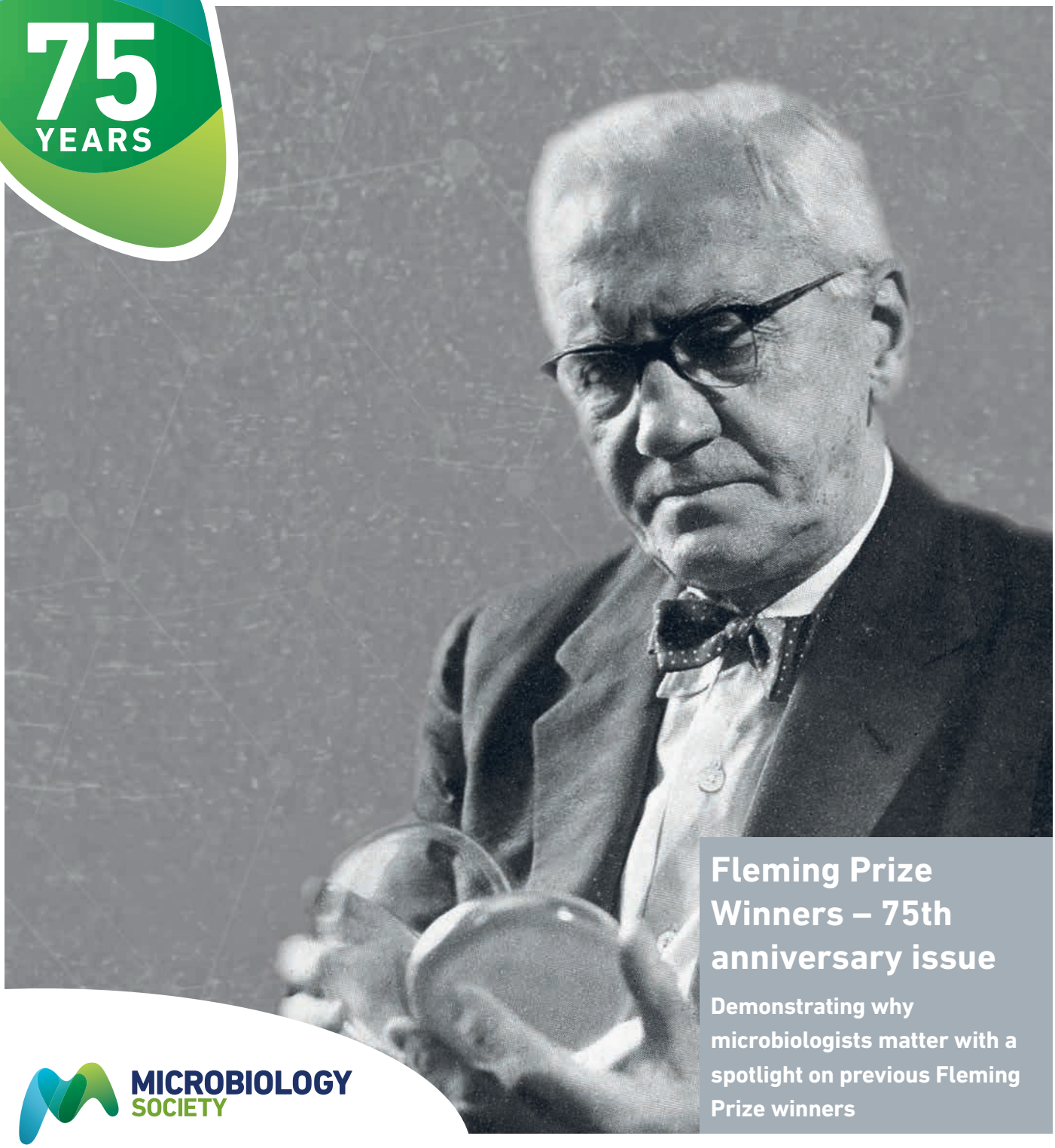
MICROBIOLOGY TODAY

47:2 October 2020

75 YEARS



Fleming Prize Winners – 75th anniversary issue

Demonstrating why microbiologists matter with a spotlight on previous Fleming Prize winners

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Editorial

Welcome to the last *Microbiology Today* of 2020. It would be an understatement to say that due to COVID-19 it has been an odd year! Personally, I'm very glad that I've been able to keep in touch with the microbiology community through email, phone, Zoom and Twitter, even if it's not quite the same as those face-to-face meetings we all value.

Whole Picture

So, with coronavirus as the backdrop to 2020, this edition of *Microbiology Today* focuses on the themes of this anniversary year, Why Microbiology Matters and Why Microbiologists Matter, with previous Fleming Prize Winners and their work the topic of this issue. It might seem obvious why microbiology and microbiologists matter to us all at the moment, but in this edition previous Fleming Prize winners have kindly given us personal insights into their career experiences and provided a broader perspective on the importance of microbiology. They address some of the challenges and changes that have occurred over the years, provide some tips for those hoping to advance in microbiology and communicate what it meant to them to be awarded the Fleming Prize.

First up, James Harris, Peter Wing and Alan Zhuang have interviewed Jane McKeating, the 1995 Prize winner, about her research into glycoprotein diversity in HIV, as well as her current work on oxygen sensing in hepatitis viruses. Madeline Mei interviews our 2010 Prize winner, Steve Diggle, who provides an insight into the importance of bacterial communication and explains how the research could impact life outside academia. Next Neil Gow, the 1993 Prize winner, speaks to Dhara Malavia about his early research into fungal morphogenesis and pathogenicity, and how he was originally inspired to focus on this area. Lynne Boddy, the Prize winner from 1991, discusses her pioneering work in the ecology of wood decay fungi with Sarah Christofides. Describing how the research has evolved, Lynne provides us with an appreciation of why fungal microbiology matters on a global scale. The 2020 Fleming Prize winner Edze Westra speaks to Rebecca Hall about molecular mechanisms and the evolutionary ecology of CRISPR-Cas systems. Outlining the development and possible future of this research, Edze also discusses the importance of mentors and what makes science fun. Last but not least, we have Alexander Finney interviewing Frank Sargent about his 2006 Fleming Prize research on bacterial Tat pathways, including current work in both anaerobic hydrogen metabolism and protein secretion pathways. All our Prize winners give us their perspectives on what they think the biggest challenges in microbiology are, now and in the future; the broader skills that could be useful for developing microbiologists; and their personal take on why microbiology matters.

As always, it has been a thoroughly enjoyable job working on this issue of *Microbiology Today*, and I'd like to thank all of the Prize winners and their interviewers for providing such interesting content. As this is my final Editorial for *Microbiology Today*, I'd also like to say a big thank you to everyone on the committee over the last four years who has made the role so fulfilling, with inspired ideas, friendly networks and good advice. I'd like to say a huge thank you to Ruth Paget (the Managing Editor) for keeping everything on track; it's been fantastic working with her over the last four years.

So that's it from me. I'm handing over to Chris Randall from the University of Leeds who is taking the reins as the new Editor for *Microbiology Today*. Good luck Chris – I am sure you'll enjoy working on *Microbiology Today* and I shall look forward to reading the 2021 editions.

Rowena Jenkins

Editor

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Alexander Fleming. Wellcome

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From the President

This is the second of two special anniversary issues of *Microbiology Today*, as 2020 marks 75 years since the founding of the Microbiology Society. A series of activities and projects have taken place this year to celebrate and highlight 'Why Microbiology Matters' (find out more on page 10). While the pandemic has forced some of these activities to change, it emphasises why microbiology matters to a wider audience and, just as importantly, why microbiologists matter.

We have individually faced a variety of challenges; be it time away from the lab, working in COVID-19 diagnostics or research, juggling caring responsibilities with work, teaching remotely, missing social interactions and many other changes to normal life. However, despite everything, the microbiology community is stronger, more active and more vibrant than I ever can remember it being. This fact (and the long days spent confined to the house) has led me to reflect on my life and my career, specifically on the challenges I've faced and how I've overcome them.

