Advancing frontiers by working together

Launch of the new National Biofilms Innovation Centre

Page 14

Inside
Frontier Bioscience
Gene experts tackle pest control
Meet International Impact Innovator
Sarah Cleaveland
The food and farming revolution
Bioplastic – the coffee cup alternative
About BBSRC

BBSRC invests in world-class bioscience research and training on behalf of the UK public.

Our aim is to further scientific knowledge to promote economic growth, wealth and job creation, and to improve quality of life in the UK and beyond.

Funded by Government, BBSRC invested over £473 million in world-class bioscience in 2015-2016. We support research and training in universities and strategically funded institutes. BBSRC research and the people we fund are helping society to meet major challenges, including food security, green energy and healthier, longer lives. Our investments underpin important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

Further details about BBSRC, our science and our impact can be found at www.bbsrc.ac.uk

Strategically funded institutes

Babraham Institute
www.babraham.ac.uk

The Pirbright Institute
www.pirbright.ac.uk

Institute for Biological, Environmental and Rural Studies
(Aberystwyth University)
www.aber.ac.uk/en/ibers

The Quadram Institute
www.quadram.ac.uk

John Innes Centre
www.jic.ac.uk

Roslin Institute
(University of Edinburgh)
www.roslin.ac.uk

Rothamsted Research
www.rothamsted.ac.uk

Earlham Institute
www.earlham.ac.uk

BBSRC is part of the Research Councils UK partnership

Front cover
Biofilm research at the University of Southampton.
The NBIC will bring the best of UK biofilm research together to accelerate the adoption of new technologies into live products and services as part of a global industry worth $5 trillion.

University of Southampton

Contacts

Plant health and agriculture
brian.harris@bbsrc.ac.uk

Animal health
ceri.lyn-adams@bbsrc.ac.uk

Bioenergy
colin.miles@bbsrc.ac.uk

Food
brian.harris@bbsrc.ac.uk

Human health
ceri.lyn-adams@bbsrc.ac.uk

Industrial biotechnology
colin.miles@bbsrc.ac.uk

International
tim.willis@bbsrc.ac.uk

Research technologies
rowan.mckibbin@bbsrc.ac.uk

Skills and training
david.mcallister@bbsrc.ac.uk

Innovation and business
lynne.guppy@bbsrc.ac.uk

About BBSRC Business

BBSRC Business is a controlled circulation magazine which is distributed free of charge to end users of research and to individuals with an interest in BBSRC.

For enquiries about Business contact the News Team:
BBSRC
Polaris House, North Star Avenue, Swindon, SN2 1UH.
Tel: 01793 442810
Email: press.office@bbsrc.ac.uk

For regular news about BBSRC and the outcomes and impacts of BBSRC-funded research visit
www.bbsrc.ac.uk/news
In this issue

Chief Executive Melanie Welham looks ahead to the challenges in 2018.

This first edition of BBSRC Business magazine for 2018 gives me the opportunity to consider what the year ahead might hold. From a BBSRC perspective, I anticipate that we will see a renewed and increasing emphasis on discovery research. The importance of researcher-led discovery science is something which I have often heard members of our research community speak passionately about – and is something which I am a fervent supporter of too. Through BBSRC’s ‘Frontier Bioscience’ theme we have highlighted our commitment and support for discovery research – and I hope this will become increasingly apparent throughout 2018. Read more on page 10.

In terms of scientific trends, we will see increasing use of digital technologies – including machine learning and artificial intelligence – allowing researchers to probe unsolved questions of scale. As we seek to understand biological complexity and its control, the importance of quantitation in biology will increase, which in turn will underpin the development of more predictive approaches. And the central role that all forms of imaging play in bioscience research, from single molecule to field scale, will continue to expand – although I’m not going to predict what the ‘next big thing’ in imaging will be!

The Industrial Strategy White paper has set out a vision for building a Britain of the future and signalled a number of priorities for the year ahead. For BBSRC this includes the ‘Transforming Food Production’ Industrial Strategy Challenge Fund programme. A cross-organisational team, from Innovate UK, BBSRC, BEIS and Defra, have been working hard on the development of this challenge, engaging with key business and academic leaders as the programme takes shape. The Business Secretary has announced a new £90 million investment in this challenge that will improve productivity and sustainability across the agri-food sector, I anticipate that this will be a key activity for the year ahead. Read more on page 17.

Related to this, BBSRC hosted the ‘Innovation Hub’ at the Oxford Farming Conference in the first week of January. I led two interactive sessions, engaging a range of conference delegates, where six teams of researchers showcased the new technologies and approaches they are developing that will enable future farming. We have tried to envisage what harvest time will be like in 2050 with the benefit of the new technology. You can read more on page 16.

BBSRC will become part of UK Research and Innovation from April. In preparation for this I have been busy interviewing potential members for BBSRC’s new Council. This newly formed Council will play a key role in supporting the BBSRC Executive Chair and shaping BBSRC’s future strategies.

I’m delighted to say that May will see the culmination of the 10th BBSRC Innovator of the Year competition, and we will be featuring the event in the next edition of Business. We featured the 2017 overall winner, Shelby Temple, in the last edition and this time we catch up with the winner of the ‘Impact Award’, Professor Sarah Cleaveland, a remarkable woman whose research has had real impact by informing the development of new strategies to control livestock diseases in Tanzania, including foot-and-mouth and malignant catarhal fever. Sarah and her team are credited with having prevented hundreds of human deaths as a consequence of their work. Read more on page 12.

2018 promises to be a year of change and opportunity!
Headlines

Distinguished role model for women in science receives global award

A world-leading Norwich-based plant scientist, who receives funding from BBSRC, has been named as a 2018 L’Oréal-UNESCO for Women in Science laureate.

Professor Dame Caroline Dean OBE, from the John Innes Centre, received the prestigious award for her “ground-breaking research on how plants adapt to their surroundings and climate change, leading to new ways for crop improvement.”

The L’Oréal Foundation and UNESCO announce the names of five outstanding scientists – one from each continent – who will receive the 2018 L’Oréal-UNESCO for Women in Science Awards in life sciences.

The L’Oréal-UNESCO for Women in Science Awards celebrate the many eminent women in science all over the world.

Professor Dean said: “It’s a great honour to be recognised by the L’Oréal Foundation with this award. I look forward to an exciting year ahead and hope that I can continue to inspire girls and female scientists to follow their curiosity.”

Director of the John Innes Centre, Professor Dale Sanders, said: “Caroline is an excellent role model and ambassador for women in science. Her passion and drive for her science is inspiring and she works with outstanding enthusiasm to encourage more women to aspire to be scientists and to reach their full potential. She is a shining example to us all.”

Melanie Welham, Chief Executive of BBSRC said: “I offer my warmest congratulations to Caroline on this prestigious award and the recognition of the important research she has conducted with her team at the John Innes Centre. As a keen advocate for women in science I am delighted that Caroline provides the inspiration to motivate and encourage other women in science.”

Bacteria development marks new era in cellular design

Scientists at the universities of Kent and Bristol have built a miniature scaffold inside bacteria that can be used to bolster cellular productivity, with implications for the next generation of biofuel production.

Because there is a growing need for the renewable production of biofuels and other commodity chemicals to move away from fossil fuels, scientists have long sought to enhance the internal organisation of bacteria and improve the efficiency of the cells for making nutrients, pharmaceuticals and chemicals.

The research team, led by Professor Martin Warren at Kent’s School of Biosciences, working with professors Dek Woolfson and Paul Verkade at Bristol, found they could make nanotubes that generated a scaffold inside bacteria.

