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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 £473M 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.

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www.aber.ac.uk/en/ibers

Institute of Food Research
www.ifr.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
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In this issue

Chief Executive Professor Melanie Welham returns from France to digest the changes facing the UK biosciences, and reveals more in a Q&A feature later in this issue.

Changes in the research landscape seem to have accelerated recently, and I am sure that the past couple of months will go down in 21st century British history as some of the most dynamic. The outcome of the EU referendum has raised a number of concerns across the research community. And we have seen changes in the leadership at the very top of UK Government, with a new Prime Minister, a new Cabinet and newly configured departments.

In May the Higher Education and Research White Paper was published, followed shortly by the announcement of the related Bill in the Queen’s speech. The intention to establish the Research Councils within the new body UK Research and Innovation (UKRI) is clearly set out and, while the exact details of UKRI remain a work in progress, we have already had really positive engagement and discussions with John Kingman, the Chair of UKRI. I am optimistic that the changes will bring new opportunities for bioscience.

We have also seen the creation of the Global Challenges Research Fund (GCRF), a new focus on research to tackle the challenges faced by low- and middle-income countries. Colleagues within BBSRC and across the Research Councils have worked to launch a series of GCRF calls (with more on the way) and a GCRF ‘call for evidence’ has provided the opportunity for wider community input.

In this issue, on pages 20-22 you can hear more about my thoughts on some of these issues in a special Q&A feature. There’s also an extended version on the BBSRC website, and our channel on the Medium platform.

“I returned from France to the announcement regarding the UK Government’s commitment to underwriting awards for European H2020 grants. This is really welcome news and emphasises the benefits of the Research Councils working closely together as we go through this period of change.”

Apres la pluie, le beau temps (after rain comes sunshine)

Part of my summer holiday was spent in Burgundy, France, and this inspired me to take a closer look at the bioscience behind viticulture. As we cycled through vineyards, occasionally stopping off to sample the fine wines on offer, it was hard not to be astounded by the differences in wines produced from the same varieties of grape – the influence of the famed ‘terroir’ (land) being a key factor.

Recent studies have suggested that the soil microbiome may contribute to the regional ‘terroir’. This holiday-inspired diversion into viticulture emphasised to me that cutting-edge technologies and approaches developed to address one biological problem so often find applicability across the breadth of bioscience research – in this case the use of Fourier transform ion cyclotron resonance mass spectrometry, which has emerged as the current state-of-the-art approach for examining the influence of soil composition on metabolite profiles in grape juice and wines.

Besides the wine, we were also fortunate enough to sample a wide array of superb food. From pages 12-19 you can catch up on BBSRC-funded research across the field – from using satellite data to track threats to mussel farming to future game-changing technologies that will affect food production techniques and a variety of foods.
£3M awarded to boost sustainable agriculture

10 new interdisciplinary projects aim to improve the sustainability of UK farming.

Grants totalling £3.2M were funded in the second round of the Sustainable Agriculture Research and Innovation Club (SARIC) by BBSRC, NERC and ESRC alongside 12 industry partners.

SARIC was formed following consultation with trade associations, levy boards, policy makers and academia that identified a need to bring together researchers from the environmental, biological and social sciences with industry, to translate knowledge and make progress towards more sustainable agricultural systems.

Among the funded studies is work to improve the weather resilience of crops, sensing soil nitrogen, and advanced technologies for crop management. Translational studies include establishing decision tools for slurry usage and potato cyst nematode management, devices to assess and improve the use of animal nutrients, and an assessment of the risks of pesticide run-off.

Centre of Excellence for Plant and Microbial Sciences (CEPAMS) opens its first laboratory with appointment of Dr Yang Bai.

CEPAMS aims to advance knowledge of how microbes interact with soil and plants in order to develop more sustainable methods of agriculture and enhance global food security. Established between the John Innes Centre (JIC), which received strategic funding from BBSRC, and the Chinese Academy of Sciences (CAS), it will also focus on the production of high-value, beneficial products from plants and microbes.

Dr Bai joins CEPAMS from the world-renowned Max Planck Institute for Plant Breeding Research in Cologne, Germany. The new Bai laboratory will be housed within the CAS Institute of Genetics and Developmental Biology in Beijing.

Dr Bai says it is a great honour to be the very first CEPAMS Group Leader. “I am looking forward to exploiting my unique position, as a joint CAS-JIC faculty member, to do some ground-breaking science and to further strengthen the UK-China scientific partnership.”

CEPAMS Director, Professor XiaoFeng Cao, says Dr Bai’s work on plant microbiota has significant importance to improve agriculture and food security. “The CEPAMS will provide him with an excellent developing environment and platform.”

The new centre was established with funding from the CAS and BBSRC. Dr Bai will be joined by a further nine Group Leaders as CEPAMS expands to full capacity.

Coming of age: Dolly the sheep at 20

Symposium marked legacy of the research that produced the world’s most famous sheep.

There’s no doubting that, in a small way, the world was never quite the same place again after a certain sheep was born: it proved that clones could be made from adult cells, which had not been done before.

To mark the anniversary of Dolly the sheep’s birth, the Roslin Institute, which receives strategic funding from BBSRC, launched the Dolly the Sheep ©20 website (http://dolly.roslin.ed.ac.uk) and hosted an event on Friday 2 September with the MRC Centre for Regenerative Medicine at the University of Edinburgh.

Earlier, BBSRC teamed up with Roslin to make a video quiz: watch it on the BBSRC website: www.bbsrc.ac.uk/dollyquiz

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Genetics research alliance aims to improve aquaculture and livestock breeding

The Roslin Institute and Hendrix Genetics establish research agreement to improve sustainability of animal production.

The agreement builds on existing collaborations in salmon disease genetics between the two organisations. The Roslin Institute, which receives strategic funding from BBSRC, already works closely with the salmon breeding company Landcatch, a Hendrix Genetics company based in Ormsary in Argyll, Scotland.

Researchers will focus on driving innovations that lead to greater disease resistance in farmed animals and better selective breeding programmes. Their goal is to reduce losses and improve welfare in the fish farming and livestock industries. It will also allow them to explore precision breeding technology, not only in aquaculture, but also in pig, chicken and turkey breeding.

This collaboration has already yielded the discovery of a gene that makes salmon more resilient to a viral disease. It has also led to the development of genetic tools that have improved selective breeding for resistance to sea lice. Scientists at the Universities of Stirling and Glasgow, as well as The University of Edinburgh’s sequencing facility Edinburgh Genomics, were also part of the research team that led to these discoveries.