Growing up, I spent a lot of time on my grandparents' farm on the Pennines. Both of my parents came from generations of Pennine Hill farmers, but my father decided to give his children every educational opportunity possible, letting us choose our own futures. I attended grammar school and was one of the few students that went on to university, having been offered a place at University College London (UCL) to study Microbiology. There, in between discovering all the capital had to offer (and meeting my future husband, John), my fascination with microbiology – specifically bacterial behaviour – grew. I went on to study for a PhD, supervised by David G. Smith, researching surface dependent morphological changes in the bacterium *Proteus mirabili*s.

There were no female senior Principal Investigators (PIs) and only three female graduate students in our department, so continuing a career in academia wasn't an obvious option. However, Biochemist Patricia (Pat) Clarke, saw something in me and became a mentor. Pat encouraged me in an almost all-male environment and gave me some very insightful advice: don't follow fashion, as fashionable areas are already full of ambitious men and you won't compete; find something that fascinates you, make your own niche and stick to it. I had become fascinated by bacterial swimming behaviour, but, rather than use the model organism *E. coli*, I decided to investigate 'decision making' in the metabolically flexible *Rhodobacter sphaeroides*, which eventually led to setting up my own lab working on the new field of motility and chemotaxis.

After further encouragement from Pat, I was awarded a Lister Fellowship and three years later started a lectureship at the University of Oxford – something I never thought I would get when applying – where I continued my work on *R. sphaeroides* motile behaviour. I became a working mother of two at a time when there was no official maternity leave or nursery provision, but my children tell me they had a happy, stable (if rather odd) upbringing, and both are now scientists.

The above very briefly summarises the work of over 40 years, over 40 graduate students and over 40 postdocs! It may seem like it was plain sailing, but there were numerous rejected grants and papers along the way and a lot of sceptical and increasingly aggressive, personal reviews as I became more established and successful, which often led me to question whether I should be where I am. I now have enough self-confidence to believe comments such as "If you can become an FRS, anyone can" and "It is only because they have quotas for women" reflect on the writers and I do deserve what recognition I have, and I have contributed a tiny amount to our understanding of how bacteria function, but it took time and a supportive peer group to get here.

You can read more details about my career, the challenges I've faced along the way and what I've learnt over the years in two posts I wrote for the Society's blog (**microb.io/blog**), Microbe Post.

Judith Armitage
President

president@microbiologysociety.org

From the Chief Executive

This year has not gone according to plan. We set out to celebrate the 75th anniversary of the Microbiology Society with a series of unique activities that highlighted the contributions of microbiologists past, present and future. Then a brand new microbe came along and changed just about everything – we had to change our plans and celebrate the value of microbiology in different ways. One of the most difficult things to do differently has been the conferences and events programme, which by its very nature involves people coming together.

From the start, we were clear that we had to do our job on behalf of the members. We could not hold physical meetings and conferences, but that did not have to stop us from offering alternatives. Doing so has allowed us to trial some innovations and has led to some fascinating results.

When lockdown came in March, we embarked on a series of workshops for our *A Sustainable Future* project, demonstrating the value and raising the profile of microbiology in addressing global challenges, and focusing on how microbiology can help to achieve the United Nations Sustainable Development Goals. For each of our three themes – antimicrobial resistance, soil health and the circular economy, we had planned a workshop bringing people together from academia and industry, as well as those working in policy and funding bodies, to discuss the role microbiology has and what barriers needed to be overcome in order to have an even greater impact.

Lockdown meant these events were not possible. So instead we ran a series of week-long focus groups for each strand with eight to ten attendees meeting by Zoom for 90 minutes each day. Each session focused on a different topic (microbiology research, interdisciplinary collaboration, industry and social and political institutions) and attendees were surveyed in advance to focus the discussion. The last session each week saw the Chairs from the previous four days come together to feedback key findings and agree recommendations. It turned out to be a brilliant way of gathering views, consolidating findings and engaging the community.

Then, in July, the Early Career Microbiologists' (ECM) Forum hosted its first online event, using the Forum's LinkedIn group (**microb.io/ECMForumLinkedIn**). The talks were great, there was plenty of interaction, and there was one observation that was particularly interesting. Within minutes, people were tweeting about how many questions were being asked, and there was a strong sense that many of them were coming from members who might not normally ask questions at a physical event. The format widened the pool of attendees who felt comfortable getting engaged.

Later in the summer, we held a Zoom workshop for people who are studying the SARS-CoV-2 virus. It was a full day of short talks for people around the UK and Ireland who have switched their research to focus on the immediate need to understand more about the microbe that causes COVID-19. It was brilliant, and by the end of the day people were telling me of links and collaborations they were building, and about research challenges that were being solved through dialogue with other groups.

We learned a lot from these events, all of which had to be organised in their online form very quickly. There are obviously some ways in which digital conferences are simpler than in-person ones – we do not need a venue for example. But overall, organising digital events that are meaningful in terms of knowledge exchange and opening collaboration requires as much, if not more, planning than an in-person event. The communication has to be different, and planning digital outputs from events is time-consuming and complex.

As we look forward to more digital events in the future, this valuable learning means they are going from strength to strength.

Peter Cotgreave

Chief Executive

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News

Aziveet Halder

Why Microbiologists Matter

Why Microbiologists Matter: a digital celebration of the journeys of our members is a one-week digital event series designed to explore the impact of microbiologists' past, present and future that will be taking place on **Monday 23 to Thursday 26 November 2020**.

The week will include both the Fleming Prize Lecture 2020 and the Microbiology Society Outreach Prize Lecture as well as the Annual General Meeting. The events will span every career stage: from senior scientists to early career microbiologists and will host the final of the Sir Howard Dalton Young Microbiologist of the Year Competition.

You'll hear about quorum-sensing communication; palaeomicrobiology; orchestrating gene regulation; predatory *Bdellovibrio* sp. bacteria; the expanding virosphere and more. Content will range from viruses to bacteria to eukaryotes. The week also includes content from this year's Fleming Showcase, which was originally scheduled to take place at our Annual Conference in April, to celebrate the Society's 75th anniversary.

Registration is now open on our website (**microbiologysociety.org/WhyMicrobiologistsMatter**) and you can find out more on page 40.

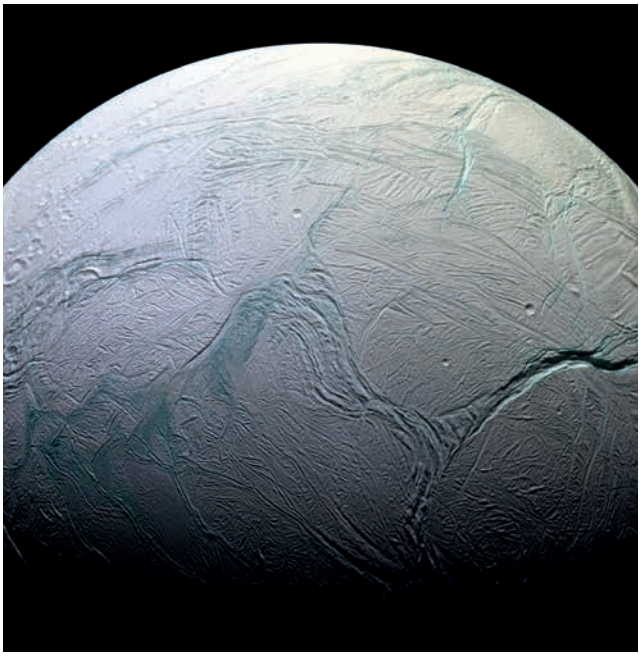
Introducing our new digital hub focusing on 'New Frontiers in Microbiology'

This year, to celebrate the Microbiology Society's 75th anniversary, we have launched a series of digital hubs that help showcase why microbiology matters, and are pleased to introduce the most recent of these hubs titled 'New Frontiers in Microbiology' (**https://microb.io/3jBwPB2**).

