Portsmouth

The COP26 Summit in Glasgow last year reflected a growing acceptance among the world's leaders of the impact that the climate emergency is already having and will continue to have in the future. While the progress made at last year's summit is to be welcomed, the fact remains that even if the Paris Agreement targets are met (and this looks unlikely) global temperatures are still set to rise.



About the authors

Professor Madeleine Thomson is Head of Climate Impacts at Wellcome and a Visiting Professor at the Centre for Health Informatics, Computing and Statistics at Lancaster University Medical School.

Professor Mike Tipton is Professor of Human & Applied Physiology at the Extreme Environments Laboratory at the School of Sport, Health & Exercise Science at the University of Portsmouth and Chair of The Physiological Society's Policy Committee.

Photographs published with the permission of The Physiological Society

The recent meeting of the Parliamentary & Scientific Committee, in conjunction with The Physiological Society, was an excellent opportunity to look beyond the headlines of greenhouse gas reduction policies and discuss some of the consequences of climate change on human health now and in the future.

What is the impact of climate change on human health?

The World Health Organization describes climate change as "single biggest health threat facing humanity"¹. Climate change increases illness and deaths through myriad pathways

by changing many of the social and environmental determinants of health and hygiene. These evolving health risks include: temperature-related mortality and morbidity; air quality deterioration which exacerbates cardiovascular and respiratory disease; direct impacts of extreme events such as higher rainfall and rising sea levels and indirect impacts on, for example, water-borne diseases such as cholera; food safety and nutrition and mental health and well-being.

Even if the world is successful in its ambition to limit the rise in temperatures to 1.5°C, many

damaging impacts of climate change are baked in. Indeed, large parts of the world are already experiencing the dangerous consequences of the climate emergency which has resulted in a manmade erosion of biodiversity.²

While the impact of climate change will be felt around the world, the reality is that it is often those who have contributed least to its causes who will be most severely impacted. The climate crisis threatens to turn back the clock on decades of progress in global health.

Wellcome is working in partnership with the

communities most affected by supporting research and science-based solutions for taking on this urgent health challenge. In October 2021, Wellcome pledged an immediate investment of up to £75m to accelerate climate and health research as a first step in its long term strategy where climate and health is considered a key challenge area alongside infectious diseases and mental health. A mixture of directed funding and one-off open calls, it will include discovery research through to translation and working across different countries. Wellcome also funds discovery research into a broad range of disciplines, including infectious disease, population health and genomics. Insights and tools from this research will contribute to solving this health challenge, as well as increasing broader understanding of life, health and wellbeing.

As part of the P&SC meeting, we heard from a Ghana-based organisation seeking to tackle the impact of climate change on health. Green Africa Youth Organization (GAYO) is constructing mechanised boreholes that provide communities with drinking water, as well as, providing irrigation for farming in response to rising temperatures. As agricultural communities find it harder and harder to access clean water, millions of people are being pushed into water, food and economic poverty.

In more urban communities, heatwaves are pushing infrastructures to their limits as heat is trapped in cities (“Urban heat islands”) as a result of limited green space and citizens using fans and air conditioning to cool their living and workspaces. We heard from Dr Marina Romanello from the Lancet Countdown on Health and Climate Change that during the

recent heatwave in Buenos Aires, Argentina, 30 of the 48 neighbourhoods that make up the city suffered from power outages.

What research is currently being undertaken into the impact of the climate emergency on human health?

The Physiological Society recently published a short policy report *Physiology and climate change* designed to highlight just some of the ways physiology (and physiologists)

human health including research into the consequences of seasonal shifts for infectious diseases in a changing climate in the Sahel. It recently awarded funding to the UK’s Office for National Statistics (ONS) to develop metrics to measure, monitor and track the impact the climate crisis is having on our health. Wellcome currently supports a number of longitudinal population studies around the world and is exploring how the rich health data these types of study

climate-related event on otherwise healthy humans is understood, effective mitigations can be designed.

As noted above, the first goal of COP26 was to halve emissions over the next decade and reach net zero carbon emissions by the middle of the century to limit global temperature rises to 1.5 °C. The world is currently way off track.

Physiologists are contributing to this effort through research in areas such as developing more



are responding to the climate emergency. These include research using physiology to tackle health problems resulting from global warming and extremes heat events, using medical technology to fight species extinctions, and understanding the impact of climate change on human performance among those working in industry, emergency services and military personnel.

Wellcome have already funded a number of projects exploring the impact of climate change on

produce could be used to better understand the impacts of climate on our health.

What are the next steps for physiology in response to the climate emergency?

Physiology is an essential part of the scientific response; it helps us understand the consequences of climate change on the human body. As the science of how the body works, physiology explains the impact of climate change on our health and therefore the very future of our species. Once the impact of

environmentally friendly nutritious diets or exploring effective ways to reduce our reliance on air conditioning, a cooling system, which releases toxic gases into the atmosphere. The second goal of COP26 was to urgently adapt to protect communities and natural habitats. People across the world are already living with devastating extreme weather heightened by the changing climate.

We have all seen the terrifying fires and floods raging across the

world over the last few years. Physiology is essential to finding solutions for people facing hotter temperatures, extreme weather, fires and floods. For example, physiologists are using their specific expertise to look at how humans respond and cope with extreme heat to develop proposals for physiological adaptation (or acclimatisation), behavioural, infrastructure, and technological adaptation which can also inform public health guidance. Crucially, the impact of

What can policymakers do to support the response to mitigating the impact of rising temperatures?

Climate change is an ongoing and worsening health crisis, and we need a global strategy for urgent action. But there is chronic under-investment in finding the solutions that will limit the damage and lead to a healthy sustainable future.

Every aspect of policy-making will be affected by climate change, and public services will



the climate emergency on human health across the life course must be mapped and responded to appropriately. We already know that older people are particularly susceptible to the consequences of increased heat but less is known about how rising temperatures affect other vulnerable populations such as people who are pregnant or living with chronic conditions such as multiple sclerosis or epilepsy.

face increased demand as a result of complications caused by the climate emergency. For example, one audience member that participated in the event noted the increasing pressure on firefighters responding to emergencies caused by heatwaves and intense heat. Around the world, labour laws may have to be adapted to prevent over-exposure to the hottest parts of the day for farm workers and tradespeople that are unable to shelter from the heat while working. In energy

and built environment policy, a transition away from a reliance on fossil fuels will also need to go hand-in-hand with architecture that encourages cooling in a cost-effective way. As decision-makers plan for a warmer planet with more extreme weather events and associated events from floods to famine to pandemics, there will be a need for a plethora of policies. Physiology (and physiologists) can and should play a key role in developing and supporting these critically important interventions.

Similarly, parliamentarians and policymakers across the world need to think carefully about how the climate emergency might influence human migration as over the next 50 years, 1 to 3 billion people are projected to be left outside the climate conditions that have served humanity well over the past 6,000 years and 2-3 billion will live under the high tide mark.³

We must, of course, respond to these health challenges in such a way that does not add to the problem. The UK's health system currently contributes 5% of the UK's overall emissions and as demand for these services grows, we must meet this demand in a sustainable way.

It is time for us all not just to raise the alarm but to act. The scale of the climate emergency is so vast that every scientific discipline and organisation needs to consider what it can do to help prevent a catastrophe. Physiologists are playing a key role in delivering on climate change mitigation and adaptation goals, as demonstrated at COP26 in Glasgow and during the P&SC's January webinar. From furthering our understanding of adaptation to heat and extreme weather, to maximising human health while reducing food and agricultural emissions, physiological research is helping the fight against climate change. Wellcome and The Physiological Society are working together to place human health, physiology, at the heart of the climate response.

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ACTION TO REDUCE AIR POLLUTION AND TRANSITION TO CLEANER FUELS NEEDS RAPID ACTION



Dr Elaine Mulcahy, Director UK Health Alliance on Climate Change

In September 2021, the editors of more than 220 international health journals simultaneously published an editorial calling for emergency action to limit global temperature increases, restore biodiversity, and protect health.

In the unprecedented call, the editors said, “Health is already being harmed by global temperature increases and the destruction of the natural world, a state of affairs health professionals have been bringing attention to for decades.” It was the sense among many that despite these repeated warnings, the message from the world’s health community was not getting through which led to this unprecedented move.

The editorial was subsequently followed by a “Healthy Climate Prescription” letter bearing the signatures of organisations representing about 45 million health professionals around the world to the Presidency of COP26 in Glasgow. In the letter, health professionals said that fundamental changes to the way we live are needed to prevent a prolonged health crisis as a direct consequence of climate change. Specific actions being called for include national commitments to limit warming, a transition from fossil fuels to cleaner energy solutions, high-income countries to transfer funds to low-income countries to help achieve targets, and the development of resilient, low-carbon, sustainable health systems.

All of this is achievable, and delivering on these actions



would not only serve to lessen the impacts of climate change, but could also lead to significant health benefits.

A report by the Academy of Medical Sciences and the Royal Society of Medicine calls for a stronger focus on health within the international climate narrative, and for the UK government to advocate for this: *“By integrating the protection and promotion of human health in all actions to address climate change in the UK and demonstrating the potential health gains of the net-zero transition, the UK can take a global leadership role.”*

They say that phasing out fossil fuels and reducing greenhouse gas emissions through

renewable energy, more energy-efficient housing, healthier dietary choices, and more active travel will all help to address climate change and improve health.

For example, the report illustrates that replacing half of UK meat and dairy consumption with fruit, vegetables and cereals, would result in a 19% reduction in agricultural greenhouse gas emissions, while also avoiding or delaying 37,000 deaths a year from coronary heart disease, stroke and diet-related cancer. Increased uptake of public transport and active travel with a transition away from private motor vehicle use, could lead to improvements in health combined with significant savings on healthcare costs as a

result of reduced air pollution and higher levels of physical activity. And, an 80% reduction in greenhouse gas emissions in power generation systems by 2050, would result in a 60% reduction in NO₂ levels in the air and save 7 million life years because of reduced exposure to NO₂.

The crisis in Ukraine has demonstrated the volatility of our reliance on fossil fuels. It has exposed a dependence on international supplies and resulted in huge rises in fossil fuel prices, exacerbating a fuel crisis with the ongoing threat of further price increases.

The government's energy strategy should aim to deliver a reduced reliance on oil and gas by focusing on generating cheaper, cleaner power sources. This could be achieved by doubling down on plans to support the expansion of wind and solar projects combined with an ambitious programme of retro-fitting, insulation, and clean heat generation in our buildings.

Sustained investment in renewable energy will contribute to decreasing emissions while also creating jobs, improving health, and alleviating poverty. On the contrary, expanding UK reliance on domestic production of oil and gas, including through fracking, is slow to achieve and will do nothing to alleviate fuel poverty or reduce carbon emissions.

Air pollution from fine particulate matter is both a major cause of ill health and climate change. These toxic particles are emitted from various sources including vehicle exhausts, tyres, brakes, burning of wood and coal, industrial processes, chemical reactions and agricultural processes. The different make-up of the air pollution differs from place to place, depending on the source of the emissions. The size of the particles is key from a human

health perspective – particles that measure 2.5micrometres or smaller are the most toxic. At this size, they can easily penetrate through the lungs, the smallest particles finding their way into the bloodstream.

No level is safe, but the WHO have put in place guidelines for countries to aim for in order to protect human health. In September 2021 the WHO guidelines recommended for countries to aim to limit the volume of PM_{2.5} in the air to 5 micrograms per cubic metre (µg/m³). The government's new long-term environmental targets announced in March propose a target of 10 µg/m³ by 2040. This is too little, too late.

Evidence from a study by researchers from the Environmental Research Group at Imperial College London and consultancy Vivid Economics, which was commissioned by the Clean Air Fund, has found that if all existing and in-the-pipeline policies already in place in the UK are properly implemented, the majority of the country could achieve the WHO-10 target by 2030. Their research found that while 41% of local authorities had PM_{2.5} exposure levels above WHO-10 in 2018, this would fall to less than 1% by 2030 if policies are successfully

implemented. And the associated health and economic benefits were significant.

There is a linear relationship between levels of PM_{2.5} in the air and health outcomes. An increase in PM_{2.5} is directly correlated with an increase in poor health outcomes, while a reduction in PM_{2.5} has the opposite effect. Some of the positive health benefits of achieving the WHO-10 target by 2030 reported in the study include 20 fewer infant deaths, 388,000 fewer asthma symptom days in children, and 6,300 fewer respiratory and cardiovascular hospital admissions annually.

In total, about 98,000 life years could be gained annually with people living longer, suffering less ill health, a reduced burden on the health service and fewer days lost to absenteeism in the workplace. The impact of this economically is estimated to result in total benefits to the UK of £384 billion between 2018 and 2134.

While the WHO have clearly stated that no level is safe, the guideline of reaching a level of 5 µg/m³ is one we should aspire to. An ambition to reach 5 µg/m³ by 2030 would put us on a good path to getting there, 2040 is too late.

As the recent report from the Intergovernmental Panel on Climate Change said, *"The cumulative scientific evidence is unequivocal: Climate change is a threat to human wellbeing and planetary health. Any further delay in concerted anticipatory global action on adaptation and mitigation will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all."*

We need to move quickly.

UK HEALTH ALLIANCE ON CLIMATE CHANGE

The UK Health Alliance on Climate Change is an alliance of 32 UK health organisations including Royal Colleges, medical journals, the BMA, Academy of Medical Sciences, and Royal Society of Medicine. Collectively, our member's membership represents about 960,000 people working in health. The Alliance brings professionals together to advocate for just responses to the climate and ecological crisis, promote the health benefits that flow from those responses, and empowers people to make the changes needed to respond to the crisis.

www.ukheathalliance.org □



Glasgow, November 9th, 2021:- An open letter signed by 600 organisations, representing 46 million nurses, doctors and health workers worldwide was formally handed over to Gillian Keegan, UK Minister of State for Care and Mental Health, Wendy Morton, UK Minister for European Neighbourhood and the Americas and Khaled Abdel Ghaffar – Minister of Higher Education and Minister of Scientific Research of Egypt, representing the presidencies of COP26 and COP27 during COP26 Science and Innovation Day in Glasgow

IS SEQUESTERING CARBON IN AGRICULTURAL SOILS A VIABLE OPTION FOR CLIMATE CHANGE MITIGATION?



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INTRODUCTION

Tackling climate change is one of the greatest and most urgent challenges facing humanity¹. Recent reports from the Intergovernmental Panel on Climate Change (IPCC) set out in stark terms how human activity is changing the climate in unprecedented ways, with grave consequences for living conditions in many parts of the globe. The 26th United Nations Climate Change conference (COP26) in Glasgow, November 2021, resulted in limited commitments to reducing greenhouse gases (GHGs), insufficient to avoid warming of 3°C by the end of the century (compared with temperatures before the Industrial Revolution). This is well above the international agreement to limit warming to 1.5–2°C. In a 2021 survey of 92 IPCC scientists, based on current rates of progress in reducing GHG emissions, 60% expected the world to warm by at least 3°C². The resulting reduction in the habitable area, due to extreme humid heat, rising sea levels, crop failure and a greater frequency of storms and wildfires, would result in an acceleration of the mass movement of people across the globe. Every country would be affected¹.

This short article sets out the role that changes in land use and management can play in storing additional soil carbon (C) and contributing to the stabilization of global temperatures; and outlines some key messages and recommendations to policy makers from a soil science perspective. We set out how the global C cycle has been disrupted and how farmers can be supported in adopting sustainable soil management (SSM) practices that improve land productivity and the provision of multiple public services such as climate change mitigation.

CARBON CYCLE DISRUPTION

The global C cycle describes the transfer of C between the land, the atmosphere and the oceans. It determines atmospheric carbon dioxide (CO₂) concentrations and associated rates of global warming. In many natural ecosystems, the C cycle is in balance, with the removal of C from the atmosphere through plant photosynthesis equalling that returned via plant and soil microbial respiration; the net effect being zero³. Such systems are in equilibrium.

In more extreme environments (such as very acidic, dry or wet soils) rates of microbial respiration and organic matter decomposition are slow to non-existent, while in cold, wet environments this can result in peat formation. Where these conditions are maintained for centuries, such as on upland bogs and lowland fens, peat accumulates. These are vital C sinks therefore, which should be protected. However, within arable agricultural systems these processes have been disrupted by cultivation, which exposes soil organic C (SOC) to oxidation. Further, many crop rotations include long periods when the soil is bare, thereby favouring respiration and SOC decomposition over photosynthesis. Peat soils are particularly susceptible and when they are drained, microbial respiration is reactivated and the peat C is emitted as CO₂ at rates of more than 30 t CO₂/ha/yr⁴. Overall, it is estimated that cultivated (or arable) soils have lost 33–62% of their SOC compared to their 'natural' state⁵.