Ageing Cell Conference at the Babraham Institute

Event will bring together international community to discuss ageing at the cellular level.

Join researchers in Cambridge, 27-28 March 2017, from the fields of immunology, genetics, epigenetics and signalling to hear the latest research addressing the complex alterations in biological functions that lead to ageing.

The conference programme, which includes keynote speakers David Gems (Institute of Healthy Ageing, UCL), Linda Partridge (Institute of Healthy Ageing, UCL) and David Sabatini (Whitehead Institute, MIT), addresses the science of ageing from four key perspectives: the ageing stem cell, the immune system, signalling pathways controlling metabolism and cellular fitness, and epigenetics.

Abstracts are welcomed from early-career and established researchers from both the public and private sectors for short talks and poster presentations. To find out more, please see the conference website: www.babraham.ac.uk/the-ageing-cell

£4.5M Newton Fund to tackle antimicrobial resistance

Six new research partnerships are looking at ways of tackling the rise of antimicrobial resistance (AMR).

As microorganisms have become resistant to antimicrobial treatments, including antibiotics, there is a very real possibility that drugs we now rely upon may become obsolete.

Cross-border collaboration is a vital step to progress in this global risk, and the investment by the UK Research Councils BBSRC, ESRC and MRC comes through the Newton Fund, an initiative intended to strengthen research and innovation partnerships between the UK and partner countries.

The partnerships will see researchers from multiple disciplines at six UK centres of excellence work in collaboration with Chinese counterparts, thanks to match funding from the National Natural Science Foundation of China (NSFC).

Speaking on behalf of the collaborating UK Research Councils, Mark Palmer, Head of International at MRC, says the growing resistance of microorganisms requires an urgent global response. “The outcomes of these awards will benefit both the UK and China through the sharing of knowledge, and hopefully lead to significant impacts on health and policy.”
£9M funding to optimise UK food supply and tackle global food security

Five new interdisciplinary research projects seek to help increase the resilience of UK food systems.

The research looks to optimise resilience, productivity and sustainability across the food system, ensure resilient supply chains and influence food choices to relieve pressure on global food systems. The successful projects will focus specifically on increasing crop and livestock tolerance to weather, emerging diseases, price volatility and other environmental and social shocks and include the development of models that can be used by the food security community globally.

The research programme was driven forward by the UK’s Global Food Security Programme, with funding from BBSRC, ESRC, NERC and the Scottish Government.

UK Science Minister Jo Johnson says these research projects will help tackle the serious threat of food shortages. “Supporting these exciting and innovative solutions will help the UK food industry be better prepared for external factors and help provide food security to millions around the world.”

“Stability of supply and access is an essential element of food security,” adds Professor Tim Benton, Global Food Security Champion. “Ensuring our food systems are resilient is therefore crucial, especially as the world is changing rapidly – whether from the weather or from social and political change.”

BBSRC scientists recognised in the Queen’s Birthday Honours list 2016

Among those honoured is Professor Caroline Dean FRS, from the BBSRC strategically funded John Innes Centre. She becomes a Dame Commander of the Order of the British Empire for services to Plant Science Research and Women in Science.

Professor Anna Dominiczak from the University of Glasgow, who has links with both BBSRC and MRC, also becomes a Dame.

Dr Vanessa Linda Mayatt, a current Trustee Board member of the BBSRC-funded Pirbright Institute, was awarded the OBE for services to public and animal health.

Professor Doug Turnbull from Newcastle University also has strong links with both BBSRC and MRC and was knighted for services to health care research, particularly for an IVF technique that prevents disabling genetic disorders from being inherited.

New international travel award scheme launched

International Travel Award Scheme (ITAS) allows scientists to add a global dimension to their BBSRC-funded research.

The ITAS is a rolling programme and BBSRC accepts submissions all year. It offers awards of up to £3,000 to help establish new contacts with international counterparts in topics relevant to current BBSRC strategic priorities. The scheme is open to Principal Investigators (PIs) and will accept proposals involving collaborations with any other country that offers added benefit to research.

Funding is available to support collaborative activities such as: a) first contact activities that require short-term travel support; b) visiting specific facilities not available in the UK, undertaking a particular piece of work, or gaining access to new techniques or materials that would benefit the BBSRC project or UK research team.

Stays of up to one month in another country can be supported, and funding is limited to travel and subsistence costs only for UK scientists. Applicants should allow a minimum of six weeks for applications to be processed: www.bbsrc.ac.uk/itas
National boost to DNA industries and precision genomics

The UK’s first fully automated DNA production facility has opened. Researchers at The Edinburgh Genome Foundry, housed at the University of Edinburgh’s School of Biological Sciences, will design and manufacture genetic material on an unprecedented scale, assembling complex pieces of DNA code quickly at relatively low cost.

The foundry’s products could lead to advances such as programming stem cells for use in personalised medicines, developing bacteria that can detect disease in the gut, or altering the DNA of biofuel crops to enable a higher yield. It is funded primarily by the RCUK Synthetic Biology for Growth Programme.

“This will help us both interrogate how cells and organisms operate and realise the many economically important applications of synthetic biology,” says Professor Susan Rosser, Co-Director of the Foundry, and Chair in Synthetic Biology at The University of Edinburgh.

The Earlham Institute (EI) has added a state-of-the-art DNA Foundry for synthetic biology to their world-leading suite of sequencing technologies.

Receiving strategic funding from BBSRC, the EI (formerly known as The Genome Analysis Centre) Foundry contains a suite of equipment for automated DNA assembly and delivery of DNA to living cells for generating highly reproducible data. It will complement the Norwich Research Park’s Industrial Biotechnology Alliance (IBA), which aims to address major societal and environmental challenges of the 21st century.

Funded by a £1.9M grant, the EI DNA Foundry is one of five locations funded by the Research Councils’ Synthetic Biology Growth Programme (and administered by BBSRC) to provide the UK’s academic community and synthetic biology industries with DNA fabrication facilities.

Two major investments open from Synthetic Biology Growth Programme.

New frontiers in crop research

Conference includes updates on projects underway within BBSRC-funded research-industry clubs.

The programme will include sessions on enhancing crop growth and yield, improving crop quality, and the outlook and challenges facing the agri-food industry. The event, to be held at SCI in London on 24 October, also aims to foster the interdisciplinary networking essential to innovation in the agri-food sector.

 Updates from projects in BBSRC research-industry clubs can also be found, including the Crop Improvement Research Club (CIRC), Horticulture and Potato Initiative (HAPI), and the Sustainable Agriculture Research and Innovation Club (SARIC).