As we have progressed through the 21st century, we have expanded and developed our understanding of how microbes are related to and interact with each other. Microbiology research has been, and continues to be, central to meeting many of the current global aspirations and challenges, such as maintaining food, water and energy security for a healthy population on a habitable earth.

We focus on three key areas: 'The every-growing tree of life', 'Synthetic biology' and 'Life on other planets', each of which comprise of additional resources and further reading, as well as a compilation of Q&As which expand on the research of microbiologists working in these fields.

Read more about our 'Why Microbiology Matters' project in the previous issue of *Microbiology Today* (**microb.io/3cCX8nG**).



NASA JPL Space Science Institute

News

Microbiology Outreach Prize 2020 Winners

Sreyashi Basu

Sanjib Bhakta

Sreyashi Basu (University College London, UK) and **Sanjib Bhakta** (Birkbeck, University of London, UK) were awarded this year's Microbiology Outreach Prize for their outreach initiative, 'Joi Hok', which has helped to educate the public about tuberculosis (TB) and effectively control the disease burden within the wider community. Find out more on our website (**microb.io/3m2uoZK**).

Sir Howard Dalton Young Microbiologist of the Year 2020: competition finalists

The Microbiology Society is pleased to announce the finalists of the 2020 Sir Howard Dalton Young Microbiologist of the Year competition. All finalists will deliver a 15-minute presentation on their research during our one-week digital event series, *Why Microbiologists Matter*.

Ekaterina Buzun	Newcastle University, UK
Amy Jacobs	National Institute for Biological Standards and Control and Imperial College London, UK
Vanessa Las Heras	University College Cork, Ireland
Abraham Lee	The Roslin Institute, University of Edinburgh, UK
Thomas O'Brien	University of Cambridge, UK
Aisling Towell	Trinity College Dublin Ireland
Emily Warman	University of Birmingham, UK

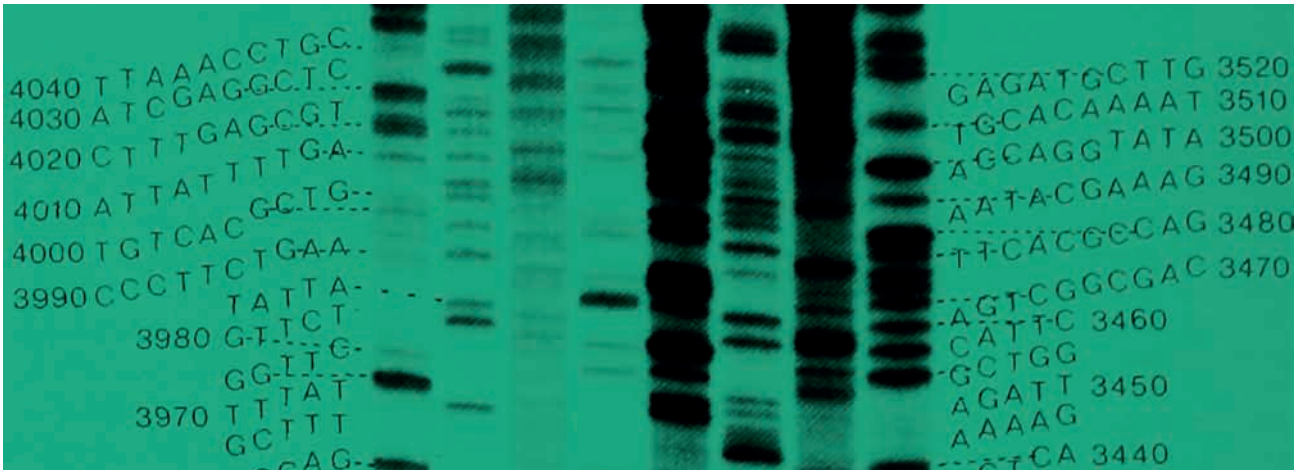
Teaching microbiology in higher education resources

We have launched a new area within Mi Society dedicated to supporting members involved in teaching microbiology in higher education.

The online hub includes *Teaching Microbiology in Higher Education Symposium* presentations, resources developed by members, other information of interest and details about upcoming Microbiology Educators' Network meetings. These Zoom meetings are monthly opportunities for members to share best practices in teaching.

All resources and information in the hub have been reviewed by our Teaching Working Group. Members are invited to share their teaching resources by contacting us at **profdev@microbiologysociety.org**.

News



Join *Microbial Genomics*' Early Career Microbiologists Board of Reviewers

'Early career scientists contribute an enormous amount to the culture and future directions of microbiology research but this is sometimes uncelebrated. We want to recognise the enthusiasm and scholarship of ECMs by providing both a platform for contributing ideas, and valuable experience of the editorial process.'
Sam Sheppard, Deputy Editor-in-Chief of Microbial Genomics

Last year *Access Microbiology* launched its Reviewer Mentee initiative and this year we are extending the scheme to *Microbial Genomics*, forming an Early Career Microbiologists (ECMs) Board of Reviewers. As part of the Board, ECMs will be acknowledged as part of the journal and, as with all Reviewers for the Society's journals, have the option to have their review activities deposited in their ORCiD records.

Please see the Society's News page (**microbiologysociety.org/news**) for more information on how to apply. Any applications should be received before the end of the month.

Grant deadlines

Date	Grant
1 December 2020	Travel Grants for members presenting at conferences or attending short training courses from 1 January 2021.
17 February 2021	Harry Smith Vacation Studentships to support undergraduate research projects during summer 2021.

For more information please visit the website (**microbiologysociety.org/grants**).

Connect with the Microbiology Society on social media:

@MicrobioSoc

Celebrating the Society's 75th anniversary

We would like to say a big thank you to all our members for making the Society what it is today: a vibrant and welcoming home for everyone, everywhere, who has an interest in microbiology. This year we are celebrating the 75th anniversary of our founding with activities dedicated to demonstrating the impact of microbiologists past, present and future – bringing together and empowering communities that are helping to shape the future of microbiology.

Why Microbiology Matters

Alongside our special anniversary issues of *Microbiology Today*, we are launching new collections of digital content to celebrate our 75th anniversary, under the heading 'Why Microbiology Matters'. From the submissions received from throughout the microbiology community, we have created a series of digital content hubs, each examining an important theme in detail, including testimony from our members and microbiologists working in each area to share a wealth of rich and interactive content. We will continue to add new content to the hubs as it becomes available; therefore, our list of resources will expand and be available beyond our anniversary year, as a lasting resource for the microbiology community.

Visit **microbiologysociety.org/WhyMicroMatters** to see the topics released to date and follow **#WhyMicroMatters** on Twitter.

Celebrating the impact of microbiologists past, present and future

We recently announced our digital event, 'Why Microbiologists Matter: a digital celebration of the journeys of our members' taking place Monday 23 to Thursday 26 November 2020.

This one-week online event series is designed to explore the impact of microbiologists' past, present and future. The week will include both the Fleming Prize Lecture 2020 and the Microbiology Society Outreach Prize Lecture as well as the Annual General Meeting. The events will span every career stage: from senior scientists to early career microbiologists and will host the final of the Sir Howard Dalton Young Microbiologist of the Year Competition.

The week also includes content from this year's Fleming Showcase, which was originally scheduled to take place at our Annual Conference in April, to celebrate the Society's 75th anniversary. Find out more on page 40.

Microbiology Images

You can still get involved in our Microbiology Images Project, which highlights how microbiology answers big questions by giving us knowledge of very small things. We welcome images of your science, of nature, of people, from the laboratory, places and events that will inspire, inform and demonstrate how the study of microbes helps us to understand our world and our place within it.

Visit **microbiologysociety.org/MicroImages** for details on how to submit images and follow **#MicroImages** on Twitter to see the submissions we have received so far.

A Sustainable Future

We continue to work on our policy project, A Sustainable Future, demonstrating the value and raising the profile of microbiology in addressing the world's biggest challenges.

Visit **microbiologysociety.org/SDGs** for more information about the project and follow **#MicroGlobalChallenges** on Twitter.

