Microbiology Society response to BBSRC's Invitation to comment on strategy for UK biotechnology and biological sciences (October 2017)

The Microbiology Society responded in October 2017 to BBSRC's invitation to comment on a strategy for UK biotechnology and biological sciences.

The Society invited members of its Council, Policy Committee, Professional Development Committee and Divisions to comment on questions posed by BBSRC about the strategy paper.

The Society does not have a formal position on the strategy paper. Our response summarises personal views received by members with knowledge of UK research funding, which do not necessarily represent the formal views of the Society. Our response also highlights relevant issues raised through the Society's policy activities, which we hope will be useful to inform BBSRC's strategy development.

The Society would welcome the opportunity to engage further with BBSRC, on behalf of the microbiology community, as its strategy for UK biotechnology and biological sciences is further developed.

We note that comments provided by our members were also shared with the Royal Society of Biology, of which the Microbiology Society is a Member Organisation.

About the Microbiology Society

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

Our members have a unique depth and breadth of knowledge about the discipline. The Society's role is to help unlock and harness the potential of that knowledge.

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<u>Strong foundations - maintaining the health of the UK bioscience base:</u>

Q1 Are these the right foundations for UK bioscience? Are there other cross-cutting, underpinning capabilities that need to be developed and supported?

- A couple of members indicated that their overall thoughts about the paper were positive and that the three foundations are appropriate for the delivery of top quality bioscience.

People and talent:

Q2 How well will this approach meet the skills needs of the research base and wider economy in the coming years? Are there other considerations?

- Members highlighted that they were pleased to see technical specialists mentioned, and the need to address skills required for working in interdisciplinary teams.
- It was suggested BBSRC should also consider supporting scientists to be better aware of and able to engage with potential ethical and cultural issues which may arise from BBSRC-funded research.
- There are often barriers returning to bioscience after a career break, although returners present a source of experience and talent. BBSRC may wish to consider how it could support returners to bioscience at all career stages, such as retraining opportunities. The Microbiology Society has been involved in the Royal Society of Biology's Returners to Bioscience Group.
- In late 2016 the Microbiology Society held a series of Microbiome Research Stakeholder workshops as part of our Microbiome Policy Project. Skills needs and gaps identified included, for example, bioinformatics, microbiology, ecology and modelling, and importantly interdisciplinary training. The Society has also highlighted skills gaps and needs relating to antimicrobial resistance through workshops organised by the Learned Society Partnership on AMR in 2015. The Society, jointly with the Society for Applied Microbiology, also highlighted a range of microbiology vulnerable skills and capabilities in our response to the 2014 BBSRC and MRC consultation on vulnerable skills. Areas highlighted included: plant pathology; plant mycology; microbial physiology; industrial biotechnology and bioenergy; food microbiology; and bioinformatics.
- A member said that the holistic approach is a good one, but we need to be sensible about the development of opportunity. There is still too much emphasis on PhD students taking an academic career route, and possibly insufficient engagement with industry and policy makers in developing career paths in biosciences there. This will require engagement with professional organisations, such as the Bioindustries Association.
- A member highlighted that breadth of professional and transferable skills is important and should be a requirement of all BBSRC-funded staff positions on grants.
- A member suggested that CPD for experienced researchers to address new methods and problems in the BBSRC remit could be very helpful. As an example, Systems Biology was recognised as having very wide application across the biosciences, but outside the centres which BBSRC established, it was difficult for researchers to embrace the new methodology until they established an appropriate network. A similar pattern seems to have evolved with Synthetic Biology. Similarly, Microbiome Research Stakeholder Workshop participants also suggested that training opportunities for experienced researchers were important to help progress microbiome research.

Infrastructure:

Q3 What are the biggest gaps in UK infrastructure for bioscience research and innovation?