With as many as a thousand tubes fitting into each cell, the tubular scaffold can be used to increase the bacteria’s efficiency to make commodities and provide the foundation for a new era of cellular protein engineering.

By applying this new technology to enzymes required for the production of ethanol – an important biofuel – the researchers were able to increase alcohol production by over 200%. BBSRC funded this collaborative project, entitled ‘Engineered synthetic scaffolds for organizing proteins within the bacterial cytoplasm’, between the University of Kent, University College London and the University of Bristol.

Quest for new medicines could be helped by cell discovery

Scientists have made a key discovery that could speed up the production of cells in the lab for studying diseases such as multiple sclerosis and Parkinson’s disease.

Experts say it could also help to boost supplies of cells for use in drug discovery research and could eventually aid production of cells for use as therapies.

Researchers at the University of Edinburgh have pinpointed two molecules that boost reprogramming of cells – a process through which cells of one type can be converted to another.

The molecules – called SMAD2 and SMAD3 – can enhance the efficiency of converting mature cells into induced pluripotent stem cells, which have the distinctive ability to become any type of cell found in the body. Usually, converting human skin cells to functional brain cells in a dish takes around 50 days. The team found that adding either of the two molecules into a dish with the cells cuts the time taken to just 25 days.
Headlines

Final pieces of the wheat genome puzzle identified

Following 10 years of large-scale, international research, a handful of scientists have finally assembled the wheat genome into its most complete and contiguous state.

The wheat genome has posed an immense puzzle to scientists for decades. It is colossal and complex, over five times the size of the human genome, and a postdoc researcher could spend their entire fellowship identifying a single gene of interest.

The immensity of the task saw the foundation of the International Wheat Genome Sequencing Consortium, consisting of 1,800 members across 62 countries. But it was six scientists from the US and UK, with a lot of very high-spec technology, who made the breakthrough.

Professor Steven Salzberg, genomicsist at Johns Hopkins University, described the genome like a gargantuan jigsaw puzzle: “The wheat genome is full of blue sky, all these pieces look like a lot of other pieces, but they’re not exactly alike.”

Assembling the genome took a total computer processing time equivalent to 53.7 years across just over five months of elapsed time. Owing to its hexaploid structure, the genome for common bread wheat, *Triticum aestivum*, has “one of the most complex genome sequences known to science.”

As the most extensively cultivated crop worldwide, against a backdrop of increasing demand to produce more food with greater security, this comes as a welcome breakthrough. It means that wheat may be able to be cultivated to become a stronger and more sustainable crop.

Major award recognises UK and global impact of wheat scientist

World-leading wheat scientist Dr Cristobal Uauy has been awarded the prestigious Research Medal by The Royal Agricultural Society of England (RASE).

The RASE award recognises a string of benefits delivered by the work of Dr Uauy and his team in developing genomic techniques – and sharing them with national and international community of wheat researchers and breeders.

Dr Uauy, a project leader in crop genetics at the John Innes Centre, Norwich, uses modern molecular genetic approaches to identify genes that deliver yield and quality improvements to wheat.

Valuable traits developed using these ground-breaking techniques include increased grain size, resistance to pests and pathogens, biofortification, and reduced pre-harvest sprouting.

Dr Uauy has pioneered next-generation sequencing approaches for marker development in wheat and facilitated the use of molecular markers (genes or DNA sequences associated with a particular trait) by breeders and researchers in the UK and across the globe.

Dr Uauy said: “I am deeply honoured to be awarded the Royal Agricultural Society of England Research Medal. This is a recognition to our vibrant research team at the John Innes Centre and our drive to have impact on the agriculture sector.”

Melanie Welham, Chief Executive of BBSRC said: “I offer my congratulations to Dr Uauy and his team. Their research has focused on using genetics and genomics to improve both yield and quality in wheat and the Research Medal awarded by The Royal Agricultural Society of England recognises the considerable benefits that their research is contributing to modern agriculture.”

The human brain can ‘see’ what is around the corner

Neuroscientists at the University of Glasgow have shown how the human brain can predict what our eyes will see next.

In a new study researchers have gained a greater understanding of visual mechanisms, and how seeing is a constant two-way dialogue between the brain and the eyes.

The research, led by Professor Lars Muckli of the University of Glasgow, used functional magnetic resonance imaging (fMRI) and a visual illusion to show that the brain anticipates the information it will see when the eyes next move.

We move our eyes approximately four times per second, meaning our brains have to process new visual information every 250 milliseconds. Nevertheless, the world appears stable. If you were to move your video camera so frequently, the film would appear jumpy. The reason we still perceive the world as stable is because our brains think ahead. In other words, the brain predicts what it is going to see after you have moved your eyes.

The research was funded by the BBSRC and a Human Brain Project grant.
New field station makes space for innovative crop science

A new facility to assist advances in crop science is taking shape in the Norfolk countryside. The field experimental station at Church Farm, Bawburgh, will allow scientists at the John Innes Centre to carry out ground-breaking research in crop improvements. Bringing together lab and field research in one location will further research in understanding how genes control plant growth in the field.

The aim is to create tools for plant breeders to produce new varieties that are more reliable, nutritious and resilient to pests and diseases.

A proposed opening is planned for July 2018. The 1700sqm building includes two laboratories, climate-controlled grain storage, office space for six staff, meeting rooms and storage space for agricultural equipment. Most of the funding for the £4.3m facility comes from the BBSRC, with a contribution from the John Innes Foundation.

In addition to scientists from the John Innes Centre, the facility will be used by researchers from The Sainsbury Laboratory, Quadram Institute, and the Earlham Institute, all located on the Norwich Research Park.

Dr Jef Grainger, Associate Director of Science Strategy at BBSRC, said: “This exciting new facility brings science closer to farmers and allows research to be tested in a real-life environment. The purpose-built facility allows scientists located at the Norwich Research Park to more easily work together in translating crop science research into real-life results.”

Incredible images of how the DNA code is read

Researchers have been able to zoom in and capture almost one million images of the DNA reading and decoding mechanism, common to all animals and plants. Funded by BBSRC, Cancer Research UK, and the Wellcome Trust, the researchers are based at the Institute for Cancer Research.

Now, armed with an advanced form of electron microscopy known as Cryo-EM, scientists are able to see what is happening in this process in greater detail than ever before. The discovery of exactly how this molecular mechanism works could open up new approaches to cancer treatment.

Universities and Science Minister Sam Gyimah said: “This incredible new advancement in DNA decoding will further our understanding of disease, potentially leading to vital lifesaving treatment, including new ways to tackle cancer.”

Cryo-EM is an advanced form of electron microscopy that involves freezing and imaging samples at -180°C to preserve minute details of protein shapes. It is so powerful that it can take pictures of tiny molecules – approximately 5 nanometres or 20000th of the width of a human hair – at almost an atomic level.

Dr Amanda Collis, interim Executive Director of Science at BBSRC, said: “Cryo-EM is rapidly advancing our knowledge of the structure and behaviour of biological molecules, and this exciting discovery demonstrates how fundamental understanding of biological systems can open the door to the development of potential new cancer therapies.”

A brand new laboratory at The Pirbright Institute, opened in 2017, has scooped a prestigious design award.

The Guildford Design Awards celebrate well-designed, innovative architectural and environmental projects that contribute to the quality and sustainability of our surroundings.

The BBSRC National Vaccinology Centre: The Jenner Building won jointly with a renovation project in the New Build category and impressed the judges with its contemporary functional design coupled with strong sustainability credentials. The £17 million building is home to over 100 scientists delivering world-leading research though energy efficient facilities including photovoltaic panels, thermal mass heating that secured the building a BREEAM ‘excellent’ rating.