Microbiology Book Club

In March, to coincide with World Book Day 2020, we launched a new activity to celebrate microbiology in literature. This project is inspired by member Jo Verran, who runs the Bad Bugs Book Club.

Find out more about how you can be involved by visiting **microbiologysociety.org/BookClub** and follow **#MicrobioBookClub** on Twitter.

If you are interested in getting involved in any of the 75th anniversary activities, please email **getinvolved@microbiologysociety.org**.

Look out for further updates on our website, or via Twitter using the hashtag **#MicrobioSoc75th**

75 years on: a brief update on the history of the Microbiology Society: Part 2

In 1995, former President John Postgate wrote a history of the Society for General Microbiology entitled *50 Years On* which covered the founding of the Society and he described in some detail many of its activities.

As part of those celebrations, we asked former President Nigel Brown to dig into the archives, speak to long-standing colleagues and make new friends, as he uncovered the history of the Society over the last 25 years.

The previous article, published in the May issue, focused on the last 25 years of the Society's history and looked at the activities of the Society and the member benefits, and how these had evolved over time. In the second part of the history, we look at the changes in the Society's name and location and how its governance has changed over the last 25 years.

Nigel Brown

Honorary Member and President of the Microbiology Society 2012–2015

The Society's name and location

The Society was originally called the Society for General Microbiology when it developed from the Society of Agricultural Bacteriologists in 1945. There was reported to be a "lively discussion" about the title, and that eventually chosen was to indicate that the new Society would cover all aspects of microbiology, not just bacteriology. At its formation on 16 February 1945 it had 241 members. A month later, the remaining members of the Society of Agricultural Bacteriologists created the Society for Applied Bacteriology, which became the Society for Applied Microbiology in 1997.

The meaning of the word 'general' has evolved over time. In 1945 it was chosen as meaning 'all-embracing'. However, these days it tends to mean 'non-specific'. The appropriateness of the title was queried at Council meetings in 1998, 2003 and 2007. On these occasions it was agreed to maintain the title as it was a strong brand. However, disquiet about the title did not disappear and was occasionally mentioned by those external to the Society, with media and government personnel wondering about the significance of having 'general' in the title. In 2013, the Society's new logo was designed in such a way that any change of title could be accommodated. Council decided on a new title in March 2015. At the 2015 AGM, 89% of members present or voting by proxy agreed to change the title to the Microbiology Society.

The President contacted the Presidents of other microbiology societies about the change of name and one American microbiologist responded with "Typical British arrogance – doesn't mention which country it is!" but apologised when he realised the 'reply all' to his President's email had been copied to our President! He was challenged to think of a suitable short regional name covering the UK and Ireland. The fact that the Society's plans and documentation need to cover both the UK and Ireland is something that Council has had to be reminded about on several occasions – usually by our Irish Council members!

From 1992 to 2014, the Society was based at Marlborough House, Spencers Wood, near Reading. However, it was thought desirable to move to London to be more closely associated with other societies and closer to opinion formers. After some debate, Council agreed and in January 2014 the Society moved to Charles Darwin House (CDH) alongside the Biochemical Society, the Society of Biology, the Society for Experimental Biology, and the British Ecological Society. The vision was to create a biology hub to act as a focus for the various disciplines constituting biology. The sale of Marlborough House allowed

Top Society staff and Council pictured at the old offices at Harvest House in 1991.
Wellcome Collection, The Society for General Microbiology archives
Bottom Marlborough House, Spencers Wood, Reading.

the Society to purchase a significant share of CDH, and also to contribute to the purchase of a nearby building on Gray's Inn Road to lease for meetings and to tenants.

In 2016 The Society for Applied Microbiology also moved to CDH, shortly followed by the British Mycological Society. However, the co-ownership agreement for the buildings and their management proved difficult and, for this and other reasons, the majority of societies agreed to sell the buildings. The societies rented or purchased properties nearby in 2019, so they could continue to collaborate without the legal and other complexities of individual charities managing communal resources. The Society moved to its current headquarters at 14–16 Meredith Street, London, in September 2019.

Governance of the Society

The Society has always been led by a President who chairs a Council composed of Officers and Elected members. The President in 1995 was Tony Trinci, who had been disturbed to note that there was not a single woman on Council in 1993/1994, a fact subsequently remedied by the election of Pat Goodwin. A positive effort was made to nominate more women to Council, resulting in 20% female membership by the end of Trinci's term of office. In 2020, 40% of Council is female and it also includes the Chair of the Early Career Microbiologists' Forum. Of 29 Presidents in our 75 years, only three have been female: Marjory Stephenson (1947–1949), Hilary Lappin-Scott (2009–2012) and Judith Armitage (2019–2021).

Council

Council has changed markedly over the last 25 years. In 1995 there was a membership of 21, comprising nine Officers and 12 Elected Members, rising to 24 with 12 Officers in 2004. In addition to the President, General Secretary and Treasurer, the Officers included the Editors of the Society's journals, and Officers for International, Education, Professional Affairs, Publications, Meetings, and periodically a Treasurer-Elect. The Elected Members met separately before Council meetings in order to discuss the agenda items. By and large this worked well but could occasionally cause a major difference of opinion between the Officers and Elected Members. Meetings were crowded and held in a small meeting room at the Society's offices in Marlborough House. Fortunately, at least in this context, meetings rarely had full attendance, with 13 apologies noted on one occasion!

Council discussed a wide range of business, including internal and external matters. Council had been very concerned about government funding for universities and the lack of representation of microbiology in the 1996 Research Assessment Exercise. The Chief Executive expressed his concern that a charitable organisation should not be engaging in such semi-political activities. However, the focus of the Society on policy issues started in 2002 with the Microbiology Awareness Campaign, which gave rise to the Lobbying Working Party in 2010 and was formalised as the Policy Committee in 2011.

Over the last 25 years there have been four Chief Executives, Hilary Bowers retired in 1996 after 13 years' service, being replaced by Ron Fraser (1996–2011), Simon Festing (2011–2014) and Peter Cotgreave (2014–date). Each of these has been supported by an excellent staff.

In 2010 the effectiveness of Council was discussed, and it was reduced in size to 13 members, with six Officers and seven Elected Members. This was further modified in 2012 and now comprises three Executive members (President, General Secretary and Treasurer), six Chairs of Committees, and six Elected Members. Much of the routine business of Council is devolved to the Committees, with Council taking appropriate oversight as Trustee-Directors. A very competent staff is responsible for the complex day-to-day organisation of the Society's affairs.

A shadowing scheme was introduced in 2018 so that an interested individual could experience Council's work. This was successful in encouraging nominations and has been extended to all committees.

The Committees of Council

In 1995, Council was served by the Treasurer's, Publications, Meetings and Professional Affairs Committees. Currently there are Committees for Finance and Operations, Professional Development, Policy, Scientific Conferences, Communications, and Publishing, with each of the Chairs being members of Council, as is the Chair of the Early Career Microbiologists' Forum. The Finance and Operations Committee is chaired by the Treasurer. In the early days the process of election of Officers and Committee Chairs was sometimes unclear, even to the person elected! From 2019 all such positions are nominated by the full membership, then shortlisted and elected by Council to ensure balance of representation and diversity. Members of the ECM Forum elect their Chair. Council initiated a review of its Committees in 2019 with a new structure from 2021 linked to the Society's strategic objectives: Building Communities, Impact and Influence, and Sustainability. These are alongside the Early Career Microbiologists Forum, the Audit, Risk and Evaluation Committee and the Finance Committee.

As a membership organisation, the Society addresses the interests of early-career and mid-career members, in particular, through the Professional Development Committee. Although there is a membership subscription, the majority of our income comes from our journals, which are overseen by the Publishing Committee. In addition, our Policy Committee is responsible for supplying information directly to opinion formers, or in conjunction with sister societies, such as the Royal Society of Biology and the Society for Applied Microbiology.