For more information visit: www.soci.org/events or via @SCIupdate on Twitter.
New microscopy technique at the Babraham Institute reveals cellular recycling processes in unprecedented molecular detail.

Derived from the Greek and meaning ‘self-eating’, autophagy describes a process whereby cellular contents are collected and recycled into new molecules and cellular structures. It’s fundamental to normal functioning of the human body, and glitches in this process or a loss in efficiency are associated with ageing and ageing-related diseases such as Alzheimer’s, rheumatoid arthritis and cancer.

Using live imaging capabilities, researchers at the Babraham Institute and their collaborators at Carl Zeiss Microscopy, Munich, and the Francis Crick Institute, London, have viewed the earliest stages of this encapsulation and recycling process in super-high resolution.

The researchers focused on determining the origin and formation of a structure only seen at the very start of the autophagy process, but which gives rise to the main structure called the autophagosome, which is like a cellular ‘bubble wrap’ that envelops the content targeted for degradation.

Due to its short-lived nature, this transient structure was difficult to characterise. So the researchers developed a new comprehensive imaging-based approach for observing autophagy-related structures. At the Babraham Institute this was achieved using live imaging followed by dStorm (direct stochastic optical reconstruction microscopy). At the Francis Crick Institute in London and the Zeiss Microscopy Labs in Munich, the researchers used a method called FIB-SEM (focused ion beam scanning electron microscopy).

By combining the information gathered from these two methods, the researchers were able to identify how the first autophagy structure forms, as well as clarify the protein and membrane associations leading to development into a fully fledged autophagosome.

Dr Nicholas Ktistakis, group leader in the signalling research programme at the Babraham Institute and lead senior author, says they have been able to characterise the site of autophagy initiation and observe the physical and functional interactions between the proteins involved in autophagy.

“This has uncovered a new level of detail of the earliest stages of autophagy and provides a general protocol for this type of analysis in other areas of cell biology,” says Ktistakis.

“Knowing more about this process increases our ability to find ways to manipulate or boost it for future therapeutic benefit.”

Further reading
Autophagy initiation by ULK complex assembly on ER tubulovesicular regions marked by ATG9 vesicles.

Nature Communications
DOI: 10.1038/ncomms12420

Next steps
• Further blending of dStorm and wide-field images to yield novel information about the developing pre-autophagosomal structure.

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Discovery pipeline
Baby girls’ future fertility may be curbed by cancer drug

Chemotherapy treatment during pregnancy may affect the ovaries of unborn baby girls.

Researchers have found that a drug called etoposide can damage the development of mouse ovary tissue grown in the lab. The drug affects specialised cells called germ cells, which give rise to eggs in women (and sperm in men).

Etoposide is used to treat several types of cancer and is considered safe for use in the second and third trimesters of pregnancy because it has a low risk of miscarriage and birth defects. Little is known, however, about the longer terms effects of the drug on the unborn baby in later life.

Scientists at the University of Edinburgh say their findings may mean that affected baby girls should be warned in later life that they may undergo an early menopause.

“If the results we have seen in these mouse studies are replicated in human tissue, it could mean that girls born to mums who are taking etoposide during pregnancy have a reduced fertility window,” says lead researcher Professor Norah Spears, of the university’s Centre for Integrative Physiology.

Life decisions

Around one in 1000 pregnant women are diagnosed with cancer. Doctors and patients have to make difficult decisions to try and save the lives of both mother and baby.

A woman’s reproductive lifespan is determined before birth, while the ovaries are developing in the womb. The second and third trimesters are particularly important as that is when female germ cells form structures called follicles that determine how many eggs she will be able to release in her lifetime.

Researchers studied the effects of etoposide treatment on the development of mouse ovary tissue grown in the lab. They found that treatment before the follicles had developed wiped out up to 90% of the germ cells, even at doses that are low relative to those given to patients.

Follicle development begins around 17 weeks into the baby’s development in the womb and is not completed until the later stages of pregnancy. Treatment after the follicles were developed had no significant adverse effects.

Further reading

Etoposide damages female germ cells in the developing ovary.

BMC Cancer

Next steps

- Further research to assess whether the drug has similar effects on human tissue.

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Discovery pipeline

More research is needed to see if the drug’s effects in mice are replicated in pregnant women.
Study offers vets clues to why dogs’ tails lose their wag

A painful condition that affects dogs’ tails may be more common than previously thought.

Dog fanciers have long wondered what causes the condition known as ‘limber tail’ that causes the tail to become limp and painful, which mostly affects larger working dog breeds such as Labrador Retrievers.

Researchers at The Roslin Institute, which receives strategic funding from BBSRC, compared 38 cases of limber tail that were identified from owners’ reports about their dogs’ health with 86 dogs that had no symptoms. Their goal was to gain insight into habits and lifestyle factors that might explain why some dogs are affected and not others.

The symptoms usually resolve within a few days or weeks so many cases are not reported to vets. This may be why it has been so underestimated in the past. However, owners report that it can be very painful and distressing for the animals.

The majority of dogs in the study were pets, but results showed that those affected by limber tail were more likely to be working dogs. And dogs with the condition were more likely to live in northern areas, lending support to anecdotal reports that limber tail is associated with exposure to the cold.

Swimming has previously been thought to be a risk factor for limber tail, which is sometimes known as ‘swimmers’ tail’. Some, but not all, of the affected dogs had been swimming prior to the onset of symptoms.

The study also found that Labradors that had suffered limber tail were more likely to be related to each other than unaffected dogs, which indicates an underlying genetic risk.

Experts hope that further studies will identify genes associated with the condition, which could one day help breeders to identify animals that are more likely to be affected. Over time, this could help to reduce the disease prevalence.

Dr Carys Pugh, who led the study at The Roslin Institute and the Royal (Dick) School of Veterinary Studies, says the researchers were surprised by how many owners were reporting limber tail.

“We have been able to add evidence to a lot of internet speculation about risk factors,” says Pugh. “The new findings relating to geographical region and family links give us avenues to pursue in understanding and avoiding the condition.”

Further reading
Cumulative incidence and risk factors for limber tail in the Dogslife Labrador retriever cohort.
Veterinary Record
DOI: 10.1136/vr.103729

Next steps
• Further research on the influence genes and environment in the condition’s development.

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Discovery pipeline

Water, working and affected relatives appear to be risk factors associated with the condition.
Cravings for high-calorie foods can be switched off in the brain

Eating a powdered semi-natural food supplement reduces cravings for foods such as chocolate, cake and pizza.