The Jenner Building, named after Edward Jenner who successfully prevented smallpox through the discovery of an effective vaccine, features open-plan laboratories that can each house between six and 30 scientists, encouraging interaction and collaboration.

Director of Capability at The Pirbright Institute, Mike Johnson, said: “This award for the BBSRC National Vaccinology Centre: The Jenner Building is a testament to the huge amount of consideration that goes into the design of all the Institute’s new facilities to ensure that they are aesthetically beautiful while delivering functionality and energy efficiency. The Jenner Building provides a fantastic design vision of the future intent for development on the Pirbright site.”
In the first meeting of its kind, 24 leading experts from the UK and Brazil came together to find practical, low-cost solutions that make more effective use of nitrogen in agriculture, while attempting to decrease pollution losses to the environment either to the atmosphere or through the soil.

Led by Ray Dixon, Professor of Molecular Microbiology at the John Innes Centre, and Sacha Mooney, Professor of Soil Physics in the School of Biosciences at the University of Nottingham, the focus was on improving nitrogen use efficiency.

The meeting revealed the overlapping goals of the two research centres and identified several opportunities for collaboration that will develop the scientific and practical outcomes for the benefit of Brazilian and UK agriculture.

Professor Dixon said: “The outcome of our discussions has uncovered exciting new opportunities to mitigate the impact of nitrogen fertilisers on the environment and increase agricultural productivity in Brazil through enhanced use of biological nitrogen fixation and improved agronomic practices.”

The workshop was funded by BBSRC via the Newton Fund.

Managing the microbes – the key to solving the global nitrogen crisis

The Pirbright Institute has been awarded joint funding with The Roslin Institute to research how the deadly Marek’s disease virus (MDV) causes tumours in poultry, and create a more effective vaccine.

MDV is highly contagious and is a major threat to the poultry industry, with losses estimated to be up to $2 billion worldwide. Nearly 22 billion vaccine doses a year are used in an attempt to control the disease, but the virus continues to evolve and form increasingly virulent strains.

The BBSRC funding will allow the Pirbright and Roslin researchers to understand the pathways involved in tumour creation during MDV infection.

The modifications to the virus that the Pirbright team makes will be analysed by Roslin researchers to identify the major pathways that are most essential for tumour production and indicate the best targets for future vaccines.

The research could pave the way for a new vaccine that is able to protect against the most destructive strains of MDV, improving poultry welfare and cutting losses to the poultry industry.

Research into new Marek’s disease vaccine

Researchers at The Pirbright Institute have shown that, when drugs are used to inhibit the cellular protein hsp90, foot-and-mouth disease virus (FMDV) production is reduced.

The research provides new insights into how FMDV replicates during infection, and also demonstrates the potential for hsp90 as a target for future antiviral treatments. Use of these drugs resulted in a tenfold reduction in virus levels, showing that hsp90 plays a vital role in capsid assembly and, without it, FMDV is unable to replicate effectively.

Although the drugs used in the current study are unsuitable for animal treatment, improved hsp90 inhibitors could provide an additional tool to aid in the fight against FMD.

This research was funded by a grant from BBSRC.

Inhibition of foot-and-mouth disease protein decreases virus production
Gene experts set to tackle pest control

A group of researchers from the University of Edinburgh’s Roslin Institute have been explaining how a genetic approach might be used to tackle pest control – a problem that is estimated to cost the UK economy £1.2 billion every year.

Experts have suggested that the latest genetic technologies might be applied to help control pests such as rats and mice.

A group of researchers from the University of Edinburgh’s Roslin Institute are investigating how a genetic approach might be used to tackle pest control using technology that could reduce or eliminate a pest population in a humane and species-specific manner.

The research will evaluate how a technology called gene drive could be used to spread an infertility gene in rats and mice. A similar approach is already being developed in mosquitoes to control the spread of disease, and researchers are now interested in whether it will also work in mammals.

Professor Bruce Whitelaw, Deputy Director at The Roslin Institute, is keen to stress that this is just the start of research into a tool that might offer a more humane method to control vermin population numbers: “We have the makings of a technology that could reduce or eliminate a pest population in a humane and species-specific manner. Poison or more physical methods are now looking increasingly out dated and in many cases are less effective when larger populations need to be controlled.”

Currently, a range of costly and sometimes ineffective pest control options are used, and include shooting, poison baiting, trapping and the release of biological agents. Often these traditional approaches can affect other animals that weren’t the original target.

The new method would mean using the gene drive, a powerful technique for ensuring that a particular genetic trait is inherited by all descendants. It means that a gene of interest can spread throughout an entire population within a few generations. Gene drives can only work within the targeted species, therefore reducing the risk of impact on non-targeted populations of animals. Usually, mammals inherit two versions of every gene – one from their mother and one from their father. As a result, there is a 50% chance that a parent will pass on a particular trait to their offspring.

Gene drive works by targeting other versions of a particular target gene and converting them to the desired version. The technology makes use of a DNA editing technique called CRISPR/Cas 9. It acts like a pair of molecular scissors that cuts out the target gene that would be inherited from the other parent.

The body’s natural mechanisms then repair
the damaged DNA. They do so by using the gene drive as a template so that all of the offspring now carry two copies of the gene drive.

The team is using mice to evaluate the technology’s effectiveness in a contained laboratory environment. They are targeting genes linked to female fertility, to explore how this could be used to curb pest rodent populations.

Professor Whitelaw remains cautious and is keen to highlight that the research is very much at an early stage: “We need more research to better understand the risks, and whether these can be mitigated, but we believe the potential benefits merit further investigation. If we can make the gene technology work then I see this as an alternative tool for use in some situations rather than a complete replacement for traditional methods.”

Additional research to investigate the potential risks associated with gene drive technology would have to be carried out before the approach could ever be applied in the real world.

If the ‘researchers’ approach is found to be successful, they say it could potentially be applied to help control other pest species, such as rabbits and cane toads.

“If we can make the gene technology work then I see this as an alternative tool for use in some situations rather than a complete replacement for traditional methods.”

Professor Whitelaw, The Roslin Institute

How would it work?

If successful, there are two options. One is to skew the population to all male and the other is to render the female as infertile. Both options would lead to a rapid decrease in the population over a fairly short timescale.

The theory is that a small number of the animals, say rats, would be engineered. Using the gene technology, they would be bred in a way that would significantly reduce their numbers over a short period of time.

The research includes having strategies in place that would limit the potential for engineered animals to spread indefinitely through a species.
Frontier BIOSCIENCE

Frontier bioscience is pioneering, innovative and creative research that can lead to far-reaching discoveries. The support for this area is central to BBSRC’s mission to advance knowledge and technology. Frontier bioscience gives high priority to world-class discovery research, recognising it as essential to ensuring the UK remains a global leader and that we deliver ‘bioscience for the future’.

Dr Huai-Ti Lin
Dynamics of insect flight

Ground-breaking research by Dr Huai-Ti Lin, from Imperial College London, is working to better understand the dynamics of insect flight.

Hundreds of mechanosensors are present on insect wings and are vital for the insect’s ability to respond quickly to the ever-changing environment during flight.

Lin, through a combination of cutting-edge technology development and visionary thinking, will tease apart the role of mechanosensors in the flight of dragonflies, hawk moths and locusts.

The understanding of mechanosensors in locomotor control will provide new knowledge relevant to all animal taxa. Increasing the fundamental knowledge of the process of flight could also lead to breakthroughs in the advancement of robotic technologies such as drone flight or self-driving cars, utilising mechanosensory information to become safer and more effective.

Professor Dame Caroline Dean
Epigenetics effects on plant processes

Professor Caroline Dean at the John Innes Centre is leading frontier research to increase the intrinsic knowledge of epigenetic effects on critical plant processes.