In the 1990s, separate groups bid for and developed group symposia at the meetings. In 1995 there were 10 groups, namely: Cells and Cell Surfaces; Clinical Virology; Education; Environmental Microbiology; Fermentation and Bioprocessing; Microbial Infection; Physiology, Biochemistry and Molecular Genetics; Systematic and Evolution; Virus; and the Irish Branch. In 1999 there was a discussion of having a "Young Microbiologists'" group, but it was 16 years before the (more correctly phrased) Early Career Microbiologists' Forum came into existence. In 1999 two new groups were formed: Clinical Microbiology, and Food and Beverages. In 2007 there was a review of meetings and the group structure. The outcome was that in 2008 the 12 extant groups were reorganised into four Divisions (Virology, Prokaryotic, Eukaryotic, and Education and Training) originally with a matrix of cross-cutting themes: Microbial Diversity and Evolution, Fundamental Microbiology, Translational and Applied Microbiology, and Infectious Disease. The Irish Branch remained unchanged. The Education and Training Division has been replaced by the Professional Development Committee's input to meetings.

In 2016 the Early Career Microbiologists' Forum was established, and an ECM member now sits on every committee. Equality, diversity and inclusion (EDI) is an important part of the Society's operation. Every Committee now has an EDI Ambassador, and these meet annually to ensure the Society is addressing EDI issues in all its activities. A member of each Committee takes responsibility for ensuring that international aspects of the Committee's work are also taken into consideration.

Membership

Membership categories were reviewed in 1999, 2001, 2007, 2013 and 2017. The School and Corporate membership categories, introduced in 2001, were abolished in 2013 and separate categories of international membership were removed in 2017. There are now five current categories without geographic limit: Full Membership, Full Concessionary Membership (currently for those on incomes less than £35,000 a year, or equivalent), Postgraduate Student Membership, Undergraduate Student Membership, and Affiliate Membership for anyone from a low income country or just interested in microbiology and wanting to stay in touch. In addition, Council has elected a number of distinguished microbiologists as Honorary Members.

Honorary Members

Whereas originally the number of Honorary Members was limited to 20, this limit was lifted in 2007. The criteria have been regularly reviewed. In 1995, scientific excellence was the main criterion for election, but in 1998 service to the Society

Members pictured at Annual Conference 2019.

was also considered to be an important criterion (reverting to the original criteria for honorary membership). Twenty-four members have been elected as Honorary Members since 1995.

Presidents

From 1995 to 2020 there have been nine Presidents of the Society, six bacteriologists, two mycologists and a virologist. Two of the three women who have been Presidents of the Society since its formation (Marjory Stephenson, 1947–1948; Hilary Lappin Scott, 2009–2012; and Judith Armitage, 2019–present) served during this time. A similar tale can be told of mycologists (Percy Brian, 1965–1967; Tony Trinci, 1994–1997; and Neil Gow, 2016–2018).

The 'running order' of Presidents since 1995 is: Tony Trinci (1994–1997); Howard Dalton (1997–2000); David Hopwood (2000–2003); Hugh Pennington (2003–2006); Robin Weiss (2006–2009); Hilary Lappin-Scott (2009–2012); Nigel Brown (2012–2015); Neil Gow (2016–2018); and Judith Armitage (2019– present). Brief biographies and photographs are available on the Society's website.

All Presidents are formally elected at the AGM, which used to be held during the Autumn meeting of the Society, and the new President took up post with immediate effect, officiating at the rest of the AGM and the meeting. This caused considerable confusion about who was responsible for different activities during the Autumn meeting, depending on the timing of the AGM. In 2014 the AGM became a separate event, independent of meetings, and in 2015 the decision was taken that the President and all Council and Committee members would serve an extra three months, from the September AGM to the end of the year, so that all new positions now start on 1 January following the AGM.

Conclusion

I have focused on only some of the many changes that there have been, and in terms of a history it is undoubtedly superficial and incomplete. The Society's documents were lodged with the Wellcome Trust in 2015, but are not yet catalogued, and, even if I were capable, it is not yet possible to undertake a scholarly analysis of the recorded history. That may be a job for the Centenary! I am immensely grateful to current and former members of staff and current and former members of Council who have helped search for and supply information.

I also noted that the Society is primarily a membership organisation. Some of the influence that the Society has had on individuals are given in this issue and on the website. From my being a student member in 1974 through to today, it has been a signal honour for me to be a member of the Society and our community. I look forward to the Society's future development.

50 Years On by John Postgate can be found on the Society website: **microbiologysociety.org/50-years-on**.

Member stories

The Microbiology Society does not operate in isolation and is overseen by and is for our members. In this section, we look at some of its members and what the Society has meant to them.

Evelyn Doyle (joined 1984) was Chair of the Irish Division (2006–2009), Scientific Meetings Officer (2011–2012) and General Secretary (2013–2016). She considers that being on Council taught her a lot about governance and project management when moving the Society to London. It allowed her to experience a management role before considering a senior role in her home institution. Chairing Scientific Conferences Committee was excellent experience in getting differing viewpoints to common agreement – a vital skill in her new role as Head of School. She proposes to take a new approach to developing her School's Strategic Plan based on the 'strip-back' approach taken by the Society in 2012. Evelyn found the Society to be excellent for networking with a wide range of microbiologists within and outside Ireland. She has particularly enjoyed her involvement with the Irish Division, which provides a platform for microbiologists on both parts of the island to get together.

Beatrix Fahnert (joined 2003) was a postdoctoral researcher when she joined the Society to be part of the community and

access the resources available. She particularly remembers receiving the membership directory which included the names of the microbiologists who had influenced her early and subsequent work. Having a particular passion for education, she uses the Society's materials for teaching and outreach, points students and staff to the Society for career development support, and served on the Education Division and its successor, the Professional Development Committee, organising a number of conferences and giving several talks. This experience led to her being recruited as the Section Editor for Professional Development in FEMS *Microbiology Letters*.

Lorena Fernández-Martínez (joined 2002) was a second-year undergraduate geneticist at Swansea when she saw an advert for the SGM vacation studentships on a staff member's door. She got the studentship with a year's membership of the Society and has been a member ever since. That studentship started her down the track of working on actinomycetes, which she has continued, first as a PhD student in Swansea, next in industry, then as a postdoc at the John Innes Centre, and now as a Reader at Edge Hill University. She says that the vacation studentship started her down her career route, and that attending Society meetings annually has helped her build and maintain a group of friends and colleagues in her research area. She encourages her undergraduate and postgraduate students to join the Society. She served on the Communications Committee 2013–2019.

Pat Goodwin (joined 1979). As a new lecturer and Principal Investigator, the Society was a useful platform to discuss education issues and for her and her students to present their work. As Scientific Meetings Officer (1995–2000) she was exposed to a broad area of science and it expanded her professional network, which was very useful in her role at the Wellcome Trust. Following her retirement from Wellcome, she was again elected to Council and was chair of the Policy Committee (2013–2018) and helped drive forward key policy projects to help advocate for microbiology.

Dave Kelly (joined 1980). As a PhD student in the 1980s Dave's supervisor (Crawford Dow) was Meetings Secretary of the Society and introduced him to several eminent international microbiologists, who gave inspirational talks at the Society's conferences and which strongly influenced his later career. Dave's first papers were published in the *Journal of General Microbiology* (now *Microbiology*) and he has since served two stints as Associate and Senior Editor for the journal. He is currently Reviews Editor for *Microbiology*. On Council (1999–2002) he was able to observe how Howard Dalton and John Beringer worked in committee. He was also involved in developing the Society's strategy under Howard Dalton. Dave has been very grateful to the Society over the years for supporting several vacation studentships in his laboratory as well as numerous travel grants.

Kim Hardie (joined 1988) states that the Society was incredibly helpful in her personal and professional career development. It provided a strong network of friends and mentors/role models who helped her become more professionally ambitious. Through her work with the Society as an Editor, a committee and Council member, and a Committee Chair, she developed her skills, which was recognised by promotion in her home department. Work with the Society also led to senior roles in the Royal Society of Biology (RSB), as an RSB Council member, the Chair of the annual Higher Education Teacher of the Year competition and delivering the 2019 RSB Charter Lecture. At a personal level, she says that the Society helped rebuild confidence and contacts following maternity leave, that it gave her broader horizons. It provided introductions to public engagement and policy work and taught her a lot of communication skills.