With obesity rates soaring across the world, scientists are increasingly interested in ways to curb our less healthy food cravings. Could a supplement based on a molecule produced by bacteria in the gut help us to manage consumption?

Scientists from Imperial College London and the University of Glasgow asked 20 volunteers to consume a milkshake that contained either an ingredient called inulin-propionate ester, or a type of fibre called inulin.

Previous studies have shown bacteria in the gut release a compound called propionate when they digest the fibre inulin, which can signal to the brain to reduce appetite. However, the inulin-propionate ester supplement releases much more propionate in the intestines than inulin alone.

After drinking the milkshakes, the participants in the current study underwent an MRI scan, where they were shown pictures of various low- or high-calorie foods such as salad, fish and vegetables or chocolate, cake and pizza.

Researchers found that, when volunteers drank the milkshake containing inulin-propionate ester, they had less activity in areas of their brain linked to reward, but only when looking at the high-calorie foods. These areas – the caudate and the nucleus accumbens found in the centre of the brain – have previously been linked to food cravings and the motivation to want a food.

The volunteers also had to rate how appealing the foods were; when they drank the milkshake with the inulin-propionate ester supplement they also rated the high-calorie foods as less appealing.

Food on the brain

In a second part of the study the volunteers were given a bowl of pasta with tomato sauce and asked to eat as much as they liked. When participants drank the inulin-propionate ester, they ate 10% less pasta than when they drank the milkshake that contained inulin alone.

Professor Gary Frost, senior author of the study from the Department of Medicine at Imperial, says their previous findings showed that people who ate this ingredient gained less weight, but they did not know why.

“This study is filling in a missing bit of the jigsaw, and shows that this supplement can decrease activity in brain areas associated with food reward at the same time as reducing the amount of food they eat.” He adds that eating enough fibre to naturally produce similar amounts of propionate would be difficult.

Claire Byrne, a PhD researcher also from Imperial’s Department of Medicine, says that using inulin-propionate ester as a food ingredient may help prevent weight gain.

“If we add this to foods it could reduce the urge to consume high-calorie foods.” She adds that some people’s gut bacteria may naturally produce more propionate than others, which may be why some people seem more naturally predisposed to gain weight.

The research was co-funded by BBSRC, the National Institute for Health Research, and Imperial Biomedical Research Centre.

Further reading
Increased colonic propionate reduces anticipatory reward responses in the human striatum to high-energy foods.
American Journal of Clinical Nutrition DOI: 10.3945/ajcn.115.126706

Next steps
- Further research on the molecular pathways by which called inulin-propionate ester affects brain and behaviour.

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Discovery pipeline
What can satellite data do for aquaculture?

The BBSRC- and NERC-funded ShellEye project seeks to help shellfish farmers manage threats from harmful algal blooms and E. coli bacteria.

“We’re shut because of a harmful algal bloom in the waters at the moment. Being shut costs us £25,000 a week, and last year we were shut for four months.”

Gary Rawle, a shellfish farmer based around St. Austell, Cornwall, is remarkably sanguine for a man whose business stands to lose more money in a week than most people earn in a year. He’s the owner of West Country Mussels of Fowey that provides high-quality mussels by the tonne for the seafood industry, which end up in restaurants all over the UK.

But when harmful algal blooms (HABs) arise – natural proliferations of mostly phytoplankton species that can thrive in the (relatively) warm and nutrient-rich Gulf Stream waters that lap around the Cornish coast – Gary and his entire business can be effectively put on hold. Some of these naturally occurring algae produce marine toxins that force the farm to close. “If we’re shut we can’t harvest or sell the mussels. Eventually, they get too heavy for the lines and we lose them,” he says. “We have to wait until the algae die and then the farm can re-open.”

Rawle has been farming shellfish for more than 25 years. He’s already moved his farm offshore from an estuary which had episodes of poor water quality. That, and losing almost a quarter of a million pounds last year in lost business, has motivated him to work with BBSRC- and NERC-funded scientists from Plymouth Marine Laboratory (PML) and other industry partners on the ShellEye project.

“To me, it’s the future,” says Rawle. “For the last two years we carried the cost during the closure, but how long we can continue with that is debatable.”

The multi-partner ShellEye project brings together industry, government and scientists from PML, the University of Exeter, the Centre for Environment Fisheries and Aquaculture Science (Cefas), and the Scottish Association for Marine Science (SAMS). The project aims to develop a satellite-based forecasting system to help fishermen like Gary avoid the worst effects of the algal blooms to protect public health, reduce food waste and contribute to the resilience of the UK food system and bioeconomy.

Fisherman’s blues

As we head out on Gary’s boat – the Spirit of Cornwall – it’s clear that this mussel farm is a key part of the local fishing economy. The farm covers an area the size of 40 football pitches and has the capacity to produce up to 400 tonnes a year of a food touted as one of the most sustainable forms of protein: they take all their nourishment from the sea and require no extra feed, unlike farmed fish. Shellfish are also good sources of iron, zinc, copper, vitamin B12 and omega-3 fatty acids – excellent components of a healthy diet.

On a bright sunny day, it’s hard to believe that these aren’t perfect mussel harvesting conditions, but it’s only because our eyes can’t see the hordes of plankton in the clear waters, let alone the potential toxins that currently make the mussels unsalable.

Dr Peter Miller of PML heads up the ShellEye project and is excited by the potential of satellite data to track algal blooms in real-time, and how these data can then be analysed, simplified and sent to fishermen in the area.
"We can use very detailed satellite images of the ocean colour to pick out certain algal species, allowing us to differentiate between the harmful and harmless algae," Miller explains.

Miller’s confidence comes from a previous project in Scotland with SAMS that helped Scottish salmon farms manage their risks from HABs, and he wanted to see if we could do the same for the shellfish aquaculture industry. It’s high-tech science that can have immediate impacts: shellfish farming is worth around £32M per year to the UK economy (see box). Miller says that the shellfish industry has a lot of potential for growth in the UK. “But there are environmental factors that are holding back this expansion,” he says. “If we can minimise risk factors from HABs and E. coli bacteria and provide an early-warning system, there will be fewer constraints on shellfish farms growing around the country.”

A key part of this protection will come from orbiting satellites – eyes in the sky that can see through the blue hue of the sea and provide detailed information on the dynamic processes happening in surface waters, such as the ESA’s newest Earth observation satellite, the Sentinel 3A. As we head back to shore, Miller looks up and draws an arc across the sky. “About now the European satellite is taking pictures of this very spot. These pictures will be combined with data from in situ surveys, meteorological data and historical data to provide an early-warning forecast of the potential risks.”