- Discussions at the Society's Microbiome Research Stakeholder Workshops highlighted that a key challenge is being able to analyse, update and archive genomic data. Participants highlighted that developing and supporting interoperability, open access, and long-term maintenance of databases was important, including supporting the research community to develop standards and best practice.
- The issue of technical specialists raised under "People and Talent" is also relevant to infrastructure. Technical specialists are needed to make the infrastructure work to address biological problems across a variety of fields. This should not simply be left to the research organisations who may have little long-term commitment if promise of longer-term funding is lacking.
- There are certain technical gaps and there always will be as new technologies emerge and funding is required to implement these. A member said that more collaborative engagement from infrastructure grant holders with the rest of the community is required. This should be an expectation on the infrastructure grant holders, not on the community. An example would be the Earlham Institute, where it is possible to have sequence analysis and bioinformatics done cheaper elsewhere if one does not require sophisticated analyses, but high-quality analysis requires the EI infrastructure.
- The BBSRC-sponsored institutes hold specific technical expertise. This is required to be maintained for as long as it is required by the UK biosciences community. There is a danger that these aspects of infrastructure might not be supported due to financial pressures on the institute.
    - An example highlighted to the Society is culture collections. There is a risk of diminishing biodiversity expertise in UK microbial culture collections resulting from a strategy focused on species of established biotechnological utility or biomedical importance (e.g. known pathogens). For example, loss of posts understood to be potentially at risk because of loss of BBSRC National Capability status by the National Collection of Yeast Cultures will lead to a restricted focus on brewing yeasts or pathogenic yeasts. Such species represent just a tiny fraction of overall yeast genome variation and trait diversity. Deceleration of new species descriptions and resultant paucity of evolutionary breadth in eukaryotic microbial reference genomes threatens to limit scientific progress over the coming years. In particular, the rapidly growing field of microbiomics is already plagued by false positives and false negatives due to limitations of the underpinning prokaryotic species genome databases. It would be wise to avoid exacerbating this situation by overlooking the crucial role of eukaryotic microbial taxonomy in understanding population structures within multispecies conglomerations of prokaryotic and eukaryotic microbes such as those found in the human microbiome.

Q4 How could the UK take a more strategic approach to the provision and use of infrastructures that are required for bioscience research and innovation?

- A member highlighted the infrastructure already available in the UK cohorts (e.g. UK Biobank, 100 000 Genomes Project, ALSPAC, Millennium cohort), and that BBSRC should consider how best to take further advantage of from a microbiological perspective, for example, in relation to microbiome research. Participants in our Microbiome Research Stakeholder Workshops also suggested that the oversight the Research Councils have of projects being funded could enable them to foster links between studies with a view of being able to pool samples and data to achieve larger sample sizes.

- In relation to questions 1-4, one member felt there is gap between the funding route for basic science and translational science, which can be an obstacle for taking forward ideas. It is relatively straight forward (if not easy) to find mechanisms to fund blue skies research and within these mechanisms there is increased emphasis to identify and protect intellectual property. However, once this has been done the routes to translational funding via RCUK seem less well resourced, fellowships in this area are much fewer and training to enable scientists to develop their entrepreneurial skills are limited. There are some schemes, but in their experience, it is much more difficult to move in this direction than continuing to drive a basic science programme. Therefore, they suggest more could be done to look at how to practically support scientists to achieve pathways to impact.

- One member highlighted a range of ways the UK could take a more strategic approach to provision and use of infrastructures:

    - Strategic development of future infrastructure should involve a foresight consultation among the bioscience community, including industry as well as researchers and funders, and should have an expectation of becoming self-sustaining or sun-setting, so the infrastructure does not become a continual drain on the science budget if not useful and relevant.

    - Infrastructure developments should have multiple owners. For example, they could be awarded to a consortium of universities as part of National Capability, and expected to be maintained as such. Equally they could be part of the National Capability supported by a relevant institute.

    - Some infrastructure could be transnational, in which case appropriate relationships need to be established to fund and maintain these. The Science and Technology Facilities Council has suitable models.

- Further to the previous comment on culture collections (Q4), another member highlighted that in the past, BBSRC was responsible for funding of several collections, directly and through its institutes. Loss of this support has led to fragmentation and lack of general, forward-looking strategy for maintenance and development of culture collections, even though many of the cultures were isolated through research funded by BBSRC. This trend will increase and the lack of centralised support for microbial culture collections is unique within Europe. The German culture collection, DSMZ, provides an excellent example of the benefits of central infrastructural, long-term support, linked to strategic research and utilising cutting-edge techniques. The issues arising from lack of centralised and co-ordinated strategic support within the UK are brought into focus by Brexit and a long-term strategy is required for culture

collection support. Recent reductions in support in the US for sequence databases raises issues that culture collections have faced over the last 1 – 2 decades and their continued support also requires strategic support.

Collaborations and partnerships:

Q5 How might opportunities for collaboration and partnership change in coming years, and how can UK bioscience make the most of these?

- A member suggested that BBSRC should consider how it can make the most of important international collaborations being initiated by the third sector (e.g. Wellcome Trust, Gates Foundation).
- Participants in our Microbiome Research Stakeholder workshops highlighted that the Research Councils can play an important role in supporting and fostering interdisciplinary collaboration and knowledge exchange. Examples of good practice highlighted by participants included the Cross Council Funding Initiative on AMR and BBSRC Networks in Industrial Biotechnology and Bioenergy.
- A further positive example highlighted by a member is BBSRC's major investment in microbiology through the UK Biofilms Programme, including the upcoming announcement of a new BBSRC and Innovate UK National Centre for Biofilms. The Centre will be a multi-site and interdisciplinary model, working to join up the community and provide new technologies at the interfaces, and so is a good opportunity/exemplar for collaboration and partnership across the UK. This example was also suggested to be relevant to Question 6: currently we do not have sufficient controls on complex microbial consortia/biofilms, but the field is now reaching maturity whereby disruptive technologies will be possible that are relevant to all three of the challenge areas of food security, industrial biotech and health.
- Members highlighted that BBSRC strategy will need to consider mechanisms to support international collaboration and partnerships within the biological sciences in the context of changes in the political position of the UK within the EU.
- A member suggested that at a national level, the UKRI should act as the conduit for promoting collaboration between the natural science disciplines, the social sciences and business and policy makers. BBSRC needs to influence UKRI to ensure that interdisciplinary work is emphasised, but not to the exclusion of single discipline work.