Paul Hoskisson (joined 1997) worked in industry for a short time before his PhD. Working on antibiotic production, there were useful Society meetings that introduced him to the wider area, including meeting the important figures in the field. He considers the Society to be like a big family, comprising both members and staff, and it has been very supportive of him, his students and postdocs, including research visits and meetings grants. His chairing committees, editing *Microbiology Today* and serving on Council have been very helpful in his day-to-day job as an academic.

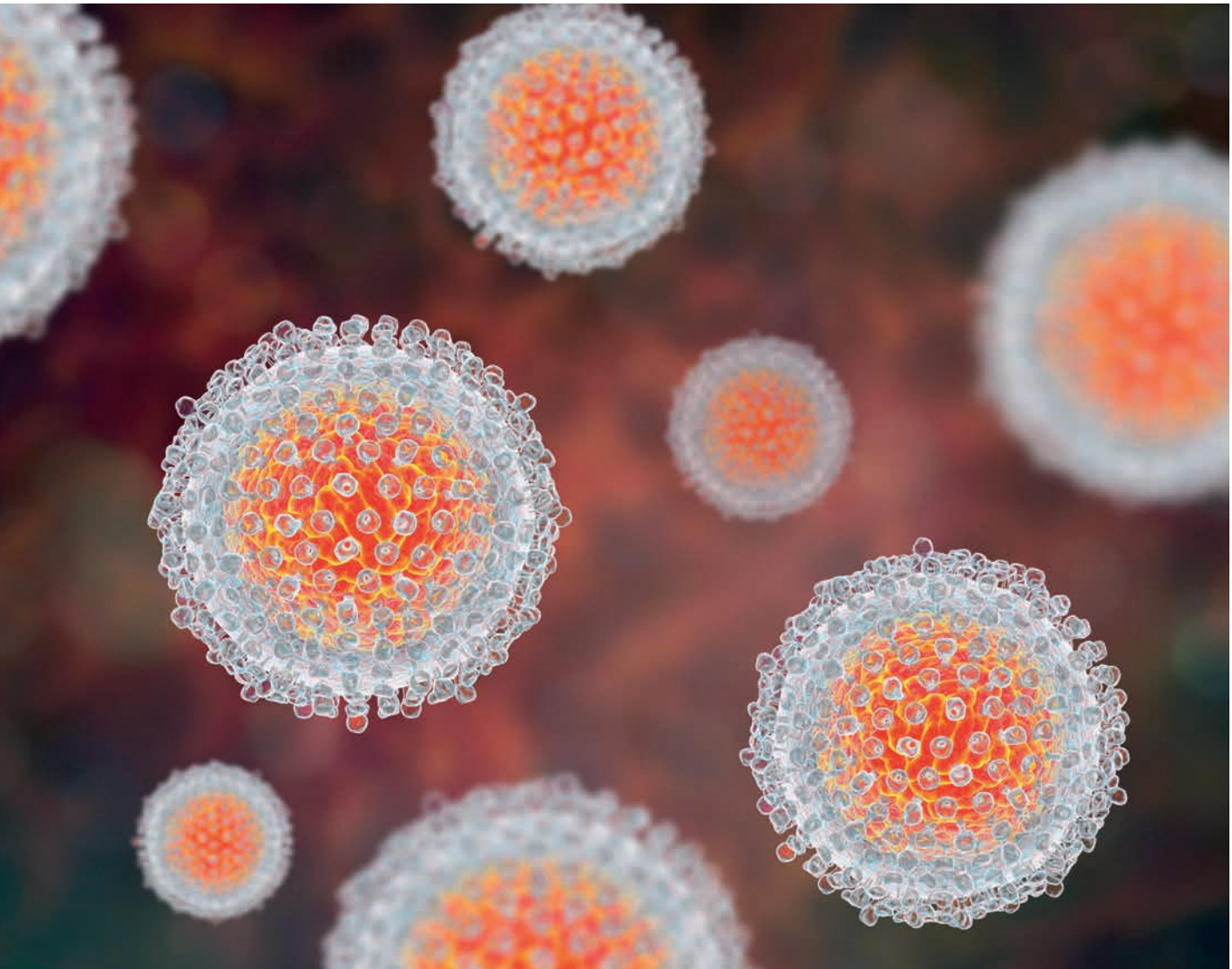
Arindam Mitra (joined 2016) is a Society Champion working on bacterial biofilms at Adamas University in India. As a Champion, the Society provides a platform for him to reach out to students and the public on relevant and timely microbiological topics and network. He reviews books and grants for the Society, as well as reviewing papers for the journals.

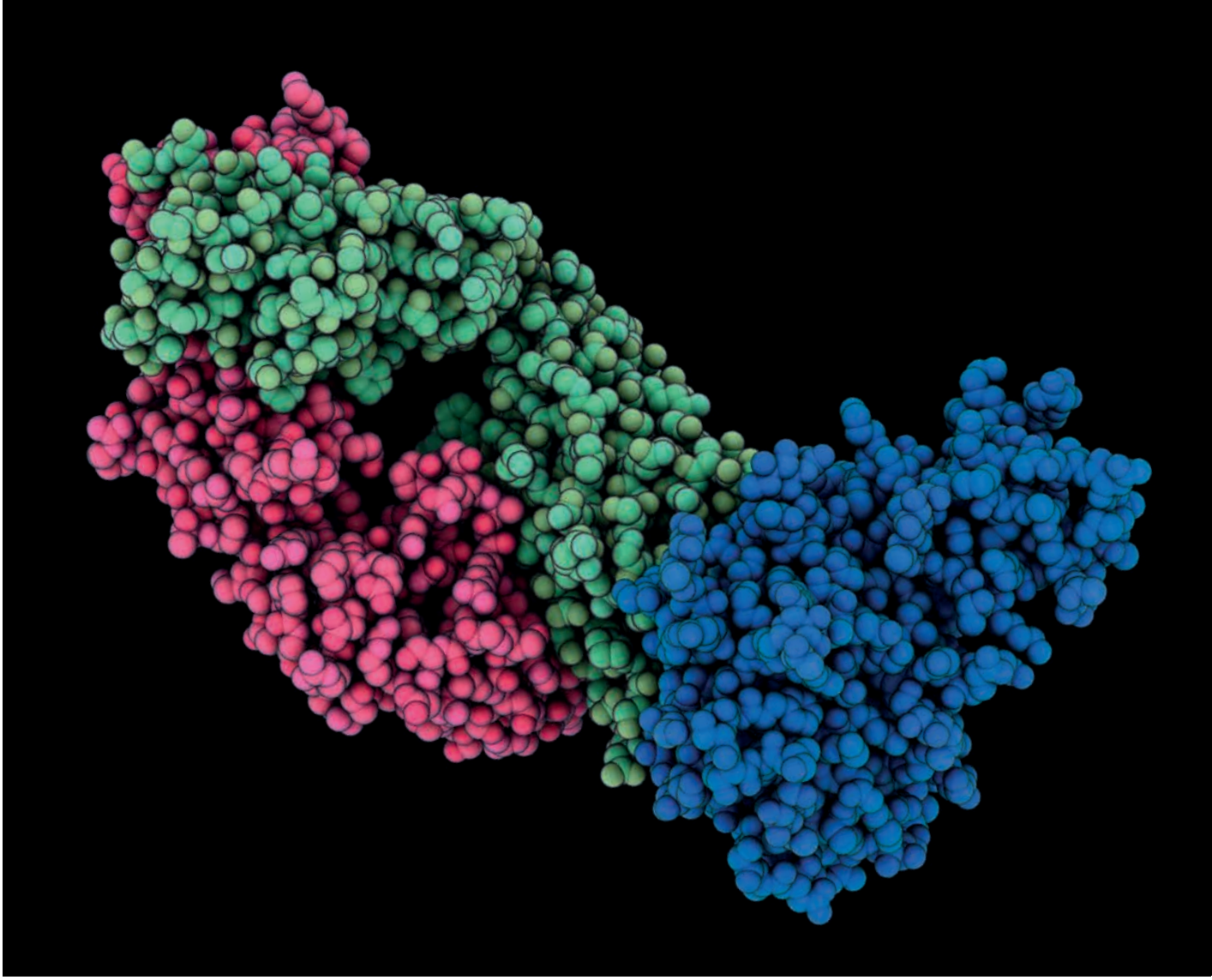
An interview with Fleming Prize winner Professor Jane McKeating