Dr Hayley Evers-King explains. “We process the data here at PML, and have specialised software to manage the corrections needed to get rid of ‘noise’ in the data, from sources like the atmosphere for example.”

A multitude of mathematical models are then employed that match algal blooms seen in the satellite images with in situ data collected from boats at sea. “We can then make a forecast and say to fishermen like Gary that there’s a heightened risk of HABs or bacterial species near to your farm. Then we can make a forecast based on the images, and what we know about how water moves in the area and how often we expect these events to occur,” she says.

Different ways to get the forecast bulletins out to fishermen and other stakeholders are currently in pilot format, but emails with images, text messages, maps on a website portal and a simple traffic light system are all under consideration.

Dr Jamie Shutler from the University of Exeter is leading the development of the short-term E. coli and biotoxin forecasts. “We should have a fully tested and evaluated approach by the end of the project. It won’t be ‘operational’ as this is a pilot project, but it’s the first step in that direction. We are continuing to develop our forecasts and we will know more at the end of the season.”

Mussel fisherman Gary Rawle is certainly keen on a forecast. “If I could get an early-warning system like a good ‘heads-up’, it would certainly be useful to me and my customers because we could manage harvesting operations differently and avoid product recalls.”

The ShellEye project is one of 21 research projects announced in 2015 (together utilising £5M support from BBSRC and NERC) to improve understanding of the factors affecting sustainable aquaculture, and help build a multidisciplinary community. Register to receive email updates: www.shelleye.org/contact

**IN NUMBERS**

- The entire UK aquaculture industry contributes £600M to the UK bioeconomy.
- Global shellfish consumption is increasing by around 5% per year.
- In 2014 the consumption of fish from aquaculture exceeded that from wild-caught fish for the first time.
- The share of aquaculture in total fishery production will grow from 44% on average in 2013–15 to surpass capture fisheries in 2021.
- There is evidence that Neanderthals cooked shellfish in Italy about 110,000 years ago.
- Mussels feed entirely on plankton by filtering more than 65 litres of water a day.
- Various projections to 2020 suggest that per capita consumption of fish and shellfish is expected to rise from the high of 20kg in 2014.
- In the UK the government forecasts a 33% increase in domestic shellfish production by 2020.
- Production of aquatic animals from aquaculture in 2014 amounted to 73.8M tonnes with an estimated first-sale value of US$160.2Bn.
The farms of the future

Researchers are taking multidisciplinary approaches to plan tomorrow’s food production.

What will the farms of the future look like? History tells us that the future will be like the past, but more so. The 19th and 20th centuries saw the introduction of mass mechanisation – the first tractors and the seed drill, with railroads leading the produce to hungry industrial towns. This trend has continued into the 21st century across the world, only now with greater automation.

“Agricultural robots will have a major impact on the way we produce food by making the whole process significantly more efficient,” says Professor Simon Blackmore from Harper Adams University, where he is also Director of the National Centre for Precision Farming. “These changes will be very disruptive both in terms of the way we farm now and how we support the farming process.”

Blackmore is using BBSRC funding for the multi-disciplinary AUTOPIC project, aimed at mechanising the harvesting of soft fruit using autonomous robotic vehicles. Other real-life rover vehicles under development include scout vehicles that can sow seeds, identify and kill weeds using lasers, and tell when the crop food is ready for harvesting. “The biggest game-changing technology is going to be the smart autonomous vehicles that can do what the farm manager wants, but also have enough smarts embedded within them to save energy in all its different forms,” says Blackmore.

These concept vehicles promise to take more than just the back-breaking labour out of agriculture, could vastly reduce the use of pesticides and other chemicals by only using them where needed, known as precision farming. It can save time and money and reduce negative environmental impacts of common inputs like fertiliser. “Intelligently targeted inputs are the biggest breakthrough,” says Blackmore.

If all this autonomy sounds unsettling, it’s worth bearing in mind that machines are already in use that can pick thousands of tomatoes per hour, one citrus fruit every 2-3 seconds, or prune 600 wine vines a day. But these are hardier fruit and veg – the real challenge is soft fruits that need a more tender touch.

Eyes in the sky

Automated precision farming techniques are being tested by autonomous flying drones like the octocopter being trialled at Rothamsted Research, an institute that receives funding from BBSRC. This demonstrator technology shows that it’s possible to measure plant growth and monitor crop stress, in reaction to water drought for example, autonomously from the air.

These unmanned aerial vehicles (UAVs) can carry multispectral cameras that see in UV, infrared as well as visible light. Under manual or GPS control, they can see, count and record aspects of plant growth that the human eye can’t see, and traverse more ground in a shorter space of time than a humble human.

Already, drones are being used to sow seeds, monitor crops and for general on-farm reconnaissance – spotting anything from a broken fence to a lost cow – but equipped with scanning lasers guiding micro spraying.
nozzles, it’s not out of the realm of science fiction to imagine drones spraying individual plants, or even individual leaves, to zap pest insects.

**Sensing, testing, measuring**

The farms of the future will make significant use of smart sensing devices. For instance, the SYield Biosensing Network project developed a prototype biosensor that could detect a certain fungal pathogen within four days of its arrival in a field of oilseed rape. Funded by BBSRC, Innovate UK and Syngenta, the system can see the ‘white mould’ *Sclerotinia sclerotiorum* that can also cause massive yield losses in fields of beans, potato, and soybean.

These advanced sensor systems are part of the emerging ‘e-Agri’ field. Dr Bruce Grieve, Director of e-Agri Sensors Centre at the University of Manchester, says this ‘Internet of Things (IoT)’ approach will offer farmers, food producers and consumers direct and meaningful data on their crops, livestock and produce that would previously only have been available via expensive and lengthy laboratory tests.

Like a fridge that can remind you to eat food before it goes off, on-farm sensors could communicate with autonomous vehicles, which in-turn talk to farmers about when to harvest, to suppliers when running low on consumables, or engineers when in need of repair.

“The real strength comes when all these new sensor systems, in people’s pockets, gardens and fields, all relay their information back to a central point,” says Grieve, whose work in this field is funded by the £70M Agri-Tech Catalyst fund set up by Innovate UK, DFID and BBSRC. He sees this new dynamic data amalgamated with traditional information such as weather forecasts and commodity prices to give real-time Google Maps-like images to help manage farms large and small, all around the world.

**There’s an app for that**

People will be able to access and provide all this information via their smartphones, and early farming-related apps are already on the market. Launched in 2013, the NERC-funded Cool Farm Tool gives farmers and food growers a simple but accurate way to estimate a farm’s greenhouse gas emissions. There’s also the aptly named Farm Crip App (formally the Farm Manure Management App). It can help farmers visually assess the nutritive and economic value of livestock manures by calculating available nitrogen, phosphate and potash values. Utilising funding from BBSRC, it won the Soil Association’s Innovation Award in 2014.