Dean’s research is working to understand the process of flowering after a period of cold temperatures, known as vernalization. Over the past 10 years, Dean has uncovered many of the mysteries of this process.

Through increasing our understanding of key epigenetic processes, this work has the potential to have positive impacts on plant breeding for increased yield and sustainability and also on human health.
Professor Bonnie Wallace
The human sodium channel

Professor Bonnie Wallace is leading a team at Birkbeck College to better understand the structure and function of the human sodium channel (isoform 8), primarily found in the peripheral nervous system, which, in a healthy organism, is responsible for pain sensation.

Mutations can cause a range of diseases, including chronic pain and certain types of multiple sclerosis. The research aims to determine the three-dimensional structure of this protein and relate these to its functional properties and the changes that result from mutations associated with different disease states.

These studies will enhance our existing knowledge of fundamental human biology but also have the potential to aid in the development of new pharmaceutical drugs with fewer side effects.

Supporting Frontier Bioscience

Professor David Stephens from the School of Biochemistry, Bristol, is Chair of one of BBSRC’s committees and an enthusiastic supporter of Frontier Bioscience.

“Frontier Bioscience is a core activity of BBSRC and the examples here show how it spans the breadth of the BBSRC remit, across all kingdoms of life, all systems and approaches. Projects in this area impact on all areas of BBSRC activity, from drug discovery and industrial biotechnology to antimicrobial resistance, animal health, and food security.

The contribution of Frontier Bioscience work to the development of new tools and technologies also cannot be understated. Recent advances in genome engineering are testament to the breakthrough science that comes from careful analysis of fundamental biological mechanisms. Detailed understanding of biological principles and mechanisms enables work with partner organisations, including clinical colleagues, industry, and other funding agencies, to develop new findings towards direct impact across the bioeconomy. This underpinning science is a major component of BBSRC activity, enabling the exploration and development of new ideas and concepts from wherever they come. There is no doubt that Frontier Bioscience forms a central component of the BBSRC funding portfolio and my own experience is that all research committees strongly encourage and support applications in this area”.

Professor Andrew James Quantock
Stem cell research

Professor Andrew James Quantock, from Cardiff University, is spearheading work to contribute to the knowledge bank of stem cell research. Ultimately, Quantock could replicate lens cells with the hope of using these in eye lens replacement therapies – changing our understanding of stem cell capabilities.

During early development, our initial pool of cells will divide and specialise to perform a specific function. At the stage before specialisation occurs, these are known as stem cells. In adults, this plasticity is lost. Our cells have defined developmental pathways. However, Nobel Prize-winning research discovered a way to reprogram adult cells into less differentiated cells, resembling cells at the early development stages. These are known as induced pluripotent stem cells (iPS cells) and have the potential to form a range of cell types.

Collaborative work between Cardiff University, Osaka University and Kyoto University led to development of the whole range of ocular tissues from iPS cells. From this, corneal cells were isolated, grown and transplanted into mice suffering from corneal blindness, leading to the restoration of sight.

In Quantock’s most recent grant, funded by the BBSRC, the aim is to expand the understanding of the eye-like iPS cell communities, determining the factors that are most important for their development.
Innovator Profile: Sarah Cleaveland

We talk to Sarah Cleaveland, OBE, won last year’s BBSRC’s ‘Innovator of the Year’ award for International Impact. The work of the Scottish-based vet is credited with having saved hundreds of human lives.

“I still call myself a vet and I am a vet!” Sarah Cleaveland, OBE, reflecting the pride she has in the work that she does.
Now based at the University of Glasgow, she is recognised for her work on animal and human infectious diseases, most notably, rabies in Africa.

She grew up in Somerset, received her veterinary training in Cambridge, got her PhD in London, went on to work in Edinburgh, and then to Glasgow. As she puts it, “I meandered around a bit, but very much enjoy being based in Scotland”.

Last year she and the University of Glasgow team received BBSRC’s Innovator of the Year award for ‘International Impact’, in recognition of their research that has informed the development of new strategies to control livestock diseases in Tanzania, including foot-and-mouth and malignant catarrhal fever.

Sarah’s story is a familiar one amongst researchers, a career that has developed and bloomed over time but not necessarily the career path that was planned. “I trained first of all as a biologist. At the end of my degree, it was a series of setbacks that got me to where I am today. I applied to be a biologist for the British Antarctic Survey and didn’t get that job and subsequently entered vet medicine and training. I did a year in practice but, for medical reasons, was unable to continue in practice and took up a research position at London Zoo, my first exposure of a research environment”.

It was during that time that she had an opportunity to go to Tanzania on the Serengeti Cheetah project as a volunteer. It was to be a pivotal experience that has helped shape the rest of her career.

“During that work I got involved with an outbreak of rabies in African wild dogs and that really stimulated my interest in rabies”.

Driven by her interest in rabies, she developed a proposal, and BBSRC’s predecessor, the Agricultural and Food Research Council agreed to fund the work.

Today Professor Cleaveland is a much-respected researcher, with a wealth of experience that gives her a unique opportunity to make a difference, and she has earned a profile that means she is listened to. She replies with a laugh, “Yes, I hope so although I’m not quite sure about that. It is definitely the case that I have a fantastic platform now with the profile of the work that has been done — to be able to talk about some of these problems. That’s of real importance for the group of neglected diseases that we are working on, raising awareness about their impact and potential mitigating actions”.

Although she now has the platform to highlight and encourage change, she recognises it isn’t always easy: “I think rabies illustrates this really well; we think we have lined up all the evidence that makes a clear case, a rational case, to do something about rabies globally and there’s very strong leadership internationally now to do that, but actually translating that into effective national policy and programmes is still quite challenging”.

This additional role of a leading researcher and scientist to deliver and demonstrate impact clearly highlights that there are many facets to the job, so is this a new responsibility? “I do think quite a lot of different skills are being demanded of us but this is now a very important role. Much gets asked of scientists, they are expected to be able to fulfil all these roles, be excellent communicators and be great at public engagement, to inform policy and demonstrate the impact of our research. It’s a lot to ask of individuals but I think collectively as an academic group we have a clear responsibility to do that”.

In 2014 she was awarded the OBE for her services to veterinary epidemiology. “It’s an amazing and wonderful accolade. It’s been an incredible few years for the recognition of the work. It’s still really hard to believe that’s it’s happened. But it’s not just about an individual, it’s a reflection of an incredible team of people that I have been working with. I’m also delighted for the recognition of the kind of work we do and the role that vets can play”.

She plays down the fact that her work has made a real difference; she is credited as having prevented hundreds of human deaths. “On a bad day, and we all have them, I remember why I am doing this. When I hear about a case history, perhaps in a remote community where a person has been bitten by a rabid dog and the impact that has on their family, then you realise why this work really matters.”

We end the conversation on an inspirational high; now in her mid-50’s, she acknowledges she has around 10 more working years in which she wants to maximise her skills and knowledge. It’s something many of us plan and very few actually do: “I’m re-focussing where I can best use my skills in the remainder of my career. There are contributions I can make but there’s only so much you can do in 10 years, and I want to be focused”.

Professor Cleaveland emphasises that the partnerships forged in Tanzania remain really strong and, most recently, her work in Malignant Catarrhal Fever field trials has shown a definite interest in upscaling vaccinations, with a view to looking at large-scale production. The future looks to be a busy one.”
Launch of the new National Biofilms Innovation Centre

The UK National Biofilms Innovation Centre (NBIC) is a new multi-site Innovation and Knowledge Centre that has been established to enhance our understanding of biofilms, and help overcome the challenges they present across industry sectors.