THE "4 PER 1000" INITIATIVE AND SUSTAINABLE SOIL MANAGEMENT (SSM)

The "4 per 1000" initiative originated from a claim that an annual increase of 0.4% (or 4‰) in soil C stocks could compensate for the annual rate of CO₂ emissions from the burning of fossil fuels. It is now generally accepted that the 0.4% per year growth rate is not a target that every country or agricultural sector can achieve but is better to be considered as a good "direction to follow"^{5,6}. Significant long-term land use change (e.g., conversion of arable land to grassland or woodland) has by far the biggest impact on SOC but is unrealistic on a large scale due to the continued need to feed a growing population. Nevertheless, it is estimated that by using SSM practices such as returning crop residues, growing

cover crops, applying bulky organic manures, including grass leys (periods of pasture) in crop rotations, and agroforestry (integrating trees into arable systems), SOC levels in arable soils could be returned to 60-70% of pre-clearance levels⁵. Changing SOC concentrations with such techniques can take decades however, and gains can be rapidly and easily reversed in the event of further land management changes. These are therefore relatively small gains that cannot be guaranteed in the longer term. For example, it has been calculated that in Great Britain, the C stock gains associated with the most extreme land use change scenarios would account for only c.2% of annual GHG emissions⁷. Further, increases in soil C will not continue indefinitely, rather C concentrations will reach new equilibria, which can themselves only be maintained by

continuation of SSM practices. Nevertheless, to improve soil health and the efficiency of agricultural systems it is important to maintain SOC as high as practically possible. SOC is essential for healthy soil functioning, with soils at a greater SOC level tending to have a more stable structure, greater water retention, greater biological activity, and better nutrient supply characteristics⁵.

Other novel techniques attracting attention are the use of biochar and enhanced weathering with rock minerals, which offer potential for rapid, longer term C storage - but the whole life cycle C costs of such techniques need to be considered before genuine sequestration benefit can be claimed. The source and chemical characteristics of biochars and rock dusts can also be problematic^{8,9}.

MEASUREMENT, MONITORING, REPORTING, VERIFICATION (MRV) AND VALUING

Despite the challenges of sequestering C in agricultural soils, relatively small changes in C stock per unit area can translate into substantial stock increases at the regional and national scale. The potential for sequestering additional C is therefore attracting interest from governments and industry to meet climate change objectives. This is leading to the development of schemes to pay farmers to adopt 'new' SSM practices. However, as the baseline soil C stores are large and any increases in SOC are slow to occur, it is difficult to measure any changes accurately. Setting up robust monitoring, reporting and verification (MRV) platforms for soil C is therefore challenging and must be

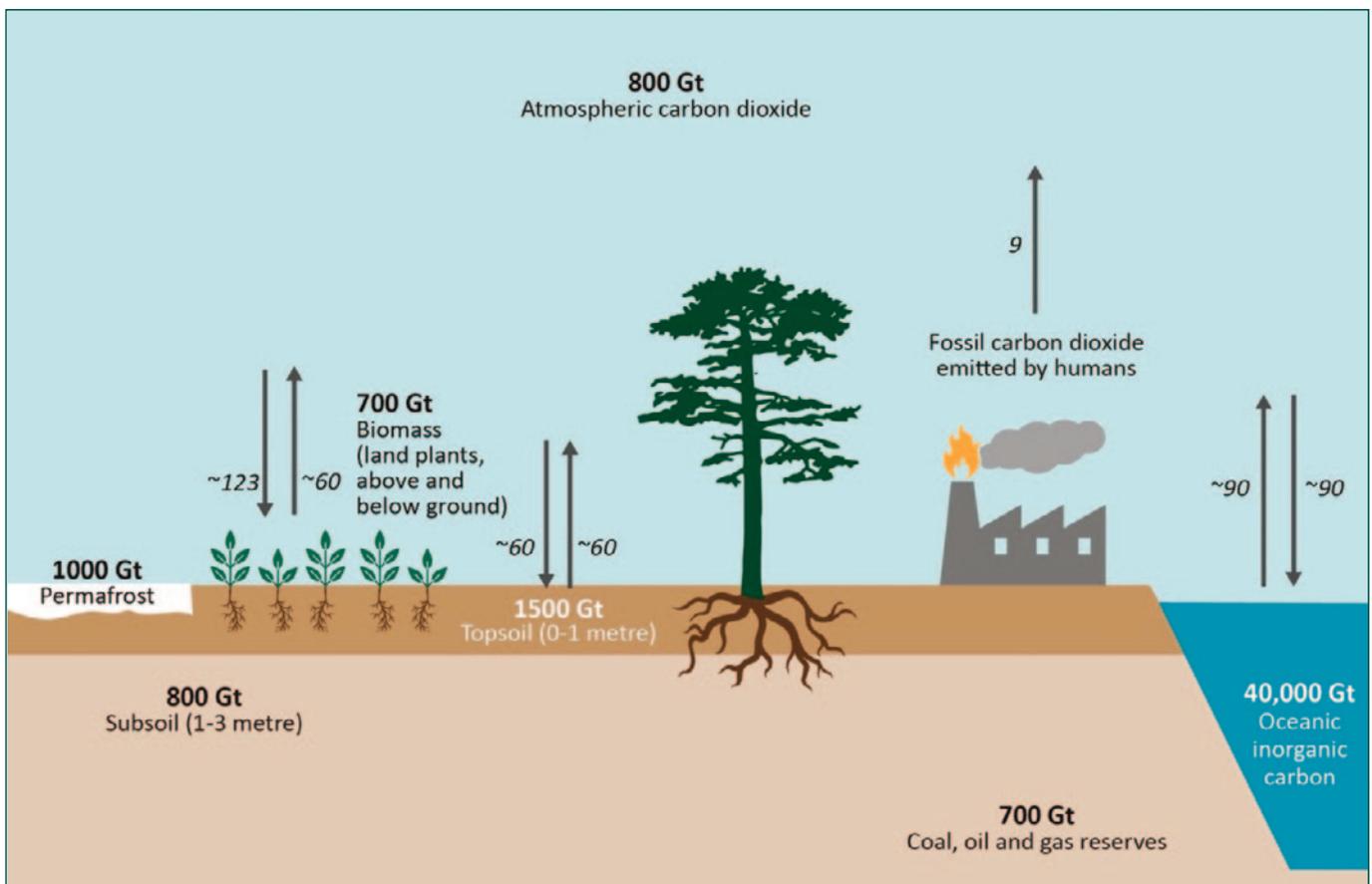


Figure 1: Carbon stocks and flows on land and in the oceans (adapted from Jenkinson, 2010³). The numbers in bold are stocks in Giga tonnes C; those in italics are flows in Giga tonnes C per year. Topsoil and subsoil stocks exclude peatlands.

planned carefully. The potential for future land management changes to re-release captured C from soils also means that monitoring must be robust for the lifetime of any payment scheme.

Differences in the way C markets estimate sequestration make it difficult to be confident that climate benefits have been achieved. The costs associated with direct measurement of soil C make it impractical as a regular, long-term monitoring option ¹⁰, which means that models and remote sensing become essential once a ground-truthed soil C baseline has been established. An alternative is to simply link specific SSM practices to mean C sequestration potential within a set of given contexts.

CONCLUSIONS

Soil C sequestration provides a useful tool in the suite of methods to tackle GHG emissions globally, but the relatively small amounts that can be sequestered, the slow rate of change, and the ease of reversibility in soil C gains, present significant challenges with respect to measurement, monitoring, quantification and verification. Moreover, the process of soil C sequestration is often misunderstood, and can lead to an overestimation of the climate change mitigation that can be achieved through this route. Stakeholders must be aware that a focus on soil C can have unintended consequences and should not be perceived as a 'quick fix'. Based on the available scientific evidence, we recommend that:

- SOC stocks should be maintained at as high a level as possible by conserving areas of natural and semi-natural vegetation, and permanent pasture, and as far as practicable sustainably

producing food on existing agricultural land.

- The best and most versatile land should be protected for sustainable food production, with the possible exception of lowland peats.
- The C stores in existing permanent grasslands, moorlands, peatlands, wetlands and woodlands should be protected.
- Agricultural and environmental policies should support wider adoption of SSM to increase SOC to improve soil health and resilience, help mitigate existing GHG emissions and protect and enhance the multiple public goods and services provided by soil (such as the retention of sufficient water for plant growth, and the transmission of excess water to groundwater).
- Sequestering C in soils and vegetation, although important, must not distract from the urgent need to reduce CO₂ emissions from the burning of fossil fuels.

Failure to address the latter will render the former irrelevant.

More detail can be found in the British Society of Soil Science (BSSS) Science Note on Soil Carbon ¹¹.

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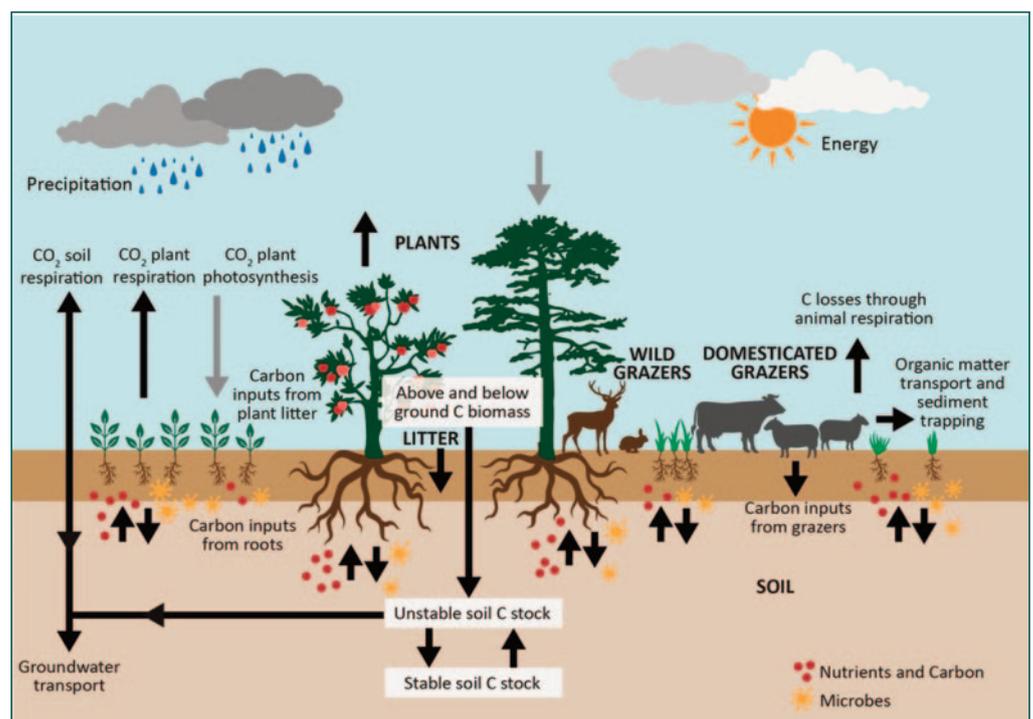


Figure 2. A simplified representation of the carbon cycle in terrestrial ecosystems

PROTECTING THE NEXT GENERATION OF SCIENTISTS: AN URGENT CALL FOR ACTION



Sreyashi Koyal Basu
Policy and Engagement Officer
Microbiology Society

A large portion of the scientific workforce consists of academics who are postgraduate students and those who have been appointed to a first position within five years after their highest degree. Members of this cohort are often referred to as ‘early-career researchers’ (ECRs). With the onset of the COVID-19 pandemic, ECRs from multiple disciplines have joined forces in the efforts to combat the impact of the virus. Alongside their invaluable contributions to the understanding of SARS-CoV-2 disease mechanisms and to the development of diagnostic tools and vaccines, many have become spokespeople, reporting scientific facts to the media, policy-makers and the public.

Despite being at the forefront of the COVID-19 response, many ECRs have faced important difficulties since the start of the pandemic. In recognition of concerns expressed by its early career members, the Microbiology Society investigated how the pandemic had posed unprecedented challenges for the microbiology community. In the spring of 2021, 205 early career microbiologists (ECMs) responded to a Society survey and several attended a follow-up series of focus groups on this matter. What arose from these discussions was published in the position statement ‘Safeguarding the Future of the Microbiology Research and Innovation Workforce’, which also included recommendations to funders, policy-makers, universities and research institutions. In this statement, the Society sheds a light on three areas of ECMs’ lives that have been impacted by the pandemic:

1. ACADEMIC OUTPUTS AND RESEARCH OPPORTUNITIES

Around two-thirds of ECMs surveyed reported that their research outputs had been affected by the pandemic. Many were unable to access laboratory facilities and collect data even once lockdown restrictions were lifted. There was a general sense of worry that the pandemic may have prolonged effects on research productivity and hinder opportunities to publish in peer-reviewed journals – a situation that ECMs felt was not being

acknowledged by funders and employers.

Another issue commonly reported was the lack of extension of funding to account for lab closures, meaning that experiments had to be hastily conducted before funding ran out. Non-funded extensions were granted but they were often perceived as unfair and contributing to a culture in which researchers are not compensated for their work. All of these issues aggregated to fuel a feeling of uncertainty and, in some cases, drove ECMs to leave academia altogether.

“Any ideas of pursuing academia have largely been removed by the pandemic – primarily because it has exposed the issues with the system, such as lack of funding and security for ECRs.”
Microbiology Society survey respondent

Opportunities for networking and collaboration were also rendered scarce by the pandemic according to 87% of ECMs surveyed, with researchers unable to travel and in-person conferences and meetings no longer a possibility. In addition to providing a useful platform for networking, these events often present hiring, funding and collaboration opportunities.

2. MENTAL HEALTH AND WELLBEING

Focus groups revealed how the feelings of isolation and loneliness at work have been exacerbated during the pandemic as the lack of in person interactions meant that ECMs were disconnected from their peers, colleagues and group leaders. This left many ECMs unable to focus and negatively impacted research outputs.

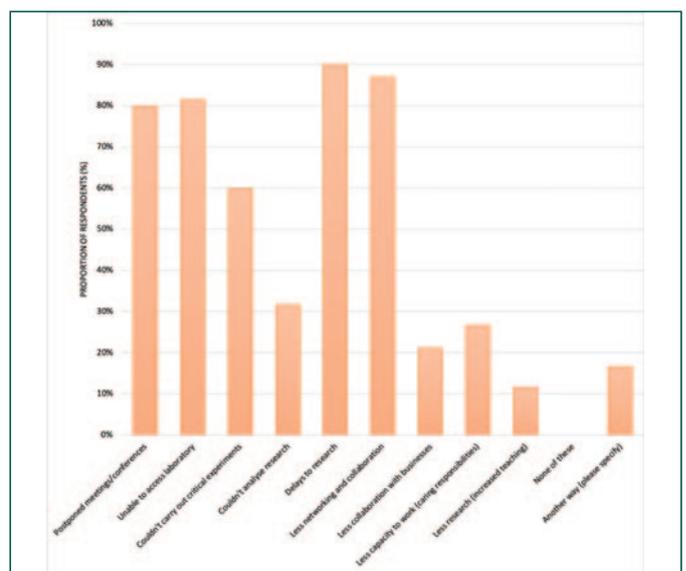


Figure 1: Ways in which research activities and academic progression of respondents was affected between March 2020 and May 2021 (time at which the survey was completed). 199 ECMs responded and were able to choose more than one option.

“Remote working is lonely, and I miss the support and social aspect of meeting co-workers on site. Some people are very demanding with emails, and do not respect personal time.”

Microbiology Society survey respondent

Other issues that considerably affected ECMs' mental health and wellbeing had to do with a lack of communication and transparency from funders and employers during the pandemic. Unclear and inconsistent information regarding funding, policies and procedures introduced a great deal of uncertainty among those surveyed.

Overall, 60.5% of respondents reported that they hadn't received appropriate mental health support throughout the pandemic. For example, one ECM recalled that the only support that they received was from virtual catch-ups arranged by friends and irregular emails from their university to indicate that 'they were doing everything humanly possible to help'.

3. AN UNHEALTHY RESEARCH CULTURE

The Microbiology Society's engagement activities revealed that the pandemic has acted as a magnifying glass on systemic issues that have been present in academia for years – from a lack of empathy for researchers, through to reduced funding transparency and inflexibility of deadlines, to limited opportunities to progress within a competitive ecosystem. Survey respondents and focus group attendees reported that there seems to be an underlying assumption that ECMs are young and willing to dedicate their life to research, meaning that there is an expectation that they will easily adapt to the new 'normal' created by the pandemic.