Jane McKeating is Professor of Molecular Virology at the University of Oxford and won the Fleming Prize in 1995. Jane previously worked at the University of Birmingham, the Institute of Cancer Research and Lister Institute of Preventative Medicine. She has also worked in industry, as a Section Head of Anti-Virals at Pfizer Central Research, UK. Jane's lab currently focuses on research into how specific host factors define infection with hepatitis B (HBV) and hepatitis C (HCV) viruses. Three members of the McKeating research group, Peter Wing, James Harris and Xiaodong Zhuang interviewed Jane about her career.

Colin Howard

Hepatitis C virus models. iStock/ Dr_Microbe





HIV-1 glycoprotein GP120 complexed with antibody b12. Laguna Design/Science Photo Library

What did you win the Fleming Prize for and what is your current research?

My Fleming Prize was awarded for my work on human immunodeficiency virus (HIV) glycoprotein diversity and its impact on virus entry and sensitivity to neutralising antibodies. I've always been interested in understanding how the apparent chaos of viral RNA genomes can affect viral persistence and pathology, and whether viral sequences can inform us about viral pathogenesis and lead to new therapies. This question is so timely as we are now living through the COVID-19 pandemic and everyone is suddenly interested in RNA viruses!

Viral replication is defined by the cellular microenvironment, and oxygen sensing and circadian pathways are key players in regulating the cell. My lab currently works on hepatitis B and C viruses and how hypoxia-inducible factors and circadian components impact virus replication and sensitivity to anti-viral intervention. Developing model systems that better reflect *in vivo* physiology provides novel insights into the complex interplay between virus and host that can inform new therapeutic approaches.

What do you think is the most important skill you need to develop to become a successful scientist?

Peter Wing, Postdoctoral Fellow

Firstly, I think you need to ask 'big picture' questions and always be driven by biology and not technology. Make sure you have the expertise and tools available to effectively answer your questions and be prepared to reformulate your questions to exploit your strengths. Secondly, science is a team sport and building good relationships with colleagues is really important. Thirdly, clear communication and generosity in sharing ideas

> Make sure you have the expertise and tools available to effectively answer your questions and be prepared to reformulate your questions to exploit your strengths.

helps engage new colleagues, and I believe it is key to a successful career in academia or the industrial sector.

Is HBV the most difficult virus when it comes to achieving a functional cure?
James Harris, third year PhD student

Probably not; that 'honour' probably goes to HIV. Like HIV, HBV can integrate into the host genome. However, HBV integrants are generally defective and don't produce infectious virus. The unintegrated HBV epigenome is the source of new virus particles and many labs are actively pursuing ways to destroy or to inactivate this small circular DNA molecule. As our understanding of the HBV life cycle improves, it is likely that we will develop therapeutic approaches that eliminate or silence this key replication intermediate. This would constitute a functional cure.

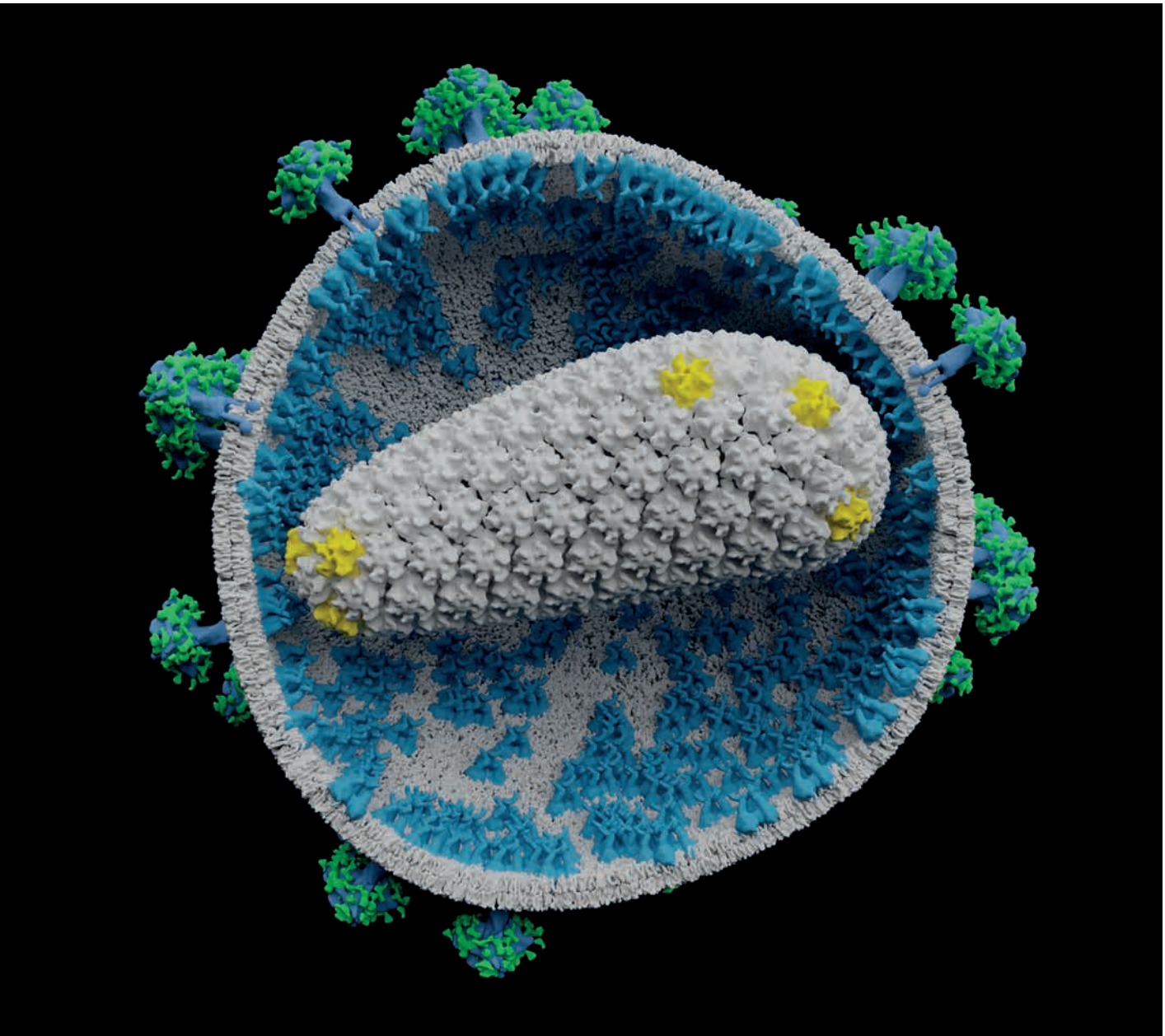
How applicable is the physiological oxygen model to other human pathogens; is it only relevant to viruses? James Harris, third year PhD student

Totally applicable to all microbial life – just consider how we classify bacteria as aerobic or anaerobic.

How important is it to focus your research early in your career? Is it ever too late to give something new a try? James Harris, third year PhD student

I would say it's never too late and I'm still learning new things all the time; this is what makes research so addictive.