Biofilms are a community of one or more types of microorganisms that can grow on many different surfaces, such as plaque on teeth. They are a leading cause of antimicrobial resistance (AMR) and are a major cause of chronic infections. Contamination, energy losses and damage by biofilms impact on the UK food industry, consumer products, and the global coatings industry.

Microorganisms that form biofilms include bacteria and fungi and because biofilms are everywhere they present a range of different challenges and opportunities to a range of industries from agriculture to healthcare.

NBIC is a major, £12.5m, five-year investment which forms a key part of The UK Biofilms Programme, led by BBSRC and Innovate UK. The investment is supported further through an in-kind contribution of up to £1m worth of access to the High Performance Computing facilities from the Science and Technology Facilities Council. The new centre will enable greater exploitation of science and commercial opportunities and is jointly led by the Universities of Edinburgh, Liverpool, Nottingham, and Southampton.

What is the NBIC?

The National Biofilms Innovation Centre is a multi-site Innovation and Knowledge Centre, led by a core partnership of the Universities of Edinburgh, Liverpool, Nottingham and Southampton.

The centre is supported by a further 11 universities and three major research centres; The Diamond Light Source, The Hartree Centre and the Quadram Institute.

NBIC will collaborate with a network of over 50 companies from different sectors to exploit the UK’s global leadership in biofilms. Other universities and companies conducting biofilm research are encouraged to participate in the NBIC and can contact the centre via the website

www.biofilms.org.uk
This new National Biofilms Innovation Centre is poised to create a fusion of world-class interdisciplinary research and industry partnerships. The UK is home to some of the most advanced research and commercial opportunities for the exploitation of biofilms, so combining our talents gives us the best opportunity to establish a national, and international, agenda to tackle some of the world’s biggest challenges and work seamlessly across academia and industry to stimulate growth in this vital area.

Jeremy Webb, Professor of Microbiology and NBIC Co-Director

Why biofilms are important

- They are a leading cause of antimicrobial resistance (AMR).
- They are the major cause of chronic infections.
- Contamination, energy losses and damage by biofilms impact on the UK foods industry, the consumer products sector, and the global coatings industry.
- Biofilm management is essential to deliver clean and globally sustainable drinking water and food security.

Dr Mark Richardson, CEO of the National Biofilms Innovation Centre

One of the main remits for Nottingham will be to kill, remove or control detrimental biofilms, as part of our efforts to combat antimicrobial resistance, and to harness beneficial biofilms, for example to generate clean water. We will do this by understanding and exploiting their life-cycle dynamics and development across a range of environments with different levels of complexity.

Professor Miguel Cámar, NBIC Co-ordinator, University of Nottingham

The Biofilms Innovation Centre is the first of its kind, representing a £12.5 million investment from BBSRC and Innovate UK, with matched resource from industry. This is a unique opportunity which brings together businesses and researchers. In partnership they will create a hub for sharing knowledge and experience to accelerate the commercialisation of world-class science and emerging technologies into new products, processes and services.

Melanie Welham, Chief Executive of BBSRC

Find out more at www.biofilms.org.uk
It promises to be an exciting future, exploring opportunities that could revolutionise farming systems with the use of drones, satellite data, and robotics along with advances in genomics and crop and livestock breeding.

Predictions of population growth suggest that by 2050 the world’s population will have expanded to over 9 billion and 60% more food will be required to avoid mass malnutrition and starvation. A huge boost in agricultural productivity will be needed to meet this demand. It is not simply about using more land for food production, but maximising efficiency of land use and resources and increasing the resilience of food supply chains, while at the same time protecting the environment.

We speak to some of the people that are helping to drive this revolution. They provide a glimpse of the future and show how research and innovative technology can transform the current harvesting routine.

Whilst some farmers are sceptical about change and the future, Dr Helen Ferrier from the National Farmers Union, with over 55,000 members, is enthusiastic. She is their Chief Science Advisor: “I think in the next 30 years the advances we see in genetic improvement, the use of big data, data-driven technologies, and also understanding farm systems is where we are really going to see the step changes in the transformation in agriculture production. If we can achieve a genuine partnership between the farming community and the science community we have the potential to transform the profitability and competitiveness of farming businesses in the UK.”

You can watch the Harvest 2050 video at: bit.ly/2FiBCns
At the Harper Adams University they have been hosting the Hands Free Hectare project, the first ever in the world to plant, tend and harvest a crop using vehicles and drones, the crops not having any physical human contact. Professor Simon Blackmore has led the team that are developing robots to carry out precision farming. He is enthusiastic about the advantages that technology is helping to provide: “Instead of using dumb machines we can use smart machines, and those smart machines can then help us to achieve what we all want; cheap, efficient, good-quality, low-impact food. If we utilise these technologies then we’ve got the ability to make the whole crop production system significantly more efficient than it is now.

There are many issues that make the push for progress important. Farm machinery such as tractors are just about as big as they can be and their size and weight is causing damage to the soil. Finding the right people to pick crops is becoming increasingly difficult and expensive.

At the Earlham Institute they are using remote sensing, computer visioning and machine-learning modelling to monitor and estimate crop and climate interactions. Dr Ji Zhou is leading a team that are looking at different ways that new technologies can help farmers, allowing them to make decisions about the timing of chemical applications and irrigation.

Dr Zhou says: “Nearly everyone is flying drones nowadays; however, how to extract the meaningful information from this data is the current bottleneck. What we are doing is utilising the latest image analysis, machine learning algorithms and data to trigger a warning message. It means that, if the crops are under stress, that will trigger a warning message and farmers will need to take action.”

Precisions Decisions is just one of many companies now helping to turn the technology into tools that farmers can use. It hasn’t been easy, as many of the technologies rely on the internet and farmland isn’t the best place to hope for great wireless connections.

Clive Blacker, a director at Precision Decisions Ltd, says: “We are currently witnessing a new data revolution in agriculture. Connectivity is the Holy Grail, and we’ve been working with some satellite companies to try to develop new wireless technology solutions so that farmers can have connected tractors and sensors in fields that are connected to the internet 24 hours a day. That will allow us a whole new opportunity to start looking at how we can connect vehicles, transfer data and support people in ways that we can only dream of today.”

Xelet is another company making the most of the latest advances; they provide specialist genetics support to the aquaculture industry worldwide.

Dr Tom Ashton is one of the founders and the CEO: “The future of the UK Aquaculture industry is going to be entirely dependent on innovation. With an increasing global population and a rapidly increasing demand for seafood, the use of modern genetic testing is becoming absolutely essential to drive steady trade gains and to prevent in-breeding. So, by 2050, we expect to see modern genetic techniques being used in the UK by the major salmon farming companies, new companies coming into existence and older companies switching to genetics for the first time.”

It promises to be an exciting future, revolutionising farming as we know it today.
Insects generally have high levels of animal protein and key micronutrients with lower environmental footprints than traditional alternatives, and they can be raised on leftovers. But cultural, social and economic hurdles remain, according to a recent review.

“Insects present a nutritional opportunity, but it is unclear how their nutritional quality is influenced by what they are fed,” says Darja Dobermann, a doctoral researcher in entomophagy at Rothamsted Research and the University of Nottingham, who led the review.

“In ideal conditions, insects have a smaller environmental impact than more traditional Western forms of animal protein; less known is how to scale up insect production while maintaining these environmental benefits,” she notes.

“Studies overall show that insects could make valuable economic and nutritional contributions to food or feed systems, but there are no clear regulations in place to bring insects into such supply systems without them turning into a more expensive version of poultry for food or soya for feed,” says Dobermann.

The review highlights how insects have been a source of food for hundreds of years in more than 100 countries with over 2000 edible species; in central Africa, up to 50% of dietary protein has come from insects, with their market value higher than many alternative sources of animal protein.