“A lot of what I hear is that essentially, a PhD is always stressful, there are always problems that have to be overcome, and projects often change over the course of three years. In this way it seems in the eyes of certain administrators, the pandemic has made little difference.”

Microbiology Society survey respondent

SAFEGUARDING THE FUTURE GENERATION OF ECRs

The pandemic has dramatically highlighted the need for systemic and fundamental change in the way all ECRs are being valued and supported in pursuing successful research careers. It is crucial that employers, funders and governments work together on that matter. Steps in the right direction include, but are not limited to:

- Supporting ECRs wellbeing and mental health. The loneliness and isolation felt by ECRs is not a new issue. Better communication between researchers and their colleagues or group leaders can enable ECRs to feel comfortable sharing their issues and seeking mentors who can support their career progression and personal development.

- Recognising and rewarding non-traditional skills. Although introducing flexible working patterns and access to labs may make up for the immediate effects of reduced outputs during the pandemic, supporting long-term career development will require going beyond considering research productivity as the sole metric of success, and recognising leadership, knowledge exchange and science communication as valuable skills.

- Re-assessing funding allocation. While public funding may be limited in the next few years, funders and employers must re-assess how the available funding is allocated. Opportunities for change include increasing small pots of money for preliminary data to support ECRs' ideas and allow them to develop a track record of independence, enabling longer contracts for post-doctoral researchers and ensuring all extensions and positions are fully funded.

- Adjusting research output requirements and expectations of ECRs. The inclusion of personal statements in the grant approval process could help alleviate ECRs fears of proving a track record of academic success uniquely based off of a CV and enable them to expand on the

challenges they may have encountered during the pandemic.

- Prioritising communication and transparency around funding, policies and procedures. Funders must prioritise communication and transparency around funding, policies and procedures to help alleviate some of the uncertainty and frustration that ECRs have been experiencing.

- Designing and implementing policies on equal opportunities, diversity and inclusion that lead to positive change. Funders and employers should urgently address disadvantages and biases in the grant approval process by creating and implementing policies that improve diversity in grant panels and ensure that resource allocation is fair and inclusive.

The above recommendations are just a few examples of actions that can be taken to systematically improve the way ECRs are being valued, without which, society as a whole risks losing an entire generation of researchers that are able to rise to global challenges. If you wish to discuss these issues, potential solutions or opportunities for collaboration with the Microbiology Society, please contact policy@microbiologysociety.org



ARE YOU SURE? COMMUNICATING UNCERTAINTY IN RESEARCH EVIDENCE



Dr John Kerr, Postdoctoral Research Associate, Winton Centre for Risk and Evidence Communication, University of Cambridge, and Parliamentary Academic Fellow (2021), Parliamentary Office of Science and Technology.

COVID, conflicts, and climate change. There is little doubt that we live in uncertain times. Uncertainty is a crucial part of the evidence Parliamentarians need to consider when engaging in decision making. And it is crucial that such uncertainty is communicated clearly.

Policymakers seeking answers to questions may have to contend with inexact estimates, conflicting results, disagreeing experts, or incomplete evidence. This is particularly the case when it comes to research evidence, such as scientific studies, which aim to understand and describe the world we live in. Communicating such uncertainty is a key challenge for those aiming to support evidence-informed policy making.

As a researcher at the Winton Centre for Risk and Evidence Communication at the University of Cambridge, I study how we think about uncertainty, and how

it influences our perceptions of information and what we do with it.

When we talk about uncertainty in research evidence it is useful to think about the two flavours of uncertainty: direct and indirect.

Direct uncertainty is statistical uncertainty around specific numbers, the kind of uncertainty

we hear about when pollsters talk about margins of error, or when scientists talk about how certain they can be about a drug's effects. It tells us, using numbers, how much uncertainty there is around a claim. We see this kind of uncertainty in official updates of the almighty 'R number' – an indicator of the rate at which the COVID-19 pandemic is growing or

shrinking. At the time of writing, the official R value for England is given as a range between 0.8 and 1.1. This uncertainty tells us we cannot be wholly sure if the pandemic is getting smaller or larger in terms of the spread of the virus.

Indirect uncertainty is not about the numbers themselves, but about the methods and

KEY TIPS FOR COMMUNICATING UNCERTAINTY IN RESEARCH EVIDENCE

Understand your audience and their level of statistical knowledge

Parliamentarians come from all walks of life and will differ in their familiarity with statistical terms and knowledge of research methods. By taking the perspective of your audience, you can better plan how to clearly explain uncertainties. Perhaps explaining a range as 'we are reasonably sure the true value is between 10% and 20%' will be more informative than describing 'a 95% confidence interval of 10%-20%'.

Use judgement on when to communicate statistical uncertainty

Not every uncertainty needs to be meticulously detailed to your audience. A pragmatic balance must be struck between accurately communicating uncertainty and not bamboozling a non-expert audience with too many numbers and minutiae of study design. Where statistical uncertainties are small and wouldn't appreciably impact one's interpretation of findings, they might be safely omitted. The important thing is that exclusion of uncertainty information should be a conscious decision and not an oversight.

Be clear about the quality of the evidence

All research comes with limitations. Research may come from other national contexts, or be based only on small studies, or a particular demographic group. Being clear about the limitations of data and studies helps your audience adjust the level of confidence they place in certain claims arising from research evidence.

Avoid unwarranted precision

Scientific models can provide very precise, but uncertain figures. For example, one survey estimated that there are 10,332,955 pet cats in the UK. No-one—including the authors—believes that is the exact number of pet cats in the UK. But this kind of precision can give the impression of certainty. Sometimes rounding can better communicate the uncertainty around such figures: there are about 10 million pet cats in the UK.

Use numbers and words

If you are talking about probabilities or chance avoid using common terms like 'probable' or 'unlikely'. Two people could interpret such words very differently. Numbers are a more accurate shared common language that can keep people on the same page. 'Probable (60% chance)' is a whole lot clearer than just 'probable'.

assumptions used to create them in the first place. An example: the latest government factsheet tells us that there were 4,215 reports of serious injuries to cyclists in 2020. Because this is administrative data, drawn from a database, we can be very sure of that number - it wasn't extrapolated from the results of a survey, or a study in one particular area. We know very precisely how many reports there were for the entire UK. However, these are reports of injuries, not injuries themselves being counted. There is indirect uncertainty around how many injuries there were because we can assume that some (perhaps many) injuries go unreported. To their credit, the Department of Transport is very clear and upfront about this uncertainty in reporting the statistics. With this kind of uncertainty we cannot be exact, we can't give a range of probable values, we can only admit there are some things we currently don't know.

When communicating these kinds of uncertainties to policymakers, it is important to think carefully about how they will be presented, understood and used. Both direct and indirect uncertainty need to be made clear (see *Key Tips For Communicating Uncertainty* box).

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST) FELLOWSHIP

The challenge of communicating uncertainty was the focus of my recent Parliamentary Academic Fellowship¹ with POST where I spent 3 months working with the team. I examined how POST discusses uncertainty in its briefings for Parliamentarians, with the aim of identifying how this can be improved.

POST is a bicameral research

service providing impartial briefings across all policy areas to both Houses on current or upcoming issues.² POST seeks to explain the latest research and set it into its policy context for busy parliamentarians.

During my Fellowship I undertook two separate projects looking at POST's briefings. The first used automated text analysis to examine the language used in briefings. I looked at the complexity of language, but also their use of 'uncertain language'

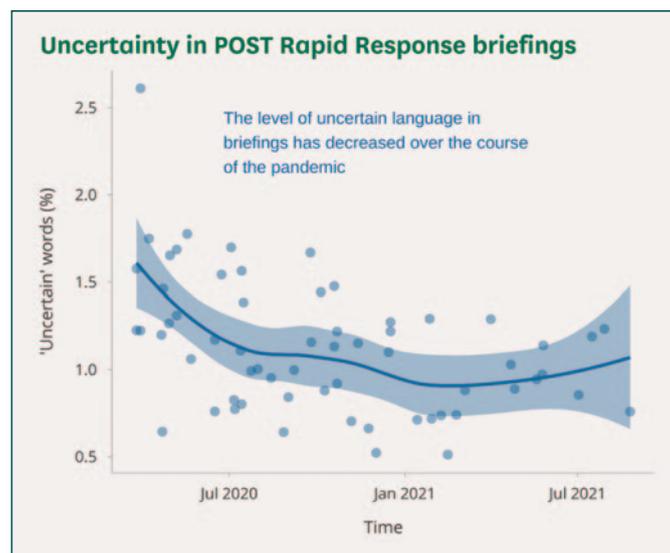


Figure: Each individual point represents a POST briefing and the line shows trend over time.

- words like 'approximately' and 'suggests' (in total a list of more than 200 words). One interesting finding was that the use of these uncertain words had decreased over time in POST's Rapid Response online briefings, which almost exclusively focus on COVID-19.³

This fits how the pandemic played out in terms of research evidence. As the months progressed, the scientific understanding of the virus began to solidify, and it appears this decreasing uncertainty is reflected in the language used in POST's briefings.

This approach to examining uncertainty meant I could analyse hundreds of documents

in a short time. But we don't really know in what context these words are being used and what the uncertainty is really about. To get that kind of insight, you really need to get your hands dirty and read through the briefings, really understanding what is being said.

In a second project I sat down and read (and re-read, and re-re-read) forty of the most recent health-related POST briefings.⁴ I tracked the different ways that POST authors discuss

uncertainty when summarising research for their audience. Did they use range to describe a statistic? Did they highlight where there was conflicting research evidence (or even no evidence), did they warn readers about the limitations of some studies? The results from this analysis painted a more detailed and nuanced picture of the kinds of uncertainty that pop up in POST briefings.

POST's briefings consistently gave readers additional information about the overall quality of research, often noting where there was limited evidence available (particularly in the case of COVID-19 research). However there was little focus on that direct, statistical

uncertainty - which perhaps isn't as critical for non-experts, when such uncertainties are small.

The process of analysing the documents highlighted potential avenues for even further enhancing how POST presents information about uncertainty and research quality to its parliamentary audience. For example, one area that would improve reader experience is for POST to make greater use of its online research glossaries to guide readers to definitions for technical terms (e.g., what is the difference between a cross-sectional vs longitudinal study? And why does that matter?).

The fellowship experience has been incredibly illuminating for me as an academic. I have gained a much deeper understanding of the way research evidence is used in Parliament and the needs of policy audiences. It forced me to think more carefully about what uncertainty information is actually important for busy decision-makers and what can be safely ignored.

Uncertainty can be difficult to get across clearly. It can be frustrating. It can make decisions harder. But it is an inherent part of scientific research and will always be a part of the policy-making process. Of that we can be certain.

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- <https://post.parliament.uk/type/postnote/>



EFFECTIVE VENTILATION FOR AIR QUALITY AND INFECTION CONTROL



Frank Mills FIMechE FCIBSE
MASHRAE
Consulting Engineer



Matt Rooney CEng MIMechE
Head of Engineering Policy, IMechE



IMechE Pandemic Infection Control
Solutions group.

Covid-19 has sharply highlighted the importance of indoor air-quality. In their response to the pandemic, the Government focussed attention on vaccines and had excellent success. However, during the initial months the country was slow to implement ventilation strategies that could have reduced the rate of virus transmission in enclosed indoor spaces.

Effective ventilation can reduce the level of harmful pathogens carried in respiratory particles thereby diluting the levels of virus suspended in the air. This is particularly important in buildings like hospitals and care facilities where occupants are more vulnerable to airborne infections, and schools due to the high impact on wider society of outbreaks in educational settings.

In North America, where a greater reliance on engineering systems is common for the control of indoor environments, due in part on more extreme weather conditions, ventilation improvements to control Covid-19 spread were more commonly implemented. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) formed a task force and started producing information to help building owners and operators and they ran training courses for engineers in the detailed aspects of infection control engineering focussed onto ventilation.¹

In the UK, the importance of ventilation to mitigate transmission was highlighted in

early Spring 2020 by the SAGE Environment and Modelling Group. The Institution of Mechanical Engineers (IMechE) have reacted to the Covid crisis by producing guidance on how to reduce transmission and the Chartered Institute of Building Service Engineers (CIBSE) has also published data on ventilation and air cleaning and made it freely available.^{2,3}

VENTILATION AND ENERGY USE

Infection control solutions, such as better ventilation, were not widely adopted or promoted by government for almost 12 months. In some instances, schools had to resort to keeping windows and doors open to promote higher ventilation rates, leading to uncomfortable classrooms in cold weather.

Advice from professional engineers included guidance on ventilation that recommended all building owners and operators to use full fresh air and to limit any recirculation as far as practically possible. In buildings that had large scale ducted systems such as VAV (variable air volume) or 100% air systems, the air handling plant had to be

modified to use 100% fresh air supply and to reject all extracted air. Whilst these buildings could still be occupied and controlled for comfort, their usage of energy and associated carbon emissions increased significantly.

Although this response was appropriate as a short-term response for existing buildings, any longer-term policies or investments made in improving ventilation must consider the parallel need to reduce carbon emissions. Effective air cleaning or heat recovery strategies can be solutions that reduce emissions and deliver more sustainable and healthy environments.

ENGINEERING SOLUTIONS FOR INFECTION CONTROL

Although good ventilation should always be the number one priority, it can be difficult and expensive to implement, especially in existing buildings. Shorter term solutions such as in-room air cleaners (UVC or HEPA filter-based devices) can be deployed to remove airborne pathogens and create a safe environment in many settings. Building Regulations Part F have

recently been issued and allows recirculation provided the air is cleaned using UVC or HEPA filtration.

These devices typically use fan to draw air through a standalone device and use various technologies to remove or inactivate microorganisms and other pollutants returning clean air back to the room. Devices which contain fine filters (HEPA filters) are the most common, however there is another class of devices which are as effective and use ultraviolet light in the UVC wavelength as the core technology. UVC doesn't physically remove pathogens but works by damaging their DNA or RNA and rendering them inactive so that they are no longer infectious.

Independent and local trials at St Teresa's school in Morden and elsewhere, using computational fluid dynamics (CFD) modelling and measurement, have shown how the installation of UVC in-room

standalone air cleaners can reduce the concentration of virus in air. Direct measurement of the effect on infection rates is challenging but early indication suggests that there may be benefits in reducing sickness absence.⁴

A report published in October 2021 by the House of Commons Health and Social Care and Science and Technology Committees failed to mention ventilation in any detail and certainly not as a major strategy. Effectively applied ventilation system will achieve a relatively safe indoor environment and allow people to get back to normal, albeit alongside other strategies such as reducing occupant density and good workplace sickness policies.⁵

One of the more successful 'immediate' solutions being investigated uses in-room UVC air cleaners in healthcare applications, including dental theatres and Rapid Assessment

Point Wards where hospitals have been able to accept patients delivered by ambulance promptly and safely into sanitized areas for triage.

Air cleaners remove particles and pathogens but not gases. Therefore, areas using medical gases should be designed to ensure removal and dilution. Fresh air change rates must be sufficient to dilute gases as required. Development of these additional measures has focussed onto use of UVC with basic filtration and the air cleaning is carried out by the UVC lamps.

A range of supplementary air cleaning strategies for healthcare have been developed to supplement existing ventilation and to overcome some of the deficiencies of existing systems. Where air change rates are lower than the required standard, additional air changes can be added by installing recirculating air cleaners. Members of IMechE in conjunction with NHS

Improvement have also led the development of a new standard for the use of in-room UVC air cleaners for healthcare settings which is expected to be published shortly.

THE IMPORTANCE OF AIR QUALITY

Engineered infection control can provide a safe and resilient environment and allow people to continue their day-to-day activity in safety. However, the UK has not required anything but the most basic standard of air cleanliness for any buildings apart from some workplaces and hospitals and even then it is only a requirement in 'clinical areas'. For almost all other buildings and for hospital areas that are non-clinical, such as the cafeteria, restaurant, shop, reception desk and so forth, air cleanliness is not a specific requirement.