Apps are great at connecting people and businesses, and the farms of the future will increasingly take advantage of specific local biological and physical opportunities. Thanet Earth in Kent directs the waste heat and CO₂ produced by on-site electricity generation back into its glasshouses. The by-products of bioethanol production, in this case yeast protein concentrate (YPC), can be a cost-competitive alternative to soya-based protein and other feeds given to chickens bred for meat production. Vertical and underground farms are appearing next to industrial and commercial centres, from underground aquaponics to rooftop bee hives.

There are common global drivers of food production that will impact upon how the farms of the future will look. Technology, from robotics to remote sensing to cloud computing to draw all the data together, will play a crucial part in this and UK scientists funded by BBSRC are well positioned to deliver.

**Vertical** farms are already a reality and being integrated into building designs.
Modern food already looks very different from the wild varieties of crops first domesticated around 10,000 years ago. Given the pressures of population growth, climate change and extreme weather, as well as better knowledge of nutrition and how foods affect our gut bacteria, there’s no reason to suppose these incremental and mostly beneficial changes won’t continue well into the future. Watch a video for more at www.bbsrc.ac.uk/futurefood

FOOD SPECIAL

Six ways that research is changing the foods of the future

The ice cream that doesn’t melt (as much)

Remember crying over melted ice cream when you were young? Tomorrow’s children will have to cry about something else, because scientists have developed an ice cream from a naturally occurring protein that makes it more resistant to melting. The protein binds together the air, fat and water in ice cream, creating a super-smooth consistency.

Funded by BBSRC and EPSRC, researchers at the Universities of Edinburgh and Dundee developed a method of producing the protein – known as BslA – in friendly gut bacteria. This is a safe and well-established technique used to produce rennet for cheese and insulin for medical use.

“We have characterised how the protein works, and as a consequence identified its commercial potential, particularly in foodstuffs,” says Professor Cait MacPhee who led the research from the University of Edinburgh. “The challenge now is to scale up that production to industry levels.”

The research could also make future products with lower levels of saturated fat and fewer calories – news that should surely bring only tears of joy.

A super food that actually deserves the name

Many people are sceptical of the term ‘super foods’ and with good reason. But one product that has a better claim than most is Beneforté ‘super broccoli’. It’s 2-3 times higher in a natural compound called glucoraphanin, which could help to maintain cardiovascular health and reduce the risk of cancer.

“We are hoping to obtain an EFSA-endorsed health claim following completion of the human studies,” says Professor Richard Mithen from the Institute of Food Research. “We are hoping to confirm the reduction in LDL cholesterol that we have observed in two previous studies. We also have a trial in progress involving men who have prostate cancer.”

Mithen himself picked the wild varieties of broccoli that led to the enhanced product in Sicily. It took 27 years of conventional breeding and product development before first being sold in major UK supermarket Marks & Spencer.

And the higher levels of glucoraphanin are good for the broccoli too – it has natural properties that deter pests like slugs, snails, rabbits and mice from eating it.
**Scientists can now breed animals that don’t get infected by or pass on certain diseases, including ones that cause sickness and death in humans.**

Chickens are hugely popular meat, with upwards of 50Bn produced globally each year. But bird flu can cause pain and suffering to the birds, and millions have been culled (and wasted) by outbreaks in the last decade. Researchers at The Roslin Institute, which receives strategic funding from BBSRC, have genetically engineered chickens that, while they are not resistant to bird flu, can’t transmit the disease to other chickens, potentially halting epidemics.

Researchers at Roslin have also used new ‘genome editing’ techniques to delete just a few base pairs of DNA to make domestic pigs more like their wild warthog relatives and resistant to African swine fever virus.

**Carbohydrates have had a hard time of it recently. A diet too high in carbs has been associated with type 2 diabetes, and the nutritional content of carb-rich foods is under the spotlight. But bread and other foods made from cereals like wheat are staple meals for billions, and how most of us obtain enough calories to get through the day. So improving a cereal’s nutrient profile, say with iron, because iron deficiency is the most common nutritional disorder in the world, is clearly a worthwhile pursuit.**

Researchers at the John Innes Centre (JIC) are looking to create varieties of wheat biofortified with more iron. It’s a tough job, says Dr Janneke Balk at JIC, because the wheat genome has more DNA than a person.

“Colleagues who work with rice, mostly based in China and Japan, are well ahead of us with research on iron biofortification. This is because rice is easier to work with: it has a relatively small genome and diploid [one pair of chromosomes],” says Balk. “In contrast, wheat has a huge genome, only just sequenced, and is hexaploid [three pairs of chromosomes].”

She says that for rice, increases of about six-fold more iron have been achieved. “These are based on genetic modification (GM) strategies. Traditional breeding strategies can only increase iron levels to about three-fold.” For wheat, the natural variation in iron levels is very limited to start with, so there is much less scope for breeding strategies. However, Balk’s team are using a non-GM ‘induced mutant’ [by chemicals or radiation] strategy, which she says looks more promising to increase iron levels in the crop.

**Butter is again outselling margarine in the UK, but all that saturated fat certainly doesn’t help the waistline, particularly with the Brits dubbed the ‘fat man of Europe’.

If only there was a way to take a pill and make it all better, like in sci-fi films. Well, there is. Adding alginate, a dietary fibre extracted from brown seaweed, to food reduces by up to 80% the activity of an enzyme called pancreatic lipase that accounts for 80% of all fat digestion. And if you don’t digest the fat you can’t absorb it.

The BBSRC-funded research is led by Dr Matthew Wilcox at the Pearson lab at Newcastle University has shown that alginate can reduce the activity of pancreatic lipase by up to 80%.

“We have completed several pilot human trails, enough to secure interest from a large alginate manufacture keen to invest in further large-scale human trials,” says Wilcox, adding that larger human trials are needed to allow health claims regarding weight management.

Alginates are already used in ice creams and salad creams, so with safety all but assured products could be in shelves in a couple of years.

**Sensitivity to fat? Don’t absorb it!**

**Biofortification for the people**

**Sensitive to fat? Don’t absorb it!**

**Livestock that can’t catch a cold**

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The tomato (Solanum lycopersicum) is one of the most valuable fruit crops in the world with an annual global value in excess of $50Bn. They also play an important role in our diet, providing valuable vitamins, minerals and health-promoting phytochemicals. Plant breeders are working continuously to supply high yielding, better tasting, more nutritious and longer lasting tomato varieties, but some of the best tasting varieties soften rapidly and can have a short shelf life.