Insects need to be large enough to make the effort of catching them worthwhile and easy to locate, preferably in predictably large quantities. They are consumed at various life stages, as raw, fried, boiled, roasted or ground food.

**Popular species for consumption include:**

- **Beetles**
  - Coleoptera
  - 31%

- **Caterpillars**
  - Lepidoptera
  - 18%

- **Bees, wasps and ants**
  - Hymenoptera
  - 14%

- **Grasshoppers, locusts and crickets**
  - Orthoptera
  - 13%

- **Cicadas, leafhoppers, planthoppers, scale insects and true bugs**
  - Hemiptera
  - 10%

- **Termites**
  - Isoptera
  - 3%

- **Dragonflies**
  - Odonata
  - 3%

- **Flies**
  - Diptera
  - 2%

**Further reading:**
bit.ly/2ECZAg1

**Contact:**
Susan Watts, Head of Communications, Rothamsted Research,
susan.watts@rothamsted.ac.uk
The gene PTEN is reportedly the second most commonly altered gene in human cancers. The study, led by Dr Len Stephens and Dr Phill Hawkins, reveals why loss of the PTEN gene has such an impact on many people with prostate cancer, as well as in some breast cancers.

PTEN is known as a tumour suppressor gene, meaning that it typically slows the growth of cells and its loss can lead to cancer. By regulating the levels of a chemical, PTEN helps to limit cell growth and so prevents cancer.

PTEN is reportedly the second most commonly altered gene in human cancers.

The gene PTEN is reportedly the second most commonly altered gene in human cancers. The study, led by Dr Len Stephens and Dr Phill Hawkins, reveals why loss of the PTEN gene has such an impact on many people with prostate cancer, as well as in some breast cancers.

PTEN is known as a tumour suppressor gene, meaning that it typically slows the growth of cells and its loss can lead to cancer. By regulating the levels of a chemical, PTEN helps to limit cell growth and so prevents cancer.

Speaking about the research, Dr Hawkins said: “Our work suggests that studying regulated processes may reveal why PTEN is such a powerful tumour suppressor and may also help us to identify new therapeutic targets in PTEN-mutated cancers.”

Dr Sabina Cosulich from AstraZeneca says: “Having such an open collaboration was essential for addressing a scientific puzzle of great significance to cancer research. Our team members are in regular contact and frequently work alongside each other. Hearing about the lipid biochemistry research from the Babraham Institute team and realising how we could translate its potential from an oncology perspective was a great moment for all of us!”

The research was supported by BBSRC through an Institute Strategic Programme Grant for Cell Signalling, AstraZeneca, the Wellcome Trust, GSK and the Japan Agency for Medical Research and Development.

Further reading:
DOI: 10.1016/j.molcel.2017.09.024
bit.ly/2CuX7P5

Contact:
Dr Jonathan Lawson, Babraham Institute, Communications Manager, jonathan.lawson@babraham.ac.uk
Multidrug resistance of microbes poses a serious threat to human health. 700,000 people die every year due to antimicrobial resistance.

The bacterium Klebsiella pneumoniae causes a number of infections including sepsis, urinary tract infections and pneumonia. As Klebsiella becomes more resistant to antibiotics, these common infections are becoming increasingly difficult to treat, which has led to the World Health Organisation recently declaring an urgent need for new therapeutics to be discovered for Klebsiella.

Professor Jose Bengoechea from the Wellcome-Wolfson Institute for Experimental Medicine at Queen’s University Belfast and one of the lead researchers explains: “Klebsiella pneumoniae is of particular concern as it can cause infections such as bladder infections and pneumonia and has mortality rates of 25-60%. Antibiotics that were previously used to treat these infections are no longer effective, meaning treatment options for common illnesses are becoming increasingly limited.”

However, a recent discovery by researchers at Queen’s University and the University of Vienna could radically change the approach to treating this common infection. The research shows that interferons, naturally produced in our bodies, are fighting back against the bacterial Klebsiella infection.

Professor Bengoechea explains: “Interferons are well-known weapons found within our bodies that fight against infections caused by viruses. This pre-clinical study has found that interferons are being produced to fight against the infection caused by Klebsiella, which is fast becoming resistant to treatment by antibiotics.”

The research has discovered how immune cells arriving at the site of infection communicate and join forces to eradicate Klebsiella during lung infections. The study suggests that future therapies of severe Klebsiella infections could target the immune system, rather than the pathogen itself.

Professor Bengoechea added: “These findings indicate that we can focus on therapy that manipulates interferons to fight Klebsiella, maximising our bodies’ natural resources to treat disease and reducing the need to use antibiotics for these infections. Further investigations are needed but these are encouraging results and open new avenues of research to fight this killer infection.”

The research study was led by Queen’s University Belfast in partnership with the University of Vienna as part of the EU INBIONET project, funded by BBSRC.

Researchers at Queen’s University Belfast together with the University of Vienna have discovered that treatment for the antibiotic-resistant bacterium Klebsiella pneumoniae could lie within our bodies’ natural defences.

Further reading:
Natural killer cell-intrinsic type I IFN signaling controls Klebsiella pneumoniae growth during lung infection.
bit.ly/2HvXfBt

Contact:
Suzanne Lagan, Queen’s University Belfast, suzanne.lagan@qub.ac.uk
Scientists discover new mechanisms bacteria use to guard themselves from antibiotics

Researchers at the University of Birmingham have identified new mechanisms used by bacteria to resist infection-fighting antibiotics.

Antibiotic resistance happens when bacteria evolve mechanisms to withstand the drugs that are used to treat infections. A team of experts at the university’s Institute of Microbiology and Infection focused their research on *Escherichia coli*, which can cause urinary and bloodstream infections.

Using novel experimental approaches, involving whole-genome DNA sequencing never previously applied in this area of research, the team identified mechanisms or ‘strategies’ that bacteria use to protect themselves from antibiotics.

Senior author Professor David Grainger said: “We investigated a gene found in bacteria that is involved in resistance to multiple antibiotics. Although we have known about this gene for many decades, the ‘nuts and bolts’ of how it provides resistance to antibiotics have been difficult to pick apart. Our research identified previously unknown roles for this gene in controlling processes that provide drug resistance. We found two completely unexpected mechanisms that bacteria use to protect themselves from antibiotics. One protected their DNA from the harmful effects of fluoroquinolone antibiotics, and the other prevented doxycycline getting inside bacteria.”

Dr Prateek Sharma, who did much of the experimental work, adds: “The resistance mechanisms that we identified are found in many different species of bacteria; therefore, our research could lead to the discovery of molecules that could be developed into new drugs that can treat bacterial infections.”

The study is the result of a decade-long research project carried out by the university.

Co-author Professor Laura Piddock concludes: “Antibiotics underpin modern medical, veterinary and farming practices worldwide. However, the efficacy of antibiotics is decreasing as more bacteria become resistant. Research such as ours that provides greater understanding of drug resistance mechanisms is vital if we are to address the global crisis of antibiotic resistance.”

The research was funded by the BBSRC.

Further reading:
DOI: 0.1038/s41467-017-01405-7
bit.ly/2GosrRV

Contact:
Emma McKinney, Communications Manager, University of Birmingham, e.j.mckinney@bham.ac.uk
Once again the stage is almost set for BBSRC’s annual Innovator of the Year awards. Now in its 10th year, Innovator of the Year recognises and rewards individuals and small teams who have harnessed the potential of their excellent research.

The awards recognise the full breadth of impacts that investments in research have, from the creation of spinout companies or social enterprises, to working in collaboration with business and working with policy makers, both in the UK and abroad.