The UK ventilation standard for hospitals is in fact a world leading code of practice and has

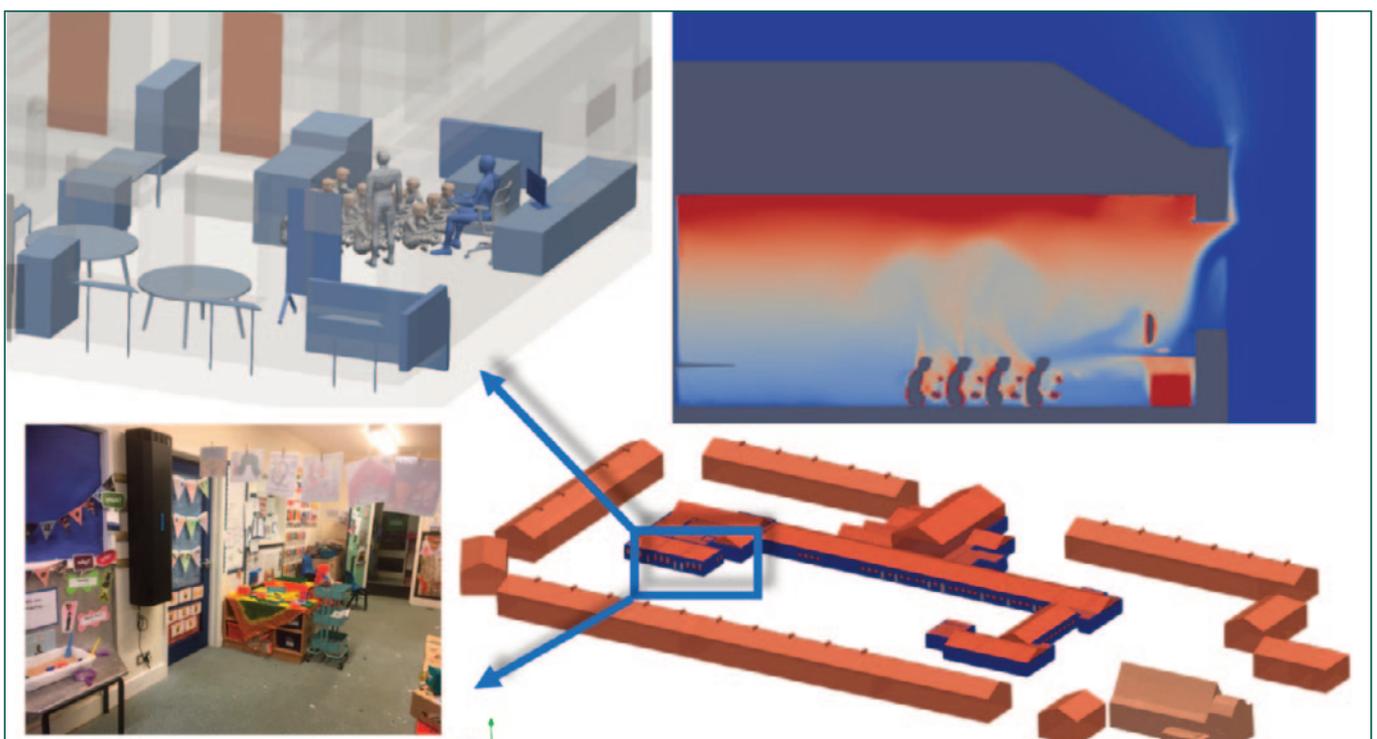


Figure 1: Computational fluid dynamics modelling of St Teresa's school in Morden showing effect of a UVC in-room air cleaner

achieved success over many years since its initial introduction in 1995. The code, now known as HTM 03-01, was revised in 2020, republished in 2021 and sets acceptable basic (minimum) requirements for hospital ventilation, air quality and control of airborne transmissions including Covid-19.⁶ However, it is likely that only 45% of UK hospitals comply with this standard because 55% were constructed before 1995 and have inherited older systems. Engineers who have been involved in assisting hospitals deal with infection outbreaks report finding inadequate ventilation - or even no ventilation in some spaces.

Leading scientists have expressed concern at the poor track record in dealing with airborne infections and the somewhat optimistic viewpoint that air, and particularly outdoor air commonly referred to as 'fresh air', is somewhat 'clean', when in fact air quality varies greatly and 'outdoor' air may be heavily polluted or may well be 'clean' and relatively safe but will vary over time, depending on location and wind direction.

These concerns are summarised and expressed in a paper compiled by a group of the leading scientists and engineers (entitled *A paradigm shift to combat indoor respiratory infection*⁷), which calls for a substantial change in society and government attitude to air quality and effectively setting out the case for taking positive steps to ensure good air quality for all.

FUTURE WORK

In July 2021, engineering institutions, including the IMechE, collaborated through the National Engineering Policy Centre (NEPC) to produce *Infection Resilient Environments*.⁸ This was a report requested by the Government Chief Scientific Adviser Sir Patrick Vallance and it lays out engineering solutions and related training and regulatory steps to achieve infection control and lower infection risk environments. This research is in the second stage of actioning clear recommendations towards a more infection-resilient infrastructure with another report to be published in the summer.

The IMechE have begun the process of purchasing or leasing air cleaners for use in our London headquarters, One Birdcage Walk. We will be trialling these systems and report the findings later in the year.

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Dr Andrew Bodey

With apologies to Dr Andrew Bodey, a section of text was incorrectly formatted in the Winter issue, below is the correct version. Members can read Dr Bodey's revised article by going to: www.scienceinparliament.org.uk

The problem is that fossil fuels are so good at what they do. They are plentiful, portable, scalable, reliable, energy dense and cheap. Unlike solar and wind, there are no problems with intermittency. Unlike batteries, they add so little bulk and weight that you can use them even for long-haul air transport (gasoline holds 35 times more energy per kg than the best lithium-ion batteries). Fossil fuels can be transported around the globe and burned only where and when they're needed. Oil is so cheap that it *actually costs less than the cheapest fizzy drinks*. (The extra cost of zero-carbon alternatives to various manufacturing materials and transport fuels are shown in Fig 5.) For *alternative* technologies to become *default* technologies, they will have to compete with all this. Innovation is therefore vital.



STEM for BRITAIN 2022

PARLIAMENTARY AND SCIENTIFIC COMMITTEE SHOWCASES BRITAIN'S FUTURE

Scientists Engineers Technologists Mathematicians

On Monday 7th March 2022, 120 early career researchers from universities and research institutions from across the United Kingdom came to Westminster to take part in STEM for BRITAIN.

This annual poster competition and exhibition is organised by the Parliamentary and Scientific Committee and designed to encourage interaction with MPs and Parliament. The event marked our return to Parliament for the full competition after two years and the 25th anniversary of its inception.

During the course of the day these scientists, engineers, technologists and mathematicians had the opportunity to show their posters and explain their research to over 50 Parliamentarians from both Houses.

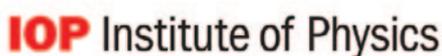
We were delighted to welcome The Speaker of the House of Commons to STEM for BRITAIN. The Rt. Hon Sir Lindsay Hoyle MP is the first holder of this office to attend our event.

The competition comprised of five specialist sections: Biological and Biomedical Sciences; Chemistry, Engineering, Mathematics, and Physics,

Gold, Silver and Bronze winners in each category received certificates and cash prizes, with medals going to the Gold winners.

The Physiological Society Prize was awarded for the fourth year running, and the Nutrition Society for the third. The Dyson Sustainability Award was presented in a new format, and IEEE Communications UK & Ireland Section gave two prizes

At the end of the day the winners of the five Gold medals competed for the Westminster Medal in memory of Dr Eric Wharton, founder of STEM for Britain. Here, with the quality of the science already proven with a Gold medal, the judges had to decide which of the five posters best



demonstrated the presenter's skill in communicating the scientific concept.

Judging panels for each category were formed of distinguished scientists, engineers and mathematicians from the Royal Academy of Engineering, the Royal Society of Chemistry, the Institute of Physics, the Royal Society of Biology, the Council for the Mathematical Sciences, The Physiological Society and the Nutrition Society.

The judges' initial task had been to select the 120 posters for the exhibition and final of the competition from nearly 400 high quality entries. We thank the judges for all their hard work in this process.

STEM for BRITAIN is a two-way process designed to strengthen the dialogue between Parliament and the science, technology, engineering and mathematical communities.

The event would not be possible without the help of all the major learned societies involved in organising the event, mentioned above, together the organisations which generously supported and sponsored the event, including: the Clay Mathematics Institute, Dyson Ltd, UK Research & Innovation, the Institute of Biomedical Science, the Heilbronn Institute for Mathematical Research, the Biochemical Society, IEEE Communications Group, and the Society for Chemical Industry.

The researchers who exhibited and displayed their work are the true 'engine room' of R&D. The success of the UK in the competitive knowledge economy of the 21st Century is going to depend crucially on their expertise.

STEM for BRITAIN 2023 will be held on **Monday 6th March**.

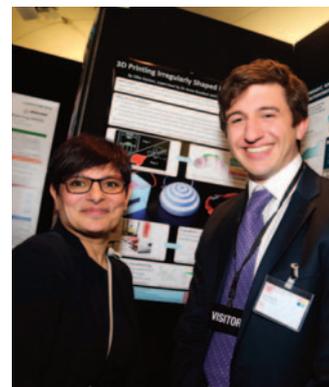
Applications open on **Monday 12th September** and close on **Monday 5th December 2022**.



Stephen Metcalfe MP, Chair, STEM for BRITAIN



Daniel Gass and Daniel Johnson, University of Central Lancashire (Physics) with **The Speaker, Rt.Hon Sir Lindsay Hoyle MP**



Thangam Debbonaire MP with Ollie Hanton, University of Bristol (Engineering)

THE WINNERS!

BIOLOGICAL AND BIOMEDICAL SCIENCES
Gold and Silver Sponsor: Institute of Biomedical Science
Bronze Sponsor: Biochemical Society



GOLD
Miquel Serna-Pascual, King's College London
Hidden Disease Signs in The Pattern of Breathing

THE PHYSIOLOGICAL SOCIETY AWARD

Miquel Serna-Pascual, King's College London
Hidden Disease Signs in The Pattern of Breathing



SILVER
Hamish Symington
University of Cambridge
Improving Flowers to Help Feed The World



BRONZE
Claire Laxton
University of Nottingham
Using an Artificial Simulated Wound Infection Model to Study Pseudomonas Aeruginosa Nutrient Scavenging by AaaA

THE NUTRITION SOCIETY AWARD



Orla Woodward
University of Cambridge
Characterisation of an Appetite-Modulating Neuronal Population in the Mouse Brain

ENGINEERING

Sponsored by the Parliamentary & Scientific Committee



GOLD

Gor Piliposyan
University of Liverpool
Hardware Security of Electronic Devices



SILVER

Hayden Salway
University of Cambridge
Perovskite Composites for Next Generation
X-Ray Detectors

CHEMISTRY

Sponsored by The Nutrition Society



GOLD

Katherine Macfarlane
University of Strathclyde
Exploiting DNA-Encoded Library Technology
for the Discovery of Novel Antibody
Recruiting Molecules against Lox-1



BRONZE

Jorge Corral Acero
University of Oxford
Automated 3D Shape and Contraction
Analysis of the Heart saves lives after
Myocardial Infarction



BRONZE

Madeleine Wyburd
University of Oxford
Using Deep Learning to Measure the Foetal
Brain in 3D from Ultrasound Volumes



SILVER

Abigail Collins
University of Cambridge
Tuning The Solar Spectrum: Green-To-Blue
Light Upconversion

IEEE COMMUNICATIONS AWARD Sponsored by IEEE UK & Ireland Section



Gor Piliposyan
University of Liverpool
Hardware Security of Electronic Devices

IEEE CIRCUITS & SYSTEMS AWARD Sponsored by IEEE UK & Ireland Section



Zeliang Zhang
University of York
Easy-Updated Embedded Limp-Home
Strategy for Post-Fault Powertrain
Operation in EVS



BRONZE

John Hudson
Swansea University
Unlocking the Magnetic Properties of
Radicals for Sustainable Technologies

MATHEMATICAL SCIENCES

Gold and Silver Sponsor: Clay Mathematics Institute
Bronze Sponsor: Heilbronn Institute of Mathematical Sciences



GOLD
Matthew Tointon
University of Bristol
Probability on Finite Transitive Graphs



SILVER
Teresa Bautista
King's College London
Mathematical Microscopy into our Expanding Universe



BRONZE
Desislava Ivanova
University of Oxford
Automated Adaptive Design in Real Time

PHYSICS

Sponsored by the Parliamentary & Scientific Committee



GOLD
Adele Parry
University of Leeds
A Better Lateral Flow Test? The Design of Novel Liquid Crystal Droplet Biosensors



SILVER
Georgina Shillito
University of St Andrews
Looking Through The Glass: Probing Concealed Samples in Closed Containers Using Shaped Laser Light



BRONZE
Ancy Anna John
University of St Andrews
Planets or Stellar Activity, Unveiling The Uncertainty

DYSON SUSTAINABILITY AWARD



FIRST PRIZE
John Hudson
Swansea University
Unlocking the Magnetic Properties of Radicals for Sustainable Technologies



SECOND PRIZE
Alexandra Jones
University of Manchester
Membrane-Free Organic Redox Flow Batteries



THIRD PRIZE
Katherine Kwa
University of Southampton
Enhanced Whole-Life Anchoring Systems for Offshore Floating Wind, Wave and Tidal Energy Devices

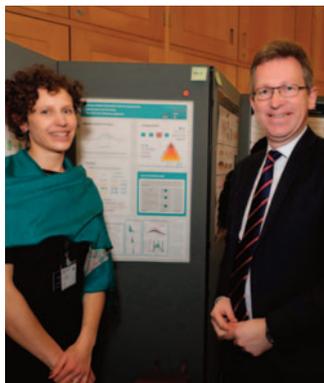
THE WESTMINSTER MEDAL Sponsored by Society of Chemical Industry



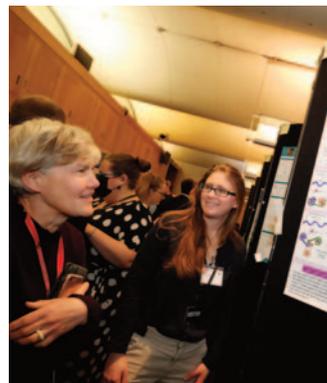
Adele Parry
University of Leeds
A Better Lateral Flow Test? The Design of Novel Liquid Crystal Droplet Biosensors



Chris Matheson MP with Thomas Spriggs, Swansea University (Physics)



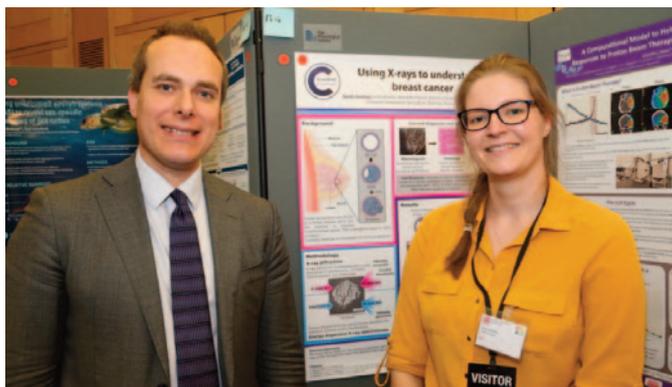
Alice Corbella, University of Warwick (Maths) with **Jeremy Browne MP**



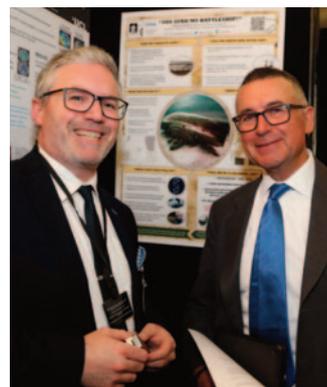
Kate Green MP and Zoe Ashridge, University of Manchester (Chemistry)



Stasa Stankovic, University of Cambridge (Biosciences) with **Daniel Zeichner MP**



David Johnston MP and Sarah Gosling, Cranfield University (Biosciences)



Gareth Thomas, University of Essex (Biosciences) with **Sir Bernard Jenkin MP**



Filipe Richeimer, National Physical Laboratory (Engineering) with **Fleur Anderson MP**



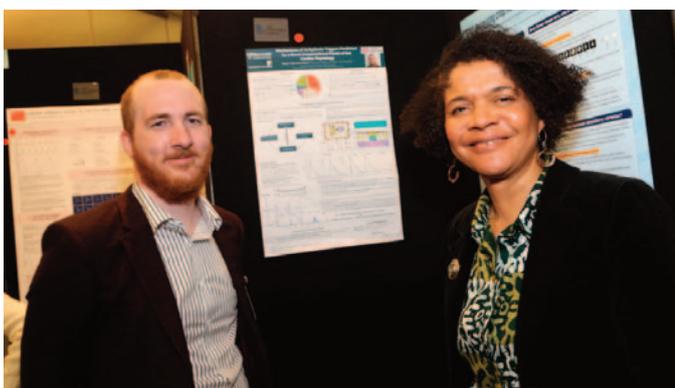
Bim Afolami MP and Holly Bonfield, GSK/University of Strathclyde (Chemistry)



Ferran Brosa Planella, University of Warwick (Maths) and **Matt Western MP**



Joseph Davies, Imperial College London (Physics) and **Florence Eshalomi MP**



Harley Stevenson-Cocks, Newcastle University (Biosciences) with P&SC Deputy Chair, **Chi Onwurah MP**



Caroline Nokes MP and Sophie Read, University of Reading (Biosciences)

LIVING WITH RISING SEAS: EVIDENCE BASED ACTION IN MANAGING THE COAST

This article follows a presentation given to the Parliamentary & Scientific Committee on the 21st February 2022



Paul Wisse



Carl Green
Wyre Council, Head of Engineering

The coast is an ever-changing place, driven by rising sea levels our coastline will experience increased erosion and flooding. It will also affect how coastal areas drain and will influence groundwater levels. This will have major implications for our coastal communities and the millions of visitors.