Research led by Professor Graham Seymour at The University of Nottingham has identified a gene that encodes an enzyme that plays a crucial role in controlling softening of the tomato fruit. The results could pave the way for new varieties of better tasting tomatoes with improved postharvest life through conventional plant breeding.

"A major scientific goal has been to identify genes that allow the targeted control of fruit softening without impacting other aspects of ripening," says Seymour. "Such work would permit excellent fruit flavour and colour development, combined with enhanced shelf life."

Sweet advance in fruit development
The question of how the tomato fruit disassembles its cell walls and softens during ripening has perplexed researchers for over two decades. This research has found the key to uncoupling softening from the other aspects of fruit quality, and the researchers have identified a gene that encodes a pectate lyase that normally degrades the pectin in the tomato cell walls during ripening.

If this gene is turned off, the fruit soften much more slowly, but still show normal changes in colour and the accumulation of taste compounds such as acids, sugars and aroma volatiles. "Natural variation exists in the levels of pectate lyase gene expression in wild relatives of cultivated tomato and these can be used for conventional breeding purposes," Seymour explains.

This latest discovery follows the sequencing of the tomato genome – research published in *Nature* in May 2012 and funded by BBSRC. Professor Seymour spearheaded the UK contribution to this international project with colleagues from Imperial College London and the James Hutton Institute.

The TomNet study was carried out by Seymour in collaboration with Professor Paul Fraser at Royal Holloway, University of London. The work also builds on BBSRC activities lead by Professor Fraser on advancing the tomato metabolome published in *Nature Scientific Reports*.

"The study shows how you can precisely alter fruit ripening properties without adverse effects on the chemical composition of the fruit," says Fraser. "In this way the consumer traits such as taste, colour, and nutritional quality are not adversely affected and in some cases enhanced."

The work was funded by BBSRC and Syngenta Seeds, a supplier of vegetable seeds to the global market.
Rice is a major crop, consumed by almost 50% of the world’s population, which has retained the ability to survive in changing environmental conditions. Together with partners at Nanjing Agricultural University, China, Dr Tony Miller and his team from the John Innes Centre have been working out how rice plants can maintain pH under these changing environments.

The nitrogen that all plants need to grow is typically available in the form of nitrate or ammonium ions in the soil, which are taken up by the plant roots. Rice thrives in flooded paddy fields – where the soggy, anaerobic conditions favour the availability of ammonium – as well as in much drier, drained soil, where increased oxygen means more nitrate is available.

For the plant, getting the right balance of nitrate and ammonium is very important: too much ammonium and plant cells become alkaline; too much nitrate and they become acidic. Either way, upsetting the pH balance means the plant’s enzymes do not work as well, affecting plant health and crop yield.

Switch on, switch off

Rice contains a gene called OsNRT2.3, which creates a protein involved in nitrate transport. This one gene makes two slightly different versions of the protein: OsNRT2.3a and OsNRT2.3b. Following tests to determine the role of both versions of the protein, Dr Miller’s team found that OsNRT2.3b is able to switch nitrate transport on or off, depending on the internal pH of the plant cell.

When this ‘b’ protein was overexpressed in rice plants they were better able to buffer themselves against pH changes in their environment. This enabled them to take up much more nitrogen, as well as more iron and phosphorus. These genetically modified rice plants gave a much higher yield of rice grain (up to 54% more yield), and their nitrogen use efficiency increased by up to 40%.

Nitrogen fertilizer is a major cost in growing many cereal crops and its overuse has a negative environmental impact. “These findings bring us a significant step closer to being able to produce more of the world’s food with a lower environmental impact,” says Miller.

This new technology has been patented by PBL, the John Innes Centre’s innovation management company, and has already been licensed to three different companies to develop new varieties of six different crop species.

This study was funded by BBSRC and grants from the Chinese Government.

Further reading
Overexpression of a pH-sensitive nitrate transporter in rice increases crop yields.
Proceedings of the National Academy of Sciences
DOI: 10.1073/pnas.1525184113

Next steps
• Investigate if other genetic switches can be found in other cereal crops in similar regions of the genome (synteny).

Contact
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How did you feel when you were offered the position as BBSRC Chief Executive?

When I joined BBSRC as Director of Science in 2012 I never imagined that one day I would become CE – so the first thing to say is this wasn’t anticipated! When I was offered the interim role BBSRC was facing considerable change and uncertainty [following the Nurse review] so I felt it was really important there was stability for the organisation. I felt that knowing BBSRC and RCUK staff as I do, having a research background and experience of interacting with our wide range of stakeholders meant I was in a good position to provide this stability.

What immediate ideas did you have about change at BBSRC?

I’m not a megalomaniac! So I didn’t have immediate changes in mind. I think it’s more about a different emphasis – valuing research that I would describe as frontier bioscience. For the last 4-5 years we’ve been quite focused on our strategic areas, like food security or healthy ageing, and consequently, I think some researchers think that’s all we’re interested in. I don’t want us to lose our connectivity with them. I’ve been there and I know what our grant applicants experience – and that brings a useful empathy.

What makes for successful bioscience in the UK?

Three elements: first, funding the best science wherever that might be found. I think that’s one of the things we do well. Second, training the next generation of researchers. They won’t all go on to be research leaders, but the students we support will go onto other careers that will draw on great training experiences. Third, we need to make sure that scientists and students have access to the best, cutting-edge equipment and the right facilities and infrastructure.

What about BBSRC’s future funding priorities: strategic funding vs Responsive Mode for example?

Our research advisory panel has considered this balance and currently around 55% of our funding supports research which is related to our strategic priorities. This felt about right to them and feels about right to me. If there was too much more of a shift towards funding research in strategic priority areas there would be a danger that we could lose out on some of the really transformational areas of frontier bioscience. BBSRC Council agreed in principle, and before the last spending review, to try and protect our responsive mode programmes.
and maintain a 20% or above success rate [as cited in RCUK Efficiency and Effectiveness of Peer Review as a lower threshold figure], so that’s reflected in BBSRC’s budget for the next two years.

**What makes for successful UK bioscience around the world?**

Science is an international endeavour, it doesn’t recognise borders and countries. There has been, and continues to be, encouragement for UK researchers to spend time working overseas to get experience and bring it back, such as BBSRC’s ITAS scheme. When I finished my PhD I spent six years in Canada working as a postdoc, so I got that vital and varied experience of working in North America. And you bring back a diversity of perspective, as well as networks of contacts that persist into the future. BBSRC supports many programmes with partner organisations in different countries, such as the Lead Agency agreement with the US National Science Foundation, and numerous programmes through the Newton Fund, which enable international collaboration.