The competition has four award categories:

- **Commercial Impact**
- **Social Impact**
- **International Impact**
- **Early Career Impact**

Nominations for the event this year closed in February and the winners in each category will receive a £10,000 award, with a further £10,000 for the overall winner, the BBSRC Innovator of the Year. The awards will be presented at a high-profile event in London on 16 May 2018 in front of an invited audience of leading figures from investment, industry, government, charity and academia.

Doctor Shelby Temple was the winner of the ‘Innovator of the Year’ title in 2017; recalling last year’s event, he said: “The event was really special, a bit like the Grammies for geeks! A bunch of scientists that all care passionately about what they do gathered together, it was an amazing and special event because it celebrates all the hard work that has taken place.”

Professor Sarah Cleaveland also has fond memories of last year’s event: “Winning BBSRC’s Innovator of the Year award for ‘International Impact’, was both exciting and unexpected. It was very much a team effort and a great opportunity to stop and review your own work. The evening was a great experience with fantastically interesting people”.

Professor Melanie Welham, BBSRC Chief Executive, said: “Now celebrating its 10th Anniversary, the BBSRC Innovator of the Year recognises the very significant potential of bioscience research and the impact that the translation of scientific discoveries into innovative solutions has. Each year we see a wide range of applications that highlight the enormous effort and progress researchers are making. I invite everyone to apply, as there are so many fantastic examples of innovation across the biosciences and these awards provide the ideal opportunity to recognise and celebrate the hard work and achievement.”
Aquaculture is the term used for the farming of fish, shellfish and other aquatic organisms. In the UK, farmed fish and shellfish are a growing component of food supplies, and the government recommendation is for twice-weekly consumption (particularly of oily fish) as part of a healthy and nutritious diet.

The value in the UK is growing and is worth over £600 million per year – mainly salmon, farmed in Scotland – and now represents around one-third of the scale of the cattle industry.

The successful and sustainable development of aquaculture, including the farming of new species, managing pests and diseases and meeting other challenges, requires strong underpinning fundamental bioscience. BBSRC has been a funder of research related to aquaculture, and much of the research has been on diseases and pests relevant to the salmon industry.

Research in aquaculture is an investment priority helping to support the Global Food Security (GFS) programme. BBSRC and NERC now run a joint UK Aquaculture Initiative which supports innovation projects and the Aquaculture Research Collaborative Hub UK (ARCH-UK). A call for collaborative research and innovation projects will see a range of projects start later this year, in October 2018.

Karen Lewis, BBSRC’s Executive Director, Innovation, said: “Aquaculture is one of the UK’s key strategic food production sectors, contributing to economic growth in rural and coastal communities, and in the wider economy. ARCH-UK will build and strengthen connections between biological and environmental academic research, businesses, policy makers and other groups in the aquaculture sector. Working together they will help address the challenges of growing a safe, sustainable aquaculture sector in the UK, advising BBSRC and NERC to ensure that investments in aquaculture research and innovation align with strategic research needs and deliver societal and economic benefit.”

Globally, over one billion people depend on aquaculture as a primary source of dietary protein, which requires little energy input to produce and generates low levels of greenhouse gas emissions.

A new network is supporting one of the UK’s key strategic food production sectors by bringing together researchers, facilitating new research and building links with businesses.

BBSRC and the Natural Environment Research Council (NERC) have invested £600K in the Aquaculture Research Collaborative Hub – UK (ARCH-UK) to ensure high-quality, innovative research that builds UK academic capability and meets the long-term needs of the sector.

The UK Aquaculture Network will ensure the aquaculture community has ownership of the research investments from BBSRC and NERC to help tackle challenges such as how to grow sustainably, with minimum environmental impact; and disease and parasites, which can have devastating effects on farms.

Aquaculture is crucial to meet the increase in food demand, providing 60% of fish for human consumption by 2030, vital for feeding a growing population, set to reach 9Bn by 2050.

ARCH-UK is led by Professor Brendan McAndrew from the University of Stirling and Professor Andrew Rowley from Swansea University, with Professor Sam Martin from the University of Aberdeen and Professor Charles Tyler of the University of Exeter.

Professor Andrew Rowley from Swansea University says: “ARCH-UK is a dedicated aquaculture network with over 200 individuals and organisations including aquaculture researchers, producers and organisations representing them, through to suppliers and retailers. It aims to bring together a community of people to facilitate knowledge exchange, and to encourage the translation of science and technology to industry and policy”.

More information about the initiative can be found at:
www.bbsrc.ac.uk/ukaquaculture
www.aquaculturehub-uk.com
Behavioural neuroscience improves firefighter decision making

Incident Commanders in UK Fire and Rescue Services are using guidance underpinned by BBSRC-funded neuroscience research to improve their decision making at incidents.

The initial research by Cardiff University focussed on identifying areas in the brain involved in a form of learning known as retrieval-mediated learning.

The BBSRC-funded research enabled a further study that led to the development of a decision control process, a rapid mental checklist to help Incident Commanders to make decisions appropriate for the situation. The decision control process has been incorporated into national guidance, which cites the BBSRC-funded research and is being used daily by Fire and Rescue Services across the UK.

Dr Sabrina Cohen-Hatton, Deputy Assistant Commissioner of the London Fire Brigade and one of the researchers who led the study, said: “It was very well received and is now thoroughly embedded in UK Fire and Rescue Services.”

As part of the research, Incident Commanders were fitted with small portable cameras to capture everything that happened at an incident. Data from the cameras showed that around 80% of the decisions made by the Incident Commanders appeared to rely on some of the more intuitive forms of decision making. In effect, they were relying on mental shortcuts developed and reinforced by their experiences of similar incidents.

Improvements to fire safety mean that there are fewer incidents that require the Fire and Rescue Service to attend. This is an immensely positive development, but it does mean that Incident Commanders have less experience to call upon when making decisions. It also means that the influence of learned associations between cues in the environment and a course of action are weaker.

The research showed that the intuitive, reflexive decision making was used more often than previously realised. While this is a very quick form of decision making, it can lead to what are known as decision traps. For instance, intuitive decisions may skip planning processes. This means the decision is not the best choice in the context of a tactical plan or broader incident objectives.

To help Incident Commanders avoid these traps, the researchers introduced a decision control process. By following a simple series of checks such as ‘Why am I doing this?’, ‘What do I think will happen?’ and ‘Are the benefits proportional to the risks?’, Incident Commanders can rapidly challenge their own decision making, especially at high-risk incidents where time is short.

The national guidance, which cites the BBSRC-funded research, has been adopted by Fire and Rescue Services and other UK emergency services. It has also been incorporated into the UK’s Joint Emergency Services Interoperability Programme (JESIP) that guides the work of the emergency services when they come together to tackle a major incident.

You can read the report here: bit.ly/2FcwIIF

DATA BREAKOUT

161,770
Number of fires attended by fire and rescue services in England in 2016/17

2,600
Number of injuries sustained by firefighters in England in 2015/16

2016
Year the revised guidelines, including the new process, were published

£402k
Value of BBSRC investment into the underpinning research
Oxford University researchers have developed and commercialised the world’s first desktop-sized super-resolution microscope, creating a compact, easy-to-use tool that allows researchers to study the interaction and dynamics of single molecules.

‘The Nanoimager’ is similar in size to a desktop computer and allows researchers to study individual molecules within living cells and to be operated on a desk by a scientist, unlike other super-resolution microscopes, which require dedicated rooms, specialist infrastructure, and operation by imaging experts. It is also three to ten times more affordable than existing instruments.