Rising sea levels also increase the level of energy at our coasts causing the loss of salt marshes and beaches. These are the first line of defence as well as important areas of bio diversity and carbon sinks. Where coastal defences have been installed this results in coastal squeeze where the buffer habitat reduces, ultimately undermining the defences. For unprotected areas erosion of the coast occurs. As a society we need to make difficult long term decisions adopting new approaches that work with, not against, nature.

A move away from hardening our coasts through the use of concrete and steel to working with nature was first proposed by the National Trust in its' 2005 Shifting Shores report with a clear message that – as a nation we can no longer rely solely on building our way out of trouble on the coast. This message is also at the forefront of the Environment Agency's 2020 Strategy. The strategy looks out to 2100 promoting 'adaptive pathways' that enable local places to better plan for future flooding and coastal change and adapt to future climate hazards. At the heart of this is being agile to the latest climate science and encouraging innovation in flood

risk management (FRM).

Adaption means different things to different audiences. For some communities it will mean difficult decisions to retreat from the coast where the risk becomes too great. It certainly requires agility to respond to environmental changes and scientific evidence that gives greater certainty to act and trust in decision makers. Whether current policy supports this agile approach is a moot point. Certainly, current investment routes for critical FRM infrastructure take decades to implement, planning for the Thames barrier for instance commenced after the tragic 1953 east coast floods and was completed nearly 30 years later in 1982. A number of steps are being taken to ensure we plan for the future of our coast in a sustainable manner.

In England and Wales the planning of new coastal defence schemes and management of the coast is carried out within the context of a Shoreline Management Plan (SMP). The SMP is a large-scale assessment of the risks associated with coastal processes and helps reduce these risks to people and the developed, historic and natural environments. Coastal

processes include tidal patterns, wave height, wave direction and the movement of beach and seabed materials. The SMPs set the strategic policy direction for coastal management and identify the most sustainable approaches to managing the risks to the coast in the short term (Epoch 1 0-20 years), medium term (Epoch 2 20-50 years) and long term (Epoch 3 50-100 years). The 22 SMPs are currently being refreshed to make sure the Plans are up to date, relevant, reliable and visible, and ensure they remain 'living' documents.

The Department of Food and Rural Affairs are investing in the innovative approach required for future coastal management through their Innovative Resilience Programme. This process has championed working with nature. The North West & North Wales coastal group was successful in a bid for Ecological Community Owned Buffer Strips ECO-CoBS which seeks to work with nature to provide time and space for the coast to adapt to climate change. The ECO-CoBS project will develop a suite of natural buffer strips to increase the coastal resilience of vulnerable hot-spots in the North West.

The application of natural and nature-based features (NNBF) has grown steadily over the past 20 years and is brought together in the 2021 US Army Corp of Engineers sponsored International Guidelines on Natural and Nature-Based Features for Flood Risk Management (NNBF Guidelines). The reports' overarching observations include:

them to act and be given sufficient information to overcome the natural inertia to change. An important part of this process is involving communities in the process of monitoring through greater sharing and clarity of the data together with direct involvement through citizen science.

The Northwest Regional Coastal Monitoring Programme, established in 2011, was

speed up the decision-making process.

Following the SMP refresh a series of triggers are in development to initiate appropriate actions to create a more dynamic application of the plan, this could be enhanced monitoring, emergency works, a larger scheme development starts, or a review of policy is undertaken. The development of triggers is very site specific and

This programme collects datasets on coastal processes and coastline response, the physical characteristics of coastal change, however, this is only part of the overall evidence base that is needed. The data collection is based on the level of risk to the surrounding communities, where the higher the risk from flooding or erosion the more data collection takes place. However, the level of risk can change as the coastline



Sefton Coast SSSI sand dunes system at Formby. The dunes are eroding at rates of up to 4m/y and provide the main coastal defence to the town of Formby. The site is managed in a way that is sensitive to working with natural processes and allows the dunes to roll back naturally.



Grange over Sands communities and infrastructure rely on natural systems such as Saltmarsh to provide protection. The saltmarsh in this area is particularly sensitive to channel movement any change in forcing conditions could significantly alter this.

- Natural features and landscapes have always contributed to flood resilience
- Sustainable FRM systems will include combinations of conventional, natural, and naturebased elements.
- The flexibility and adaptability of NNBF are useful for achieving flood resilience.
- Innovation in practice will be key to addressing future problems and opportunities.
- Coordination, collaboration, and partnership will fuel successful implementation of NNBF.

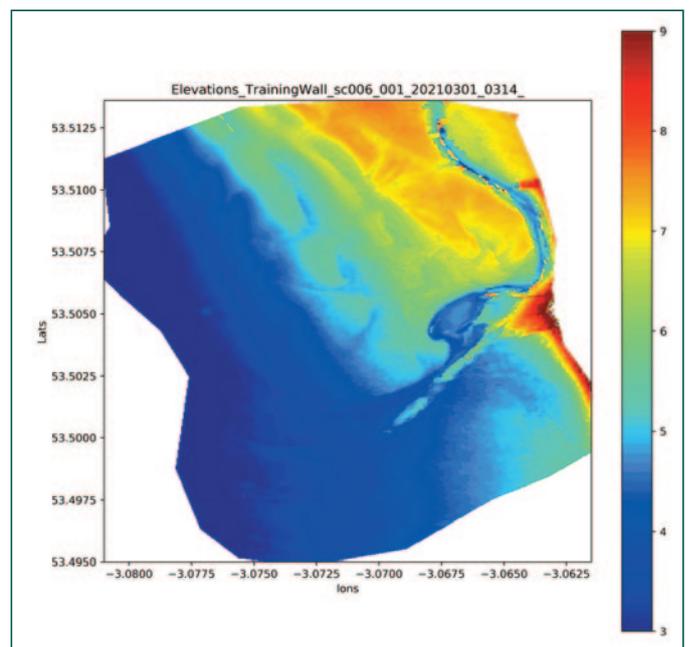
These new approaches will require coastal communities to be a greater part of the process; both in understanding the risk and taking greater ownership of the solution. It will also require

developed to understand coastal change at a local and regional level to inform the delivery of the SMP and support other sustainable coastal management decisions. The programme is part of a National Network of Regional Coastal Monitoring Programmes which coordinates and share best practice across the country and to ensure appropriate data collection is taking place. Funding is sought on a 6-year cycle through the Environment Agency's flood and coastal erosion risk management investment programme.

The programme is aspiring to create a common understanding, or 'one truth', across all partners and users of coastal data, where everyone is using the same information sources to bring consistency and

can vary across a short length of coast, they are also likely to change over time as the impacts of sea level rise are felt.

evolves over time and in response to climate change, and as such the monitoring needs to be able to flex to respond to this.



Intertidal topographic model derived from radar images over a tidal cycle.

Optimising the monitoring is a necessity to ensure that appropriate data is collected to provide a robust evidence base and new and emerging technologies are regularly reviewed for their suitability.

The programme has invested in technology, originally developed by the National Oceanography Centre, using radars to provide 24/7 data collection of several derived datasets such as bathymetry, intertidal topography, surface currents and some wave parameters. There currently isn't any other method to achieve this in a cost-effective manner.

The radars are a significant step

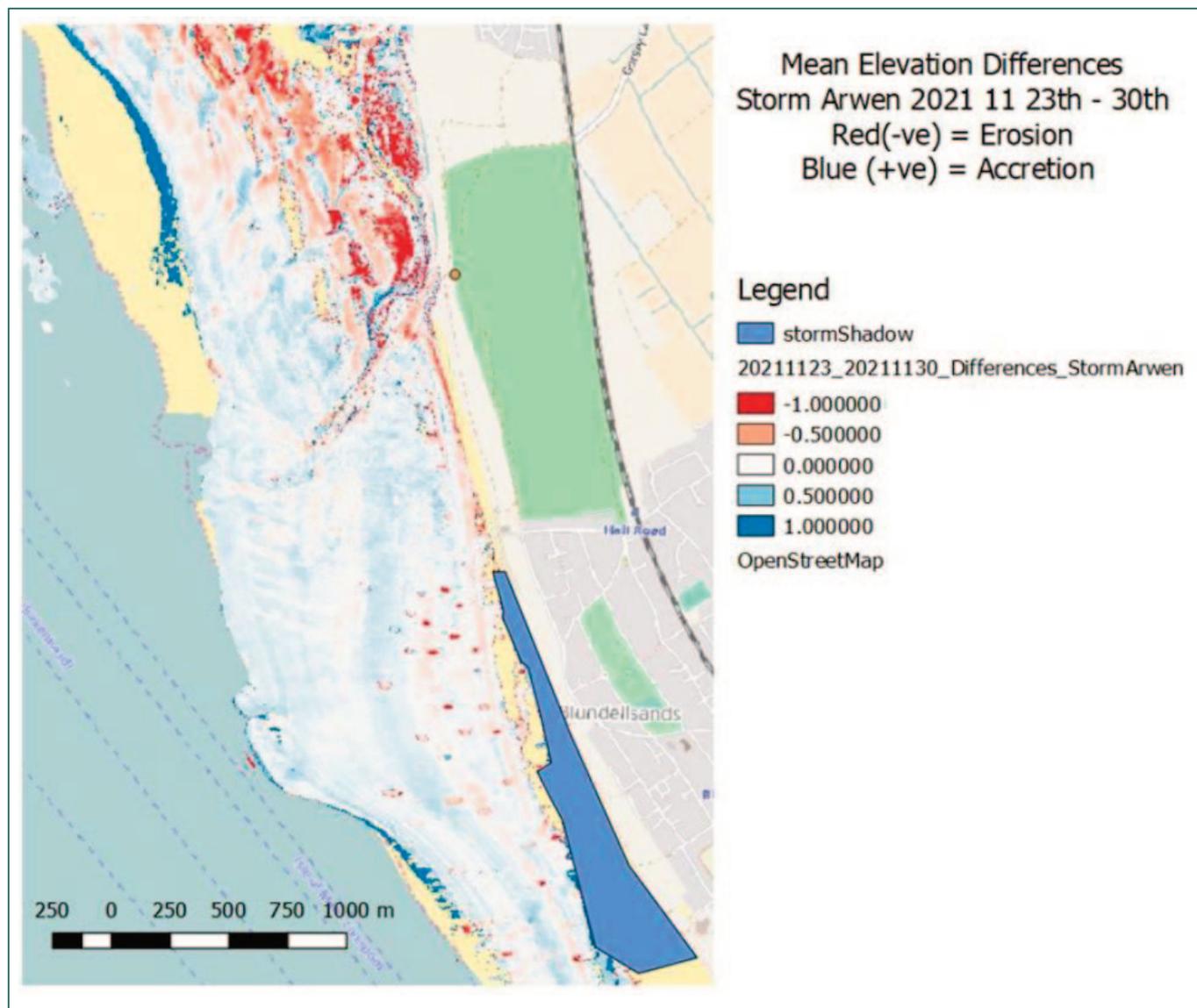
forward to understand how the Northwest's sedimentary coasts are behaving and responding to storm events but it can also provide information to other users, for example it can track bird movements, which is particularly important on designated sites, and currently being explored is supporting RNLI with their launching and emergency assessments at Lytham.

The coast has always changed and communities have adapted to the shifting shores. However, climate change and the influence of sea level rise will require greater adaptability and agility. This will require proactive

working across government departments and farsighted policy options that give coastal communities resourced options that can be implemented in a timely manner.

Nature based solutions will continue to be an important part of FRM but it will innovation in practice and community ownership of them that is needed to address future challenges and maximise opportunities. Gathering the evidence to demonstrate the effectiveness of nature based solutions and the complex series of parameters shaping the coastline is critical for an adaptable and sustainable coast.

The requirement for a "single truth" which is used to communicate future risks and evaluate interventions is urgently required. Coastal communities must be at the heart of decision-making and are key to the success of future FRM. □



Storm Arwen - Radar derived difference model of beach levels following storm Arwen.

The Move to Sustainable, Non-Fossil Carbon Feedstocks

One key industry in push to tackle the climate emergency is the petrochemical industry, amounting to 11% of our carbon dioxide emissions. This evening, organised in partnership with the Society of Chemical Industry, we heard from four expert speakers about how this industry is changing and what needs to be done to further progress. Andreea Sapunaru, Clean Future Marketing Director for Unilever Fabric Cleaning, spoke to us about consumer considerations when moving to more sustainable options and how Unilever is trying to make sustainability more accessible. Thomas Birk, Vice President and Managing Director at BASF UK & Ireland, spoke to us about the industry producing the necessary chemical for many everyday products and how we can look for more sustainable production. Nick Challoner, Group Chief Scientific Officer at Croda International PLC, spoke to us about how Croda specifically is moving to more sustainable production and how these methods could be used by the wider industry. Lastly, Dr Jem Woods, Reader in Sustainable Development at Imperial College's Centre for Environmental Policy, explained the scale of the challenge we face and what key considerations need to be made when implanting policies. The Q&A section focused largely on how government can help the petrochemical industry meet the necessary targets for environmental impact reduction.

Consumers want to be more sustainable, and Ms Sapunaru explained how over recent years awareness of the environmental impact of products has been rising; at the height of the pandemic 71% of Unilever's costumers believed that tackling climate change was just as important as tackling COVID-19. However, customers still require products to be effective and affordable, and so Unilever is working to reduce their products environmental impact whilst still keeping costs down and quality high. However, Unilever can only

go so far, as it's a downstream consumer of materials produced from petrochemicals.

The key challenge for this industry is in the production of these chemicals. Mr Birk explained how the processing plants run by BASF are large and highly efficient, and we'll need a method of reducing carbon output whilst keeping this efficiency. That is possible, with one options being the use of palm oil as a source of fatty acids to produce the chemicals required. However, this isn't without its challenges, and considerations of land use need to be taken seriously. Mr Challoner outlined how Croda aims to be climate positive, land positive, and people positive by 2030. A key way to achieve these is to use biomaterials to produce the necessary chemicals for their cliental. It's also necessary to consider how carbon is used over the whole supply chain. For a lot of companies are large portion of the environmental impacts comes from 'indirect' emissions, such as through customer processing or end of life treatment of materials. All of these need to be taken into account to limit environmental impact.

Croda is well-positioned to make these changes, but all of the guest speakers outlined the need for a wider industry and governmental strategy to meet the necessary targets. Dr Woods explained the scale of the challenged faced here. The industry is a complex interconnection of entities and all of these need to work in a coordinated manner to achieve the necessary changes. Dr Woods also outlined how as a society we need to be able to feed more people, produce more energy and materials for people, whilst reducing emissions. This simply isn't possible without a coordinated strategy.

*Alfie Hoar
P&SC Discussion Meeting, 'The Move to
Sustainable, Non-Fossil Carbon Feedstocks'
28th March 2022*



HOUSE OF COMMONS SELECT COMMITTEES

BUSINESS, ENERGY AND INDUSTRIAL STRATEGY COMMITTEE

The Business, Energy and Industrial Strategy Committee scrutinises the policy, spending and administration of the Department for Business, Energy and Industrial Strategy and its public bodies, including Ofgem, the Financial Reporting Council and the Committee on Climate Change.