**What about other areas where BBSRC is making progress, but there’s more do to?**

My predecessor, Professor Jackie Hunter, was a real champion for the women in science area and got equality and diversity high on the agenda in the Research Councils. Now there’s an RCUK action plan and a BBSRC action plan associated with it. We’re continuing to engage with our community on what we’re doing, and what we want to see, such as Athena Swan awards for our institutes.

But there’s a long way to go. In bioscience, 60-65% are women at undergraduate level, which drops to 30-35% for academic staff, then to around 17% at professorial level. This is a shocking statistic – it’s an awful lot of talent we’re not retaining in our research base. Some of the things we can do to get there include thinking about the language we use – not singling out and highlighting women heading into male-dominated areas.

Then there’s raising awareness, being a champion, and calling out bad behaviours. I fully support female researchers who call out bad behaviour, and I appreciate it’s not easy, especially when challenging an authority figure. And of course male researchers should call it out too.

**You have a passion for ‘frontier’ bioscience. What does it mean to you?**

“Frontier” bioscience is reaching for that “I never would have thought” feeling of excitement. The frontier is about push back the boundaries of knowledge in ways that you can’t imagine. It’s taking a fundamental biological question that hasn’t been solved and working creatively towards solutions.

**What game-changing technology or impacts might we see from frontier research in the next 20 years?**

Well, gene editing is already having major impacts and I think that will continue, using CRISPR and other systems in agriculture. We will also see transformation arising from interdisciplinary areas such as deep/machine learning, where we can generate knowledge from large data sets that we just couldn’t do before, millions of individuals compared to mere hundreds or thousands.

Then there are opportunities of connecting areas such as earth observation and agriculture. Satellite technology is starting to impact the way we manage our land and agricultural environments.

And personalised health: in 10 years will we all have our genomes and microbiomes sequenced? This could make a big difference not only for doctors prescribing medication tailored to the patient but also in opening up new opportunities to promote and maintain health.

**People say that the UK has brilliant scientists but lacks entrepreneurial zeal. Is this true or a cliché?**

I think it’s a bit of a cliché. A recent study showed we were #2 in the world for innovation. There are different metrics for this sort of thing, but we wouldn’t have got up there if we weren’t already really good.
However, and now more than ever, we want to make sure there’s inward investment to grow UK industries.

**Innovate UK will be joining the seven Research Councils in the new UK Research and Innovation (UKRI) body. What challenges lie ahead?**

The challenge ahead is to retain focus on our core business, which is supporting our research community, the best bioscience in the UK, and to continue to show leadership, while we go through a period of transition. But we need clarity on where the responsibilities are for the discipline-facing councils vs the overarching body.

**What opportunities does UKRI bring for Research Councils such as BBSRC?**

One thing I’m very much involved with is the new research and innovation grant funding service to replace our existing systems – which are creaking, to be fair. I look forward to a brave new world of an end-to-end digital service that is more intuitive and user friendly for researchers, our reviewers and ourselves that is harmonised across all Research Councils and Innovate UK – that we can use to make decisions.

**When did you first realise you wanted a career in science?**

I enjoyed the practical elements, the hands-on stuff. I remember in my ‘A’ level biology classes we had a vat full of large rodents, formalin-fixed, and I asked my biology teacher if there was a spare one I could take home! My mother banished me to the bottom of the garden, but having practised it really helped during my practical dissection exam.

**Do you have a direct message to send to the UK science community, including EU researchers based in Britain?**

It’s business as usual in the short term, and we welcome the Chancellor’s statement that UK scientists should continue to bid for competitive EU funds like H2020 while the UK remains a member of the EU, and that these funds will be guaranteed. But we understand researchers will have anxieties about Brexit.

The Research Councils can work with the UK Government to ensure that the key elements for world-class research in the UK are recognised in the EU negotiations. The government recognises that bioscience is one of the areas where we are truly world-leading, and we have to protect that.

**How do you manage your work-life balance?**

I have a 17-year-old daughter, and a 19-year old daughter, and a husband. My husband is a professional too, and my daughters are studying, so we accept that we’re all busy. But we try to eat together as much as possible – food is a great way to connect!

I like to get out on my bicycle as much as possible, and had a brilliant time this year watching a couple of days of the Tour de France with friends. It reminded me that we tackle the biggest journeys and challenges of our lives in stages – and inspired me to cycle up Mt Ventoux for the second time in a year!
Coming soon

October

6 October
UK Regenerative Medicine Platform invitation for ‘Challenge Ideas’
Application deadline: 6 October 2016, 4pm
www.bbsrc.ac.uk/ukrmp

11 October
Follow-on Funding call
Application deadline (Standard FOF and SuperFOF): 11 October 2016
www.bbsrc.ac.uk/followon

20 October
Primming Food Partnerships
Full proposals application deadline (invite only): 20 October 2016, 4pm
www.bbsrc.ac.uk/primingpartnerships

26 October
Agri-Tech Catalyst
Registration deadlines:
EoI stage (industrial research awards only): 26 October 2016, 12pm
Full stage (early and late stage awards only): 25 January 2017, 12pm
Application deadlines:
EoI stage (industrial research awards only): 2 November 2016, 12pm
Full stage (early and late stage awards only): 1 February 2017, 12pm
Full proposals application deadline (invite only): 5 July 2016, 1600 CET
www.bbsrc.ac.uk/agritechcatalyst

November

2 November
Bioinformatics and Biological Resources Fund
Full proposal application deadline: 2 November 2016, 4pm
www.bbsrc.ac.uk/bbr

3 November
GCRF: Networks in Vector Borne Disease Research
Expressions of interest application deadline: 3 November 2016, 4pm
www.bbsrc.ac.uk/gcrfvbd

9 November
Enterprise Fellowships
Application deadline: 9 November 2016, 4pm
www.bbsrc.ac.uk/enterprisefellowships

16 November
Ecology and Evolution of Infectious Diseases
Letter of Intent deadline: 14 October 2016
Full application deadline: 16 November 2016, 4pm
www.bbsrc.ac.uk/eeid

17 November
International partnering awards
Application deadline: 17 November 2016, 4pm
www.bbsrc.ac.uk/internationalworkshops

23 November
Tools and resources development fund: Bioimaging
Application deadline: 23 November 2016, 4pm
www.bbsrc.ac.uk/trdf