Pushing the frontiers of bioscience discovery:

Q6 What are likely to be the 'next generation' of breakthroughs that will revolutionise bioscience research, or open up new opportunities for innovation?

- Members highlighted that emerging areas are not readily predictable, which emphasises the importance of maintaining funding of curiosity-driven science as a route to generate new areas of research and innovation. New areas from the research community will likely also be

driven by ideas developed in partnerships between industrial and academic scientists supported by BBSRC programmes and networks (e.g. like BBSRC NIBBs).

- Members emphasised that multidisciplinary research (including collaborations between bioscientists, social scientists, economists and others) will also likely be important for driving new breakthroughs and emerging areas of research relevant to several areas of BBSRC's remit.
- The Society would welcome the opportunity to work with BBSRC further to consult the microbiology community to identify the potential 'next generation' of breakthroughs and opportunities for innovation.

Q7 How can the UK foster an environment in which creative, curiosity-driven research can thrive and advance the frontiers of bioscience knowledge?

- Microbiology Society members have emphasised the importance of maintaining funding levels for curiosity-driven research. One member said: "Creative curiosity-driven research can be facilitated by maintaining a good level of funding for basic science (which may ultimately feed innovation) and not over-emphasising the need for science to contribute to the economy at an early stage. For example, the Industrial Strategy, although worthy, is a political construct that is affecting the type of science that can be done. The National Productivity Investment Fund is providing Fellowships at very short notice for work aimed directly at the Challenge Areas of the Industrial Strategy. The Research Councils need to emphasise the requirement for basic science to provide long term innovation potential."
- As highlighted in the Microbiology Society's joint response with the Society for Applied Microbiology to the recent House of Commons Science and Technology Committee Genomics and Genome editing Inquiry, it is important to recognise that revolutionary discoveries such as CRISPR-Cas, which has applications in both research and innovation, came from fundamental research.

<u>Strategic challenges - building a more resilient, productive and secure future:</u>

Q8 Are these the right strategic challenges for UK bioscience to focus on? Are there others?

- A member responding to this question agreed these are areas for non-medical bioscience to focus on, and they will address many societal challenges, such as climate change and antimicrobial resistance.

Q9 What do you see as the greatest opportunities for UK bioscience research and innovation to effect a step change in how these challenges are addressed?

- The Society received no specific responses for this question, but would welcome the opportunity to work with BBSRC further to consult the microbiology community.

Other comments:

Q10 Is there anything else that BBSRC should consider in developing a strategy for UK biotechnology and biological sciences that is not covered in the previous sections, including, for example, any particular risks or threats you see for UK biotechnology and biological sciences over the coming years?

- A member emphasised that "undoubtedly the biggest risk to UK science is the loss of collaborative opportunities with the best scientists across Europe and replacing those with new mechanisms post-Brexit. This requires political intervention at the highest levels." Other Society members have also raised concern about impacts to bioscience from potential restrictions to mobility of skills and people, potential loss of access to funding and collaborative mechanisms from EU research programmes.

- Antimicrobial resistance is a major global challenge, which many members of the Society are working on. As the UK and other governments and international bodies have recognised, this requires an interdisciplinary One Health approach and BBSRC should continue to consider this given its remit.

- Pertinent to several of the questions posed, it was emphasised to us that BBSRC has been successful in its approach to funding industrial biotechnology and this should continue as part of strategy going forward.

  The Networks in Biotechnology and Bioengineering, set up by the BBSRC in 2014, have brought together large numbers of academic and industrial scientists from various disciplines and funded a diverse range of "proof of concept" projects, fostering general collaboration to an unprecedented degree.

  Microbiologists have further benefited from the IB Catalyst programme, which has been an important source of funding for translational research and a route for industry to de-risk the pursuit of more innovative concepts through co-funding. Bearing in mind that the impact of this type of research may take several years to be realised and true value ascertained, there is concern from members regarding the future structure and funding of the NIBBs and IB Catalyst, or their replacements. With the paucity of international funding in this area and increasingly cautious industrial investment, these BBSRC schemes are of major importance in maintaining this high-profile area of applied microbiology.