The Committee regularly holds accountability evidence hearings with Government Ministers and with bodies such as the Financial Reporting Council, the Committee on Climate Change and Ofgem. The BEIS Committee also hears from a range of stakeholders in the course of its work, receiving evidence from academics, business groups, NGOs and charities to its inquiries.

Membership:

Darren Jones MP, Labour, Chair
Alan Brown MP, Scottish National Party
Judith Cummins MP, Labour
Richard Fuller MP, Conservative
Nusrat Ghani MP, Conservative
Paul Howell MP, Conservative
Mark Jenkinson MP, Conservative
Andy McDonald MP, Labour
Charlotte Nichols MP, Labour
Mark Pawsey MP, Conservative
Alexander Stafford MP, Conservative

Inquiries:

- Net zero and UN climate summits - Opened 6 March 2020. Government response published 17th May 2021.
- The impact of coronavirus on businesses and workers - Opened 13 March 2020. Government response published 19th May 2021.
- Delivering audit reform - Opened 18 March 2020.
- Work of the Department and Government Response to coronavirus - Opened 14 April 2020
- Post-pandemic economic growth - Opened 3 June 2020.
- Post-pandemic economic growth: Industrial Strategy – Opened 23rd July 2020. Government response published 24th September 2021.
- Post-pandemic economic growth: Levelling up local and regional structures and the delivery of economic growth – Opened 24th July 2020. Report published 3rd December 2021.
- Forced Labour in UK value chains – Opened 18th September 2020. Government response published 8th July 2021.
- Decarbonising heat in homes – Opened 2nd October. Accepting written evidence until 13th November 2020.
- Business and Brexit preparedness – Opened 17th November 2020.
- Mineworkers' Pension Scheme – Opened 18th March 2021. Government response published 5th July.
- Findings of the Report of Climate Change Assembly UK – Opened 19th April 2021. Government response published 9th September.
- Liberty Steel and the Future of the UK Steel Industry – Opened 27th April 2021. Report published 5th November 2021.

- Net Zero Governance: Opened 23rd June 2021.
 - Post-pandemic economic growth: State Aid and Post Brexit Competition Policy. Opened 23rd September.
 - Energy National Policy Statements – Opened 3rd November 2021
 - Energy Pricing and the future of the Energy Market – Opened 8th December 2021. Written evidence. Deadline 31st January 2022.
- For further details: Tel: 020 7219 5777 Email: beiscom@parliament.uk

ENVIRONMENTAL AUDIT COMMITTEE

The remit of the Environmental Audit Committee is to consider the extent to which the policies and programmes of government departments and non-departmental public bodies contribute to environmental protection and sustainable development, and to audit their performance against sustainable development and environmental protection targets.

Unlike most select committees, the Committee's remit cuts across government rather than focuses on the work of a particular department.

From its beginning in 1997, in carrying out its environmental 'audit' role the Committee has had extensive support from the National Audit Office, providing seconded staff and research and briefing papers.

Membership:

Rt Hon Philip Dunne MP, Conservative, Chair
Duncan Baker MP, Conservative
Sir Christopher Chope MP, Conservative
Barry Gardiner MP, Labour
Rt Hon Sir Robert Goodwill MP, Conservative
James Gray MP, Conservative
Helen Hayes MP, Labour
Ian Levy MP, Conservative
Clive Lewis MP, Labour
Caroline Lucas MP, Green Party
Cherilyn Mackrory, Conservative
Jerome Mayhew MP, Conservative
John McNally MP, Scottish National Party
Dr Matthew Offord MP, Conservative
Claudia Webbe MP, Independent

Inquiries

- Preparation for COP26 - Opened 17 March 2020.
- Greening the post-Covid Recovery - Opened 13 May 2020. Government response published 22nd June 2021.
- Energy Efficiency of Existing Homes - Opened 18 May 2020. Government response published 13th May 2021.
- Biodiversity and Ecosystems – Opened 13th July 2020. Report published 30th September 2021.
- Fixing Fashion follow up – Opened 6th October 2020
- Technological Innovations and Climate Change: Tidal Power – Opened 9th November 2020
- Green Jobs – Opened 17th November 2020. Report published 25th October 2021.
- Water Quality in Rivers – Opened 8th December 2020.

- Technological Innovations and Climate Change: Community Energy – Opened 19th February
- Sustainability of the built environment – Opened 25th March 2021
- Technological Innovations and Climate Change: Supply chain for Battery Electric Vehicles – opened 4th May 2021
- Mapping the path to net zero: Opened 25th June 2021.
- Net zero aviation and shipping: Opened 20th July 2021.
- Carbon border adjustment mechanism: Opened 24th September 2021.
- Technological Innovations and Climate Change: Negative emissions and Technologies – Opened 28th September 2021.
- Aligning the UK's economic goals with environmental sustainability – Opened 29th November 2021.
- Technological Innovations and Climate Change: Green Steel. Opened 3rd February 2021.

For further details: Tel: 020 7219 5776 Email: eacom@parliament.uk

SCIENCE AND TECHNOLOGY COMMITTEE

For further details: Tel: 020 7219 2793

Email: scitechcom@parliament.uk

The work of many Government departments makes use of – or has implications for – science, engineering, technology and research. The Science and Technology Committee exists to ensure that Government policies and decision-making are based on solid scientific evidence and advice. It is chaired by Greg Clark MP.

The Committee has a similarly broad remit and can examine the activities of government departments that make use of science, engineering, technology and research (otherwise known as science for policy). In addition, the Committee scrutinises policies that affect the science and technology sectors, such as research funding and skills (often referred to policy for science).

Membership:

Rt Hon Greg Clark MP, Conservative, Chair
 Aaron Bell MP, Conservative
 Dawn Butler MP, Labour
 Chris Clarkson MP, Conservative
 Dehenna Davison MP, Conservative
 Katherine Fletcher MP, Conservative
 Mark Logan MP, Conservative
 Rebecca Long-Bailey MP, Labour
 Carol Monaghan MP, Scottish National Party
 Graham Stringer MP, Labour
 Zarah Sultana MP, Labour

Inquiries

- UK Science, Research and Technology Capability and Influence in Global Disease Outbreaks. – Opened 20 March 2020. Government response published 14th May 2021.
- The role of technology, research and innovation in the COVID-19 recovery – Opened 24th July 2020.
- Coronavirus – Lessons Learnt – Opened 6th October 2020. Report published 12th October 2021.
- The Role of Hydrogen in Achieving Net Zero – Opened 4th December 2020.
- UK space strategy and UK satellite infrastructure – Opened 23rd April 2021.
- Reproducibility and research integrity. Opened 22nd July 2021. Closed 30th September 2021.

- Diversity and inclusion in STEM – Opened 22nd November 2021.
- The right to privacy: digital data – Opened 16th December 2021.

HEALTH AND SOCIAL CARE COMMITTEE

The Committee scrutinises government and in particular the work of the Department of Health and Social Care. It is chaired by Jeremy Hunt MP.

The Committee also scrutinises the work of public bodies in the health system in England, such as NHS England and Improvement, Public Health England and the Care Quality Commission, and professional regulators such as the General Medical Council and the Nursing and Midwifery Council. They do so by holding inquiries on specific topics and accountability hearings with the Secretary of State, and Chief Executives of relevant public bodies.

Membership:

Rt Hon Jeremy Hunt MP, Conservative, Chair
 Lucy Allan MP, Conservative
 Paul Bristow MP, Conservative
 Rosie Cooper MP, Labour
 Martyn Day MP, Scottish National Party
 Dr Luke Evans MP, Conservative
 Barbara Keeley MP, Labour
 Taiwo Owatemi MP, Labour
 Sarah Owen MP, Labour
 Dean Russell MP, Conservative
 Laura Trott MP, Conservative

Inquiries

- Workforce burnout and resistance in the NHS and social care – Opened 30th July 2020. Published 8th June 2021.
- Coronavirus – Lessons Learnt – Opened 6th October 2020. Report published 8th October 2021.
- Children and young people's mental health – Opened 29th January 2021. Report published 9th December 2021.
- Treatment of autistic people and individuals with learning disabilities – Opened 3rd February 2021. Report published 13th July 2021.
- Supporting those with dementia and their carers – Opened 12th May 2021. Published 29th October 2021.
- Cancer services: Opened 6th July 2021.
- Clearing the backlog caused by the pandemic – Opened 20th July 2021.
- NHS litigation reform: Opened 22nd September 2021.
- The future of general practice – Opened 16th November 2021.
- Workforce: recruitment, training and retention in health and social care – Opened 23rd November 2021.
- The impact of body image on physical and mental health – Opened 1st December 2021.

For further details: Tel: 020 7219 6182 Email: hscocom@parliament.uk





HOUSE OF LORDS SELECT COMMITTEES

SCIENCE AND TECHNOLOGY COMMITTEE

The Science and Technology Committee has a broad remit “to consider science and technology”. It is chaired by Lord Patel.

The Committee scrutinises Government policy by undertaking cross-departmental inquiries into a range of different activities. These include:

- public policy areas which ought to be informed by scientific research (for example, health effects of air travel),
- technological challenges and opportunities (for example, genomic medicine) and
- public policy towards science itself (for example, setting priorities for publicly funded research).

In addition, the Committee undertakes from time to time shorter inquiries, either taking evidence from Ministers and officials on topical issues, or following up previous work.

Members:

The Baroness Brown of Cambridge DBE FREng FRS, Crossbench, Chair

The Baroness Blackwood of North Oxford, Conservative

Viscount Hanworth, Labour

The Lord Holmes of Richmond MBE

The Lord Krebs, Crossbench

The Baroness Manningham-Buller LG DCB, Crossbench

The Lord Mitchell, Labour

The Lord Rees of Ludlow OM, Crossbench

The Baroness Rock, Conservative

The Lord Sarfraz, Conservative

The Baroness Sheehan, Liberal Democrat

The Baroness Walmsley, Liberal Democrat

The Baroness Warwick of Undercliff, Labour

The Lord Winston, Labour

Inquiries

- The science of COVID-19 Opened 7 May 2020.
- The Contribution of Innovation Catapults to Delivering the R&D Roadmap – Opened 11th November 2020. Government response published 6th April 2021.
- Role of batteries and fuel in allowing Net Zero – Opened 3rd March 2021. Report published 27th July 2021. Government response published 27th September 2021.
- Nature-based solutions for climate change: Opened 9th June 2021. Deadline 30th September 2021.
- Delivering a UK science and technology strategy. Opened 10th February 2022.

For further details: Tel: 020 7219 5750

Email: hlsceince@parliament.uk



PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST)

POST is a bicameral body that bridges research and policy, providing reliable and up-to-date research evidence for the UK Parliament. It is overseen by a Board of MPs, Peers and external experts.

POST briefings are impartial, non-partisan, and peer-reviewed. Timely and forward-thinking, they are designed to make scientific research accessible to the UK Parliament. POSTnotes are four-page summaries of public policy issues based on reviews of the research literature and interviews with stakeholders from across academia, industry, government and the third sector. They are peer-reviewed by external experts. POSTnotes are often produced proactively, so that parliamentarians have advance knowledge of key issues before they reach the top of the political agenda. Our research is published on our website.

POSTnotes produced since January 2022 were:

667: Financial risks of nature loss

666: The use of biological methods in asylum age assessments

665: International shipping and emissions

664: Sharing public sector data

663: Genome edited food crops

662: Restoring agricultural soils

661: Reducing agricultural pressures on freshwater ecosystems

660: Preventing emerging zoonoses

POSTbriefs are responsive policy briefings based on mini-literature reviews and peer reviews. Those produced since January 2022 were:

45: Mining and the sustainability of metals

POST has also continued rapid response articles that summarise the research around COVID-19:

COVID-19: Omicron, recent developments, and the likely impact of future variants on the pandemic

Addressing COVID-19 in the long-term – the role of immunisation

COVID-19 glossary

Ongoing and future projects approved by the POST Board:

BIOLOGY AND HEALTH

In production

Reform of the Mental Health Act – Impacts on People from Black, Asian and Minority Ethnic Communities
Reform of the Mental Health Act impacts on children
Disorders of consciousness
Testosterone and sports performance

ENERGY AND ENVIRONMENT

In production

Green Steel
Biosecurity-invasive non-native species
Low-carbon hydrogen use
Managing soils for carbon and plant productivity
Reducing agricultural pressures on freshwater ecosystems
Geothermal energy resources
Sustainable mining
Peat land restoration

DIGITAL AND PHYSICAL SCIENCES

In production

Cyber warfare
Sharing public sector data
Energy consumption of computing

SOCIAL SCIENCES

In production

The impact of digital technology on arts and culture in the UK
Innovation in adult social care
Invisible disabilities
The impact of remote and hybrid work on workers and organisations

KNOWLEDGE EXCHANGE

In production

Parliament-research knowledge exchange mechanisms around the world

The POST Board oversees POST's objectives, outputs and future work programme. It meets quarterly.

Officers

- Chair: Adam Afriyie MP
- Vice-Chair: Professor the Lord Winston, FmedSci, FRSA, FRCP, FRCOG, FREng
- Secretary: Claire Quigley

House of Commons

- Rt Hon Greg Clark MP
- Katherine Fletcher MP
- Stephen Metcalfe MP
- Maria Miller MP
- Carol Monaghan MP
- Dr Ben Spencer MP
- Alan Whitehead MP

House of Lords

- Lord Oxburgh, KBE, FRS-
- Lord Haskel
- Lord Patel KT, FMedSci, FRSE

Non-parliamentary

- Professor Elizabeth Fisher, FMedSci
- Paul Martynenko, FBCS
- Professor Sir Bernard Silverman, FRS, FAcSS
- Professor Dame Sarah Whatmore, FBA

Ex-officio

- Oliver Bennett MBE, Head of the Parliamentary Office of Science and Technology
- Penny Young, House of Commons Librarian and Managing Director of Research & Information
- Farrah Bhatti, Principal Clerk, Committee Office, House of Commons
- Xameerah Malik, Head of Science and Environment Section, House of Commons Library
- Nicolas Besly, Clerk of Select Committees, House of Lords

Head of POST

- Oliver Bennett MBE

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY

Houses of Parliament
Westminster
London SW1A 0AA



HOUSE OF COMMONS LIBRARY

The House of Commons Library is an impartial research and information service for Members of Parliament of all parties and their staff.

The Library provides confidential, impartial and bespoke briefing to Members of the House of Commons and their offices supporting the full range of parliamentary work, from policy development to constituency issues.

The Library also publishes a range of products including topical research briefings, shorter insight articles and briefings for non-

legislative debates, all of which are available online for MPs and the public. These briefings include analysis of all major pieces of legislation. You can find publications on the Commons Library website (<https://commonslibrary.parliament.uk>) where you can also sign up for alerts.

The Science and Environment Section (SES) is one of eight teams in the Research Service in the House of Commons Library. In recent months they have published and updated briefings on issues including:

Early medical abortion at home during and after the pandemic

Published 15 March 2022, CBP 9496

This briefing looks at how access to early medical abortion has changed during the pandemic.

Animal Welfare (Sentience) Bill

Published on 10 March 2022, CBP 9423

This briefing was published ahead of the Commons remaining stages debates on this bill to require the Government to set up an Animal Sentience Committee to examine whether “the welfare of animals as sentient beings” is considered in policy decisions.

UK vaccination policy

Published 8 March 2022, CBP 9076

This Commons Library briefing paper provides an overview of UK vaccination policy. It includes an introduction to the science of vaccination and covers UK vaccination programmes, as well as considering the response of the Government to the UK's loss of the World Health Organization's (WHO) measles elimination status.

Plastic waste

Published 8 March 2022, CBP 8515

A House of Commons Library Briefing Paper on plastic waste in the UK, including statistics on plastic waste and information on the UK Government and devolved Governments' plans and ambitions to reduce avoidable plastic waste.

Large solar farms

Published 7 March 2022, CDP 2022/0051

A briefing for a debate on large solar farms in Westminster Hall on 9 March.

Debate on an e-petition relating to badger culling

Published on 16 February 2022, CDP 2022/0058

A briefing for a debate on an e-petition relating to badger culling in Westminster Hall on 21 March 2022.

Energy price rises and the Energy Bills Rebate

Published 9 February 2022, CBP 9461

This briefing summarises the Government support packages following news of a 54% rise in the cap on gas and electricity, and the reaction to them. It also answers frequently asked questions about support available to help customers with energy bills.

E-petition 591775 calling for laboratory animals to be included under the Animal Welfare Act

Published 4 February 2022, CBP 9449

A briefing for a debate on an e-petition relating to laboratory animals in Westminster Hall on 7 January 2022.