Spin-out company ONI (Oxford Nanoimaging) was formed in May 2016 to market the microscopes and received £1.2m seed funding from private investors. Professor Achillefs Kapanidis and his DPhil student Mr Bo Jing, now CEO of ONI, created ‘The Nanoimager’. Bo Jing says, “We integrated the latest technology available and created a tool that is both powerful and affordable, enabling a wider range of scientists to use super-resolution microscopy for the first time, to answer significant biological questions which impact society.”

The Nanoimager is opening up new possibilities in fundamental research, and in diverse applications such as medical and animal diagnostics, drug discovery, environmental and food testing, and chemical and material analysis.

A Joint Synthetic Biology Initiative grant part-funded by BBSRC helped the researchers create the first prototype of their microscope. To answer the biological questions they were asking, the researchers needed a single-molecule fluorescence microscope. Realising that any commercially-available microscopes of this type were prohibitively expensive and were limited in their use, they built their own, as their research progressed. Kapanidis and his colleagues continually improved their microscope so that it became more sensitive, faster, and smaller, eventually leading to the development of the Nanoimager.

It was an award of £120k from the Joint Synthetic Biology Initiative, funded by BBSRC, the Defence Science & Technology Laboratory, EPSRC, and MRC, that helped the researchers to develop their first prototype of the Nanoimager. Following further funding from the European Research Council (ERC), Kapanidis and Jing formed spin-out Oxford Nanoimaging in May 2016.

Professor Achillefs Kapanidis says: “With single-molecule fluorescence microscopy you can, for example, have one colour representing DNA and another colour representing a protein that interacts with DNA, and then you can visualise the interactions even in living cells. This is not a technology we invented but, because of its very compact, robust design, our microscope is popularising this methodology.”

“We learned a lot of lessons from basic science,” says Kapanidis. “A project that is driven by basic science will always require new tools, so, as we climb the wall of a difficult biological problem with huge academic value, at the same time we’re pushing forward technology.”
WHAT IS BIOPLASTIC?

A bioplastic is a plastic made partly or wholly from materials from biological sources, such as sugarcane, potato starch or the cellulose from trees and straw. Bioplastics are often designed so that they biodegrade or compost at the end of their useful life, aided by fungi, bacteria and enzymes.

Bioplastics can generally be directly substituted for their oil-based equivalents. They can also be made to be chemically identical to standard industrial plastics.

Time to go Bioplastic?

The problem of recycling used take-away coffee cups is in the spotlight again amongst growing concern about the use of plastic packaging and the threat of marine pollution in our oceans.

Food supermarket Iceland recently announced they are to be the first major retailer to stop using plastic packaging from all of their own-brand products by the end of 2023, and has once again ignited interest in the issue of disposable cups, discarded after a visit to the local coffee shop.

BBSRC has been supporting research into providing an alternative to traditional polyethylene-lined disposable coffee cups. Traditional plastic-lined disposable coffee cups have long been an environmental concern, especially as it’s estimated that in the UK we use 7 million disposable coffee cups every day, that’s 2.5 billion every year.

The Environmental Audit Committee has set out a strategy for the UK to deal with the waste and has suggested the Government introduce a 25p “fatte levy” on disposable coffee cups, and requested all disposable coffee cups be recyclable by 2023.

Many of us think that disposable coffee cups are already recycled, although in reality the plastic lining that holds the liquid makes the cups difficult and expensive to recycle.

We are already familiar with a levy to encourage us to think greener, following the 5p cost of a plastic bag. It forced us all to rethink how we carry our groceries home and make an effort not to bin our plastic carrier bags but save and re-use them, often replace a flimsy throwaway bags for stronger and sturdier bags with a longer life. Following the introduction of charges for bags, single-use plastic bag use in England fell by nearly 90% in some cases.

Last year Biome Bioplastics, a Southampton-based company that has received research funding from BBSRC and Innovate UK, launched materials for disposable coffee cups and lids, derived from plant-based bioplastics. Unlike regular cups and lids, these containers can be recycled and composted.

The Chief Executive of Biome Bioplastics is Paul Mines. He thinks society is listening and the time has come for change: “I’d argue that the disposable cups that society deems essential be sourced, not from fossil fuels, but from 100% renewable, bio-based sources. Bioplastics can perform just as well but can be recycled, composted and come without the carbon footprint”.

Biome Bioplastics is one of the UK’s leading developers of intelligent, natural plastics, with a mission to produce bioplastics that can challenge the dominance of oil-based polymers, and ultimately replace them completely.

Iceland’s Managing Director, Richard Walker, having announced pioneering changes to their own-brand packaging, agrees the time is right for change: “The world has woken up to the scourge of plastics. A truckload is entering our oceans every minute, causing untold damage to our marine environment and ultimately humanity. The onus is on retailers, as leading contributors to plastic packaging pollution and waste, to take a stand and deliver meaningful change”.

Research and advances in technology mean there is now a real alternative to an increasing problem; it could just be that the time is right to make a change and a real difference.

Paul Mines sums it up: “British bioplastic research and development is at the cutting edge of innovation. Our industry is ready and waiting to solve society’s plastic problems with smart and environmentally friendly solutions”.

Find out more about Biome Bioplastics: www.biomebioplastics.com
A strategy for future development

Bioscience is a rapidly evolving discipline, and our Chief Executive recently blogged about some of the game-changing advances in technology and data-driven approaches that are revolutionising bioscience research. At the same time, the wider research and innovation landscape is changing with the establishment of UK Research and Innovation, implementation of the government’s Industrial Strategy, the increasing internationalisation of the research endeavour and the UK’s changing relationship with the European Union.

As the primary public-sector funder of UK bioscience, part of BBSRC’s role is to ensure that UK bioscience is well placed to respond to these developments, and to continue to deliver world-leading research with a range of scientific, societal and economic impacts.

Over the last few months, we have been working with our research community and diverse stakeholders through our extensive strategy advisory network to consider the direction of travel and future priorities for UK bioscience in the context of the changing landscape. During the autumn, we also ran an online consultation inviting views from the wider community, and were pleased to receive more than 100 responses from a range of stakeholders in academia, learned societies, policy organisations, NGOs and industry.

Some of the high-level messages we took from these activities were:

• A need to ensure that UK bioscience is built on strong foundations of people, infrastructure and partnerships; establishing and maintaining these key capabilities requires a coordinated approach involving funders, research organisations, government and industry.

• The importance of promoting creative, curiosity-driven, frontier bioscience research that addresses fundamental questions in biology, and of achieving a balance between ‘blue skies’ research and research that is motivated by addressing a specific societal or economic challenge.

• Recognition of the increasing emphasis on data-driven approaches to bioscience, and the need to ensure that the UK has access to the necessary infrastructures and skills to enable this.

• Ongoing support for ‘agriculture and food’, ‘industrial biotechnology’ and ‘health’ as three areas where there are significant opportunities for bioscience to help address societal challenges, whilst simultaneously acting as a driver for innovation and growth in the Bioeconomy.

The advice we receive from our community and stakeholders is tremendously valuable to BBSRC in making sure that we have a clear understanding of what our community sees as the most important issues for UK bioscience. This will help to guide BBSRC’s actions and investments in the coming years, as well as providing a framework for our interactions with a wide range of partners and our input to UKRI-wide strategy development.
You can now have the latest news and funding highlights delivered direct to your inbox each month with our new-look BBSRC Newsletter.

To subscribe visit: www.bbsrc.ac.uk/newsemail

Read our Chief Executive’s latest blog: blogs.bbsrc.ac.uk

Connect with BBSRC on

www.bbsrc.ac.uk

From April 2018 BBSRC will form part of UK Research and Innovation

www.ukri.org  twitter.com/UKRI_News

UK Research and Innovation