Animals (Penalty Notices) Bill

Published on 2 February 2022, CBP 9433

This briefing was published ahead of the Commons remaining stages debates on this Private Members' Bill.

The Independent Medicines and Medical Devices Safety Review

Published 2 February 2022, CBP 9274

This briefing provides an overview on the Independent Medicines and Medical Devices Safety review, its findings, and the Government action in response to its recommendations.

Criminality within and regulation of the waste industry

Published 31 January 2022, CDP 2022/0023

A briefing for a debate in Westminster Hall on 1 February on criminality within and regulation of the waste industry.

Government approval for the use of neonicotinoids and the impact on bees

Published 21 January 2022, CDP 2022/0024

A briefing for a debate in Westminster Hall on 2 February on Government approval for the use of neonicotinoids and the impact on bees.

Building Safety Bill: committee stage

Published on 17 January 2022, CBP 9424

This briefing covers progress of the Building Safety Bill 2021-22 during its Commons committee stage.

Farm funding: implementation of new approaches

Published 16 January 2022, CBP 9431

From 2021-27 the Government will phase out in England the CAP-style 'direct payments' which are based on how much land is farmed. This briefing covers new types of support.

The regulation of e-cigarettes

Published 8 January 2022, CBP 8114

This briefing paper provides an overview on the regulation of e-cigarettes.

Frequently asked questions: Demonstrating Covid-19 and vaccination status

Published on 30 December 2021, CBP 9375

This briefing sets out responses to FAQs about demonstrating Covid status (otherwise called Covid status certification or vaccine passports) and use of the NHS Covid Pass in England.

Contested heritage: Controversy surrounding public monuments

Published 17 December 2021, CBP 9405

Monuments to figures involved in the slave trade have long been controversial. Since 2020, the demolition of unlisted monuments has required planning permission. This briefing covers the background.

□

SCIENCE DIRECTORY

UK Research and Innovation

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Big challenges demand big thinkers - those who can unlock the answers and further our understanding of the important issues of our time. Our work encompasses everything from the physical, biological and social sciences, to innovation, engineering, medicine, the environment and the cultural impact of the arts and humanities. In all of these areas, our role is to bring together the people who can innovate and change the world for the better. We work with the government to invest over £7 billion a year in research and innovation by partnering with academia and industry to make the impossible, possible. Through the UK's nine leading academic and industrial funding councils, we create knowledge with impact.



Website: www.ahrc.ukri.org

AHRC funds outstanding original research across the whole range of the arts and humanities. This research provides economic, social and cultural benefits to the UK, and contributes to the culture and welfare of societies around the globe.



Website: www.bbsrc.ukri.org

BBSRC invests in world-class bioscience research and training. This research is helping society to meet major challenges, including food security, green energy and healthier, longer lives and underpinning important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.



Website: www.esrc.ukri.org

ESRC is the UK's largest funder of research on the social and economic questions facing us today. This research shapes public policy and contributes to making the economy more competitive, as well as giving people a better understanding of 21st century society.



Website: www.epsrc.ukri.org

EPSRC invests in world-leading research and postgraduate training across the engineering and physical sciences. This research builds the knowledge and skills base needed to address scientific and technological challenges and provides a platform for future UK prosperity by contributing to a healthy, connected, resilient, productive nation.



Website: www.gov.uk/government/organisations/innovate-uk

Innovate UK drives productivity and economic growth by supporting businesses to develop and realise the potential of new ideas, including those from the UK's world-class research base. They connect businesses to the partners, customers and investors that can help them turn these ideas into commercially successful products and services, and business growth.



Website: www.mrc.ukri.org

MRC is at the forefront of scientific discovery to improve human health. Its scientists tackle some of the greatest health problems facing humanity in the 21st century, from the rising tide of chronic diseases associated with ageing to the threats posed by rapidly mutating micro-organisms.



Website: www.nerc.ukri.org

NERC is the driving force of investment in environmental science. Its leading research, skills and infrastructure help solve major issues and bring benefits to the UK, such as affordable clean energy, air pollution, and resilience of our infrastructure.



Website: www.re.ukri.org

Research England creates and sustains the conditions for a healthy and dynamic research and knowledge exchange system in English universities. Working to understand their strategies, capabilities and capacity; supporting and challenging universities to create new knowledge, strengthen the economy, and enrich society.



Website: www.stfc.ukri.org

STFC is a world-leading multi-disciplinary science organisation. Its research seeks to understand the Universe from the largest astronomical scales to the tiniest constituents of matter, and creates impact on a very tangible, human scale.

SCIENCE DIRECTORY

Association of the British Pharmaceutical Industry



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Website: www.abpi.org.uk

The Association of the British Pharmaceutical Industry (ABPI) represents innovative research-based biopharmaceutical companies, large, medium and small, leading an exciting new era of biosciences in the UK. Our industry, a major contributor to the economy of the UK, brings life-saving and life-enhancing medicines to patients. Our members are researching and developing over two-thirds of the current medicines pipeline, ensuring that the UK remains at the forefront of helping patients prevent and overcome diseases. Topics we focus on include:

- All aspects of the research and development of medicines including clinical research and licensing
- Stratified medicine
- Vaccines, biosimilars, small and large molecules, cell therapy and regenerative medicine



Contact: Dr Jane Gate, Executive Director
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Website: www.airto.co.uk

AIRTO, the Association of Innovation, Research and Technology Organisations, comprises approximately sixty principal organisations operating in the UK's Innovation, Research and Technology (IRT) sector. The IRT sector has a combined turnover of £6.9Bn, employs over 57,000 people and contributes £34Bn to UK GVA. AIRTO's members work at the interface between academia and industry, for both private and public sector clients. Members include independent Research and Technology Organisations, Catapult Centres, Public Sector Research Establishments, National Laboratories, some university Technology Transfer Offices and some privately held innovation companies.

AMPS

The Association of Management and Professional Staffs.

Contact:
Tony Harding
07895 162 896 for all queries whether for membership or assistance.
Branch Office Address:
Merchant Quay,
Salford Quays, Salford
M50 3SG.

Website: www.amps-tradeunion.com

We are a Trades Union for Management and Professional Staff working in the pharmaceutical, chemical and allied industries.

We have produced a training programme funded by the EU on diversity and helping women managers remain in the workplace after a career break. This training programme is aimed at both men and women and is intended to address the shortfall in qualified personnel in the chemical and allied industries.

We are experts in performance based and field related issues and are affiliated to our counterparts in EU Professional Management Unions.



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AWE plays a crucial role in our nation's defence by providing and maintaining warheads for the UK's nuclear deterrent and delivers advice and guidance on a 24/7 basis to UK government in the area of national security.

We are a centre of scientific, engineering and technological excellence, with some of the most advanced research, design and production facilities in the world. AWE is contracted to the Ministry of Defence (MOD) through a Government-owned-contractor-operated (GOCO) arrangement. While our sites and facilities remain in government ownership, their management, day-to-day operations and maintenance of Britain's nuclear stockpile is contracted to a private company: AWE Management Limited (AWE ML). AWE ML is a consortium comprising three partners: Jacobs Engineering Group, the Lockheed Martin Corporation and Serco Group plc.



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The Biochemical Society works to promote the molecular biosciences; facilitating the sharing of expertise, supporting the advancement of biochemistry and molecular biology and raising awareness of their importance in addressing societal grand challenges. We achieve our mission by:

- bringing together molecular bioscientists;
- supporting the next generation of biochemists;
- promoting and sharing knowledge and
- promoting the importance of our discipline.



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Twitter: @BESPolicy

The British Ecological Society is an independent, authoritative learned society, and the voice of the UK's ecological community. Working with our members we gather and communicate the best available ecological evidence to inform decision making. We offer a source of unbiased, objective ecological knowledge, and promote an evidence-informed approach to finding the right solutions to environmental questions.

British In Vitro Diagnostics Association (BIVDA)



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BIVDA is the UK industry association representing companies who manufacture and/or distribute the diagnostics tests and equipment to diagnose, monitor and manage disease largely through the NHS pathology services. Increasingly diagnostics are used outside the laboratory in community settings and also to identify those patients who would benefit from specific drug treatment particularly for cancer.



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The British Pharmacological Society is a charity with a mission to promote and advance the whole spectrum of pharmacology. It is the primary UK learned society concerned with drugs and the way they work, and leads the way in the research and application of pharmacology around the world.

Founded in 1931, the Society champions pharmacology in all its forms, across academia, industry, regulatory agencies and the health service. With over 3,500 members from over 60 countries worldwide, the Society is a friendly and collaborative community. Enquiries about the discovery, development and application of drugs are welcome.



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BSAC is a learned society whose members are among the world's leading infectious disease physicians, pharmacists, microbiologists, and nurses.

With more than 45 years of leadership in antibiotic research and education, BSAC is dedicated to saving lives by fighting infection. It does this by supporting a global network of experts via workshops, conferences, evidence-based guidelines, e-learning courses, and its own high-impact international journal.

BSAC also provides national surveillance and susceptibility testing programmes, an outpatient parenteral antimicrobial therapy (OPAT) initiative, research and development grants, and the secretariat for the All-Party Parliamentary Group on Antibiotics.

BSAC has members in 40 nations and active learners in more than 135 countries.

SCIENCE DIRECTORY



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The British Society for Immunology's mission is to promote excellence in immunological research, scholarship and clinical practice in order to improve human and animal health. We are the leading UK membership organisation working with scientists and clinicians from academia and industry to forward immunology research and application around the world. Our friendly, accessible community of over 3,500 immunologists gives us a powerful voice to advocate for immunological science and health for the benefit of society.



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The British Society of Soil Science (BSSS) was founded in 1947 and is an established international membership organisation and charity committed to the study of soil in its widest aspects. The society brings together those working within academia, practitioners implementing soil science in industry and all those working with, or with an interest in soils.

We promote research and education, both academically and in practice, and build collaborative partnerships to help safeguard our soil for the future. This includes hosting the World Congress of Soil Science 2022 in Glasgow, where those with an interest in soil science can meet to discuss the critical global issues relating to soil.



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Brunel University London is an international research active university with 3 leading research institutes:

Institute of Energy Futures: Led by Professor Sawas Tassou, the main themes of the Institute are *Advanced Engines and Biofuels, Energy Efficient and Sustainable Technologies, Smart Power Networks, and Resource Efficient Future Cities.*

Institute of Materials and Manufacturing: The main themes of research are *Design for Sustainable Manufacturing, Liquid Metal Engineering, Materials Characterisation and Processing, Micro-Nano Manufacturing, and Structural Integrity.* The Institute is led by Professor Luiz Wrobel.

Institute of Environment, Health and Societies: Professor Susan Jobling leads this pioneering research institute whose themes are *Health and Environment, Healthy Ageing, Health Economics Synthetic Biology, Biomedical Engineering and Healthcare Technologies, and Social Sciences and Health.*

Brunel University London offers a wide range of expertise and knowledge, and prides itself on having academic excellence at the core of its offer, and was ranked in the recent REF as 33rd in the UK for Research Power (average quality rating by number of submissions) and described by The Times Higher Education as one of the real winners of the REF 2014.



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The Cavendish Laboratory houses the Department of Physics of the University of Cambridge.

The research programme covers the breadth of contemporary physics

Extreme Universe: Astrophysics, cosmology and high energy physics

Quantum Universe: Cold atoms, condensed matter theory, scientific computing, quantum matter and semiconductor physics

Materials Universe: Optoelectronics, nanophotonics, detector physics, thin film magnetism, surface physics and the Winton programme for the physics of sustainability

Biological Universe: Physics of medicine, biological systems and soft matter

The Laboratory has world-wide collaborations with other universities and industry



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Our vision is integrated design to improve life, wellbeing and performance through science, engineering, technology and psychology. The Institute is one of the largest in the world representing the discipline and profession of Human Factors and Ergonomics. We have sector groups in most industries from defence to aviation and pharmaceuticals that provide expert advice to industry and government. We accredit university courses and consultancy practices and work closely with allied learned societies.



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CTPA is the UK trade association representing manufacturers of cosmetic products and suppliers to the cosmetic products industry. 'Cosmetic products' are legally defined and subject to stringent EU safety laws. CTPA is the authoritative public voice of a vibrant and responsible UK industry trusted to act for the consumer; ensuring the science behind cosmetics is fully understood.



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- Clifton Scientific Trust Ltd is registered charity in England and Wales 1086933



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The Council for the Mathematical Sciences is an authoritative and objective body that works to develop, influence and respond to UK policy issues affecting mathematical sciences in higher education and research, and therefore the UK economy and society by:

- providing expert advice;
- engaging with government, funding agencies and other decision makers;
- raising public awareness; and
- facilitating communication between the mathematical sciences community and other stakeholders



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The Francis Crick Institute is a biomedical research institute carrying out world-class discovery research to understand how living things work and to drive benefits for human health. Our discoveries will enhance our understanding of the fundamental processes of life, and have the potential to transform the prevention, diagnosis and treatment of human disease.

The Crick was formed in 2015, commencing full operations in 2017 in a brand new state-of-the-art building in central London which brings together more than 2,000 scientists, staff and students working collaboratively across disciplines.

SCIENCE DIRECTORY



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Founded in 1992 in memory of the UK's first female Professor of Physics, the Trust is the UK's leading charity dedicated to realising the potential of scientists and engineers returning to research after career breaks for family, caring and health reasons. Recently, we have expanded our remit to incorporate the social sciences and arts & humanities. Our Fellowship programme, working in partnership with universities, UKRI, charities, learned societies and industry, enables individuals to undertake part-time research in universities and research institutes. Fellowships comprise a research project alongside an individually tailored retraining programme, with additional mentoring and support, enabling recipients to re-establish their research credentials, update skills and redevelop confidence, in a suitably supportive environment.



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The Energy Institute (EI) is the chartered professional membership body bringing together expertise for urgent global challenges. Our ambition is that energy, and its critical role in our world, is better understood, managed and valued. We're a unique network with insight spanning the world of energy, from conventional oil and gas to the most innovative renewable and energy efficient technologies. We gather and share essential knowledge about energy, the skills that are helping us all use it more wisely, and the good practice needed to keep it safe and secure. We articulate the voice of energy experts, taking the know-how of around 20,000 members and 200 companies from 120 countries to the heart of the public debate. And we're an independent, not-for-profit, safe space for evidence-based collaboration, an honest broker between industry, academia and policy makers.



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EngineeringUK is an independent organisation that promotes the vital role of engineers, engineering and technology in our society. EngineeringUK partners business and industry, Government and the wider science and technology community: producing evidence on the state of engineering; sharing knowledge within engineering, and inspiring young people to choose a career in engineering, matching employers' demand for skills.



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Fera provides expert analytical and professional services to governments, agrichemical companies, food retailers, manufacturers and farmers to facilitate safety, productivity and quality across the agrifood supply chain in a sustainable and environmentally compatible way.

Fera uses its world leading scientific expertise to provide robust evidence, rigorous analysis and professional advice to governments, international bodies and companies worldwide. Our food integrity, plant health, agri-tech and agri-informatics services ensure that our customers have access to leading edge science, technology and expertise.



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GAMBICA is the voice of the laboratory technology, instrumentation, control and automation industries, providing influence, knowledge and community. We offer members a common platform for voicing their opinions and representing their common interests to a range of stakeholders. GAMBICA seeks to spread best-practice and be thought leaders in our sectors.



-serving science, profession & society

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The Geological Society is the national learned and professional body for Earth sciences, with 12,000 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government, with a wide range of perspectives and views on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-technical audiences.



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Advancing knowledge and setting standards in biomedical science

With over 20,000 members in 61 countries, the Institute of Biomedical Science (IBMS) is the leading professional body for scientists, support staff and students in the field of biomedical science.

Since 1912 we have been dedicated to the promotion, development and delivery of excellence in biomedical science within all aspects of healthcare, and to providing the highest standards of service to patients and the public.

By supporting our members in their practice, we set quality standards for the profession through training, education, assessments, examinations and continuous professional development.



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We are the UK's leading professional body for those involved in all aspects of food science and technology. We are an internationally respected independent membership body, supporting food professionals through knowledge sharing and professional recognition.

Our core aim is the advancement of food science and technology based on impartial science and knowledge sharing.

Our membership comprises individuals from a wide range of backgrounds, from students to experts, working across a wide range of disciplines within the sector.



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IKE is the UK's professional body for innovators. It accredits and certifies innovation practices. We influence the inter-relationship between education, business, and government through research and collaborative networks. Our Innovation Manifesto highlights our commitment to support the development of innovative people and organisations. IKE runs think-tanks, conducts research, develops new business models and tools and supports organisations to benchmark their innovation capabilities.

Institute of Marine Engineering, Science and Technology (IMarEST)



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Established in London in 1889, the IMarEST is a leading international membership body and learned society for marine professionals, with over 15,000 members worldwide. The IMarEST has an extensive marine network of 50 international branches, affiliations with major marine societies around the world, representation on the key marine technical committees and non-governmental status at the International Maritime Organization (IMO) as well as other intergovernmental organisations.

Institute of Measurement and Control



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The Institute of Measurement and Control is a professional engineering institution and learned society dedicated to the science and application of measurement and control technology for the public benefit. The InstMC has a comprehensive range of membership grades for individuals engaged in both technical and non-technical occupations. Also, it is licensed by the Engineering Council to assess and register individuals as Chartered Engineers (CEng), Incorporated Engineers (IEng) and Engineering Technicians (EngTech).

The InstMC works to develop the knowledge and skills of individual engineers, fostering communication and advancing the science and practices within the industry.

IOP Institute of Physics

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The Institute of Physics (IOP) is the professional body and learned society for physics in the UK and Ireland. The IOP's mission is to raise public awareness and understanding of physics, inspire people to develop their knowledge, understanding and enjoyment of physics and support the development of a diverse and inclusive physics community. As a charity, the IOP seeks to ensure that physics delivers on its exceptional potential to benefit society.



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IPEM is a registered, incorporated charity committed to our Mission of Improving Health through Physics and Engineering in Medicine. Our vision is one in which professionalism drives improvements in diagnosis, treatment and care, transforming the lives of patients. Our members, the professional community of medical physicists, biomedical engineers and clinical technologists working in hospitals, academia and industry around the world are the people who deliver our mission and vision. We work to support them through professional development, community and leadership initiatives, including training and CPD, events, campaigns, publications and scientific meetings. IPEM is licensed by the Science Council to award CSci, RSci and RSciTech, and by the Engineering Council to award CEng, IEng and EngTech.



The Institution of Chemical Engineers

The Institution of Chemical Engineers (IChemE) advances chemical engineering's contribution worldwide for the benefit of society. We support the development of chemical engineering professionals and provide connections to a powerful network of around 35,000 members in 100 countries.

We support our members in applying their expertise and experience to make an influential contribution to solving major global challenges, and are the only organisation to award Chartered Chemical Engineer status and Professional Process Safety Engineer registration.

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The IET is a world leading professional organisation, sharing and advancing knowledge to promote science, engineering and technology across the world. Dating back to 1871, the IET has over 163,000 members in 127 countries with offices in Europe, North America, and Asia-Pacific.



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LGC is a global leader in the life sciences tools sector, including human healthcare and applied markets (food, agbio and the environment). LGC provides a comprehensive range of measurement tools, proficiency testing schemes, supply chain assurance standards and specialty genomics tools (oligos, PCR tools, NGS reagents), underpinned by leading analytical and measurement science capabilities. Under the Government Chemist function, LGC fulfils specific statutory duties as the referee analyst and provides advice for Government and the wider analytical community on the implications of analytical measurement for matters of policy, standards and regulation. LGC is also the UK's National Measurement Laboratory for chemical and bio-measurement.

With headquarters in Teddington, South West London, LGC has laboratories and sites across Europe, the US, China, Brazil, India, and South Africa.



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L'Oréal employs more than 3,800 researchers world-wide and dedicates over €877 million each year to research and innovation in the field of healthy skin and hair. The company supports women in science research through the L'Oréal UNESCO For Women In Science Programme and engages young people with science through the L'Oréal Young Scientist Centre at the Royal Institution. L'Oréal also collaborates with a vast number of institutions in the UK and globally.



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As the world's oldest active biological society, the Linnean Society is an essential forum and meeting point for those interested in the natural world. The Society holds regular public lectures and events, publishes three peer-reviewed journals, and promotes the study of the natural world with several educational initiatives. The Society is home to a world famous library and collection of natural history specimens. The Society's Fellows have a considerable range of biological expertise that can be harnessed to inform and advise on scientific and public policy issues.

A Forum for Natural History

SCIENCE DIRECTORY

Marine Biological Association



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Since 1884 the Marine Biological Association has been delivering its mission 'to promote scientific research into all aspects of life in the sea, including the environment on which it depends, and to disseminate to the public the knowledge gained.' The MBA represents its members in providing a clear independent voice to government on behalf of the marine biological community. It also has an extensive research programme and a long history as an expert provider of advice for the benefit of policy makers and wider society.

Institution of MECHANICAL ENGINEERS

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The Institution provides politicians and civil servants with information, expertise and advice on a diverse range of subjects, focusing on manufacturing, energy, environment, transport and education policy. We regularly publish policy statements and host political briefings and policy events to establish a working relationship between the engineering profession and parliament.



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The Met Office doesn't just forecast the weather on television. Our forecasts and warnings protect UK communities and infrastructure from severe weather and environmental hazards every day – they save lives and money. Our Climate Programme delivers evidence to underpin Government policy through the Met Office Hadley Centre. Our Mobile Meteorological Unit supports the Armed Forces around the world. We build capacity overseas in support of international development. All of this built on world-class environmental science.



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The Microbiology Society is a membership charity for scientists interested in microbes, their effects and their practical uses. It is one of the largest microbiology societies in Europe with a worldwide membership based in universities, industry, hospitals, research institutes and schools.

Our principal goal is to develop, expand and strengthen the networks available to our members so that they can generate new knowledge about microbes and ensure that it is shared with other communities. The impacts from this will drive us towards a world in which the science of microbiology provides maximum benefit to society.



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The National Physical Laboratory (NPL) is the United Kingdom's national measurement institute, an internationally respected and independent centre of excellence in research, development and knowledge transfer in measurement and materials science. For more than a century, NPL has developed and maintained the nation's primary measurement standards - the heart of an infrastructure designed to ensure accuracy, consistency and innovation in physical measurement.



Advancing the science of nature

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We challenge the way people think about the natural world – its past, present and future

We use our unique collection and unrivalled expertise to tackle the biggest challenges facing the world today.

We are leaders in the scientific understanding of the origin of our planet, life on it and can predict the impact of future change.

We study the diversity of life and the delicate balance of ecosystems to ensure the survival of our planet.

We help enable food security, eradicate disease and manage resource scarcity.

We inspire people to engage with science to solve major societal challenges.



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The University of Northampton is an institution committed to science education through initial teacher training, a STEM Ambassador network which works within the community and teaching and research to doctoral level. We are an Ashoka U 'Changemaker Campus' status university recognising our commitment to social innovation and entrepreneurship.



The University of Nottingham

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With 43,000 students and campuses in Nottingham, China and Malaysia, The University of Nottingham is 'the nearest Britain has to a truly global university'. With more than 97 per cent of research at the University recognised internationally according to the Research Excellence Framework 2014, the University is ranked in the top 1% of the world's universities by the QS World University Rankings.



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The Nutrition Society is a not for profit, membership organisation which is dedicated to delivering its mission of advancing the scientific study of nutrition and its application to the maintenance of human and animal health. Highly regarded by the scientific community, the Society is one of the largest learned societies for nutrition in the world and anyone with a genuine interest in the science of human or animal nutrition can become a member.

SCIENCE DIRECTORY



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As the largest network of physiologists in Europe, with academic journals of global reach, we continue our 140-year tradition of being at the forefront of the life sciences.

We bring together scientists from over 60 countries, and our Members have included numerous Nobel Prize winners from Ivan Pavlov to John O'Keefe.



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Prospect is an independent, thriving and forward-looking trade union with over 120,000 members across the private and public sectors and a diverse range of occupations. We represent scientists, technologists and other professions in the civil service, research councils and private sector.

Prospect's collective voice champions the interests of the engineering and scientific community to key opinion-formers and policy makers. With negotiating rights with over 300 employers, we seek to secure a better life at work by putting members' pay, conditions and careers first.

QUADRAM INSTITUTE



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The £75m Quadram Institute opened in 2019 and is focused on fundamental and translational research into the interfaces between the gut microbiome, food, and human health. The Quadram Institute combines leading-edge bioscience capabilities with NHS endoscopy, clinical trials and biobank facilities. The Quadram Institute is a partnership between the Norfolk and Norwich University Hospital, University of East Anglia, Quadram Institute Bioscience and BBSRC.



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As the UK's national academy for engineering, we bring together the most successful and talented engineers for a shared purpose: to advance and promote excellence in engineering. We have four strategic challenges: drive faster and more balanced economic growth; foster better education and skills; lead the profession; and promote engineering at the heart of society.



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RBG Kew is a centre of global scientific expertise in plant and fungal diversity, conservation, and sustainable use, housed in two world-class gardens. Our scientific vision is to document and understand global plant and fungal diversity and its uses, bringing authoritative expertise to bear on the critical challenges facing humanity today.

Kew's strategic priorities for science are:

1. To document and conduct research into global plant and fungal diversity and its uses for humanity.
2. To curate and provide data-rich evidence from Kew's unrivalled collections as a global asset for scientific research.
3. To disseminate our scientific knowledge of plants and fungi, maximising its impact in science, education, conservation policy and management.

These priorities enable us to curate, use, enhance, explore and share Kew's global resource, providing robust data and a strong evidence base for our UK and global stakeholders. Kew is a non-departmental government body with exempt charitable status, partially funded by Defra.

Ri The Royal Institution Science Lives Here

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www.richannel.org
Twitter: [ri_science](https://twitter.com/ri_science)

The Royal Institution (Ri) has been at the forefront of public engagement with science for over 200 years and our purpose is to encourage people to think further about the wonders of science. We run public events and the famous CHRISTMAS LECTURES®, a national programme of Masterclasses for young people in mathematics, engineering and computer science, educational activities at the L'Oréal Young Scientist Centre and policy discussions with science students. And through the Ri Channel we share the stories behind cutting-edge science with people around the world.

THE ROYAL SOCIETY

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The Royal Society is the academy of science in the UK and the Commonwealth comprising 1400 outstanding individuals representing the sciences, engineering and medicine. The Society has played a part in some of the most fundamental, significant and life-changing discoveries in scientific history and Royal Society scientists continue to make outstanding contributions to science across the wide breadth of research areas. Through its Fellowship and permanent staff, it seeks to ensure that its contribution to shaping the future of science in the UK and beyond has a deep and enduring impact, supporting excellence in science and encouraging the development and use of science for the benefit of humanity.



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The Royal Society of Biology is a single unified voice, representing a diverse membership of individuals, learned societies and other organisations. We are committed to ensuring that we provide Government and other policy makers – including funders of biological education and research – with a distinct point of access to authoritative, independent, and evidence-based opinion, representative of the widest range of bioscience disciplines. Our vision is of a world that understands the true value of biology and how it can contribute to improving life for all.



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The Royal Society of Chemistry is the world's leading chemistry community, advancing excellence in the chemical sciences. With over 50,000 members and a knowledge business that spans the globe, we are the UK's professional body for chemical scientists; a not-for-profit organisation with 170 years of history and an international vision of the future. We promote, support and celebrate chemistry. We work to shape the future of the chemical sciences – for the benefit of science and humanity.

SCIENCE DIRECTORY



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SfAM utilises the expertise of its international membership to advance, for the benefit of the public, the application of microbiology to the environment, human and animal health, agriculture, and industry. Our values include equality, diversity and inclusivity; collaboration to amplify impact; scientific integrity; evidence-based decision-making and political neutrality. With Wiley-Blackwell, SfAM publishes five internationally acclaimed journals.

Society for Underwater Technology



Society for Underwater Technology
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The SUT is a multidisciplinary learned society that brings together individuals and organisations with a common interest in underwater technology, ocean science, and offshore/subsea engineering. The society was founded in 1966 and has members from over 40 countries, including engineers, scientists, other professionals and students working in these areas.

Society of Chemical Industry

SCI: where science meets business

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Established by Royal Charter in 1881, SCI is a unique multi-disciplinary community. Set up by a prominent group of forward thinking scientists, inventors and entrepreneurs, SCI continues to be a multi-science and industry network based around chemistry and related sciences. Our charitable objective is to promote links between science and industry for the benefit of society. Our passion is invention and creation.

We deliver our charitable objective by:

- Supporting the commercial application of science into industry
- Tackling global challenges across Agrifood, Energy, Environment, Health and Materials

Society of Cosmetic Scientists



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Advancing the science of cosmetics is the primary objective of the SCS. Cosmetic science covers a wide range of disciplines from organic and physical chemistry to biology and photo-biology, dermatology, microbiology, physical sciences and psychology.

Members are scientists and the SCS helps them progress their careers and the science of cosmetics ethically and responsibly. Services include publications, educational courses and scientific meetings.



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The Society of Maritime Industries (SMI) is the voice and champion of the UK maritime engineering, marine science & technology and business service sectors.



THE SOCIETY FOR RADIOLOGICAL PROTECTION

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The Society for Radiological Protection is the principal independent professional body for radiation protection in the UK. Its members operate in the fields of medicine, the nuclear power cycle and other industries, research, and teaching. We offer a profession-wide view to regulators and are involved in training and educational outreach. We ensure that professional standards are maintained at the highest levels.



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The **UK Innovation & Science Seed Fund** is a leading patient capital investor with more than £330 million private investment leveraged to date. The Fund works to build technology companies from the earliest stage by working closely with its partners led by STFC, BBSRC, NERC and Dstl, with the National Research and Innovation Campuses they support, and with entrepreneurial science-led teams. UK Innovation & Science Seed Fund is also closely aligned with the Catapults and InnovateUK, helping to commercialise key technological advances in industrial biotech, agricultural technology, healthcare, medicine, clean energy, materials, artificial intelligence, software and space.



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Understanding Animal Research is a not-for-profit organisation that explains why animals are used in medical, veterinary, environmental and other scientific research. We aim to achieve a broad understanding of the humane use of animals in medical, veterinary, scientific and environmental research in the UK. We work closely with policymakers to ensure regulation is effective and are a trusted source of information for the national and international media. We are funded by our members who include universities, professional societies, trade unions, industry and charities.



University of Essex

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Established in 1964, the University of Essex is ranked as one of the Top 20 universities in the Research Excellence Framework and is awarded Gold in the Teaching Excellence Framework. It is home to world-leading expertise in analytics and data science, with research peaks spanning the social sciences, sciences, and humanities. Pioneers of quantitative methods and artificial intelligence techniques, Essex is also in the UK top 10 for Knowledge Transfer Partnerships, and works with businesses to embed innovation into operations, through KTPs, knowledge exchange and contract research.

SCIENCE DIRECTORY

Universities Federation for Animal Welfare



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Registered in England Charity No: 207996

UFAW, the international animal welfare science society, is an independent scientific and educational charity. It works to improve animal lives by:

- supporting animal welfare research
- educating and raising awareness of welfare issues in the UK and overseas
- producing the quarterly scientific journal *Animal Welfare* and other high-quality publications on animal care and welfare
- providing advice to government departments and other concerned bodies.



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The Welding Institute is the leading institution providing engineering solutions and knowledge transfer in all aspects of manufacturing, fabrication and whole-life integrity management.

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SCIENCE DIARY

PARLIAMENTARY AND SCIENTIFIC COMMITTEE – ALL-PARTY PARLIAMENTARY GROUP

Email: office@scienceinparliament.org.uk
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FORTHCOMING DISCUSSION AND OTHER MEETINGS

Monday 6th June
Discussion Meeting on Coastal Water Quality
5.30pm to 7.00pm by Zoom

Monday 4th July
Discussion Meeting Topic TBA

Palace of Westminster
5.30pm to 7.00pm

Tuesday 5th July
Annual Luncheon
12.30pm to 2.00pm
House of Lords

ROYAL SOCIETY OF BIOLOGY

Tuesday 28th June
Parliamentary Links Day
Palace of Westminster
For further details please contact
Karen Patel: events@rsb.org

ROYAL SOCIETY OF CHEMISTRY

Tuesday 17th May
Science and the Senedd
Cardiff Bay
For further details please contact
events@rsc.org

ROYAL SOCIETY

Details of all events can be found on the events calendar at events@royalsociety.org
For scientific meetings queries:
scientificmeetings@royalsociety.org

THE ROYAL INSTITUTION

Details of all events and booking
Information can be found at
www.rigb.org/whats-on



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The closing date is Friday 10th June

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invite you to

Parliamentary Links Day 2022

Science and International Collaboration

Tuesday 28 June 2022 | 10:00-12:30 | The Attlee Suite, Portcullis House

Register at: www.rsb.org.uk/LinksDay22