Computer illustration of a HIV (human immunodeficiency virus) particle. Research Visualized/Science Photo Library



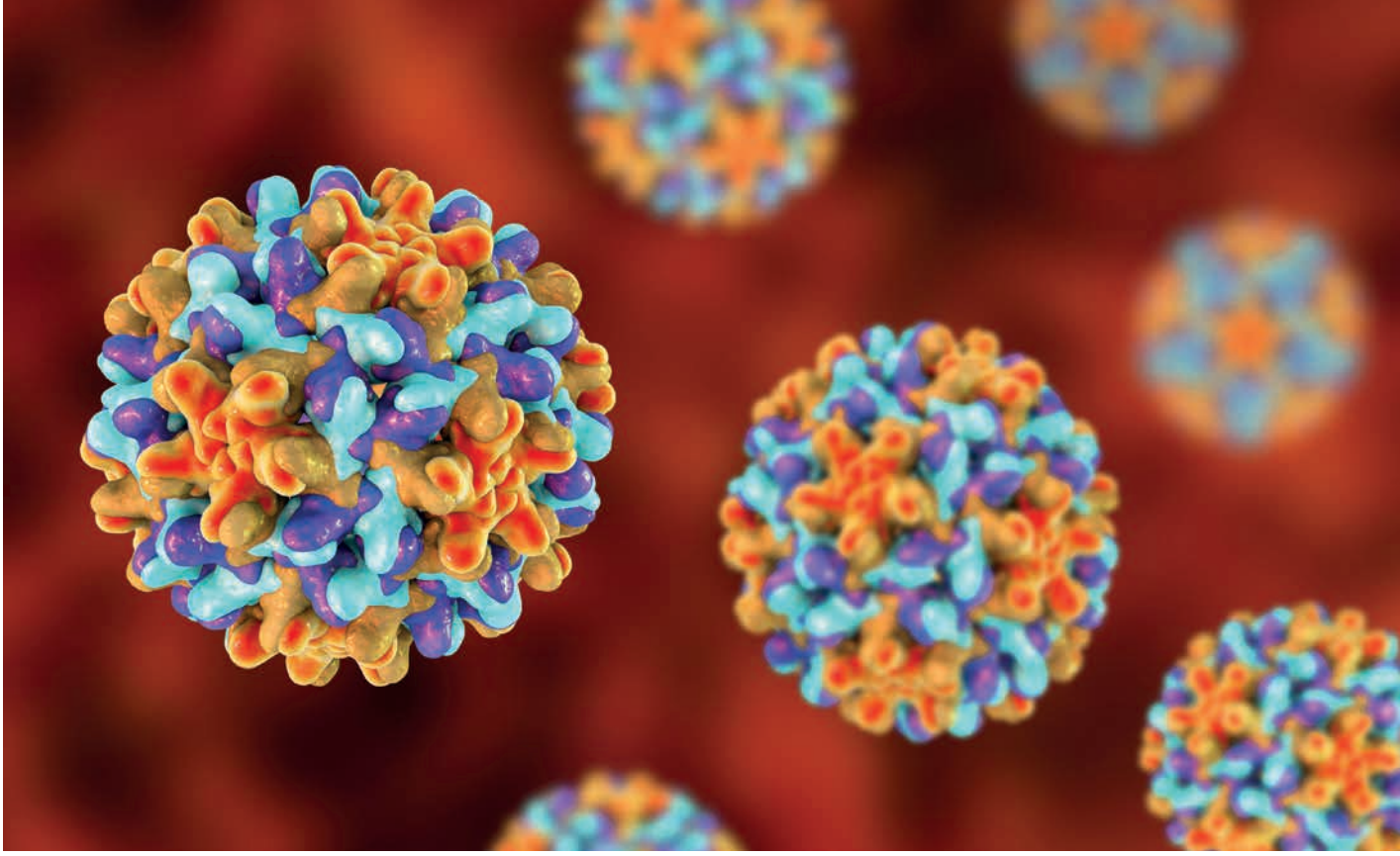


Illustration of heptitis B viruses. iStock/ Dr_Microbe

However, I would always advise finding mentors and collaborators with expertise who can guide you to prevent 'reinventing the wheel'.

What is the biggest change in science you have seen over your career? James Harris, third year PhD student

One very obvious change is the sheer quantity of publications and ever-increasing number of journals, making it a continuous challenge to keep on top of the literature. The electronic landscape of publishing now provides instant access to most journals – I can't remember when I last visited a library. If I think back to how I designed experiments as a PhD student to how we work now – conceptually the thought processes underpinning 'discovery science' have not changed, but the technical approaches now available provide data faster and at a greater resolution.

What was the biggest challenge when you first became a Principal Investigator (PI)? Xiaodong Zhuang, Senior Postdoctoral Fellow

As a newly appointed lecturer, I was shown my lab and office and left to get on with it. Setting up a new laboratory, managing grant finances, coordinating multiple research projects and learning how to teach – quite a challenge with lots of mistakes made *en route*. Perhaps the biggest single challenge was managing my time to cover the many aspects of a PI's role. Having a partner who understands and supports you in this exciting enterprise is essential.

What is the biggest challenge for a postdoc to become a PI and the best advice you can give? Xiaodong Zhuang, Senior Postdoctoral Fellow

To maintain your confidence and self-belief in the merits of your research plans and to be open-minded when the data disagrees with you. Very few postdocs obtain a fellowship on their first attempt, so perseverance is essential. In terms of advice, find a mentor (or even better two) whose opinion and guidance you trust even when it may seem negative at the time.

What did it mean to you to be awarded the Fleming Prize?

Confidence and affirmation that my research was valuable to the wider community.

Why does microbiology matter?

In the current climate I feel I don't need to answer this question. We clearly need to understand all aspects of microbiology and pathogen–host interactions in order to be better prepared for the next pandemic.

Interviewers: Peter Wing

Postdoctoral Fellow, University of Oxford, UK

James Harris

Third year PhD student, University of Oxford, UK

Xiaodong Zhuang

Senior Postdoctoral Fellow, University of Oxford, UK

An interview with Fleming Prize Winner Professor Stephen Diggle

Professor Stephen (Steve) Diggle graduated in Biological Sciences (BSc, University of Salford, 1997, 1st Class) prior to undertaking a PhD in molecular microbiology studying quorum sensing in *Pseudomonas aeruginosa* (University of Nottingham, 2001). He worked as a Postdoctoral Fellow at Nottingham, on both EU and BBSRC funded grants, before obtaining a Royal Society University Fellowship (2006–2014). He was promoted to Associate Professor in 2013, and in April 2017, he moved to the School of Biological Sciences at Georgia Institute of Technology (Georgia Tech) in the US. He currently serves on the Editorial Board of *Microbiology*, and has previously served on the Editorial Boards of *FEMS Microbiology Letters*, *BMC Microbiology*, *MicrobiologyOpen* and *Royal Society Open Science*. Steve was an Elected Member of the Microbiology Society Council (2012–2016) and has also served on the Scientific Conferences and Policy Committees.

Steve Diggle

His research is primarily focused on cooperation and communication in microbes and how these are related to virulence, biofilms and antimicrobial resistance. He has had a long-standing interest in understanding how the opportunistic pathogen *Pseudomonas aeruginosa* causes disease and is especially interested in how this organism evolves during chronic infections – such as those found in cystic fibrosis lungs and chronic wounds.

In his spare time, he plays bass guitar, has played in a number of covers bands and recorded some original music in a band called Meaner. For this interview, Steve spoke to Madeline Mei, a PhD student from his research group, about winning the Fleming Prize in 2010 and his research career.

Could you provide a brief description of your research and the research you were awarded the Fleming Prize for?

I received the Fleming Prize because, in collaboration with evolutionary biologists, we were one of the first groups to look at quorum sensing from an evolutionary perspective; not just focusing on how it functions at a molecular level, but asking about the fitness benefits it provides in environments. I became interested in explaining how quorum sensing is maintained in natural populations, given that we showed it is exploitable by anti-social cheats. Our group therefore made connections between mechanism and evolutionary ecology, and we had great multi-disciplinary collaborations.

What did it mean to you to be awarded the Fleming Prize?

It was a real honour for me personally, and it feels great to be recognised by the Society and your peers for doing novel and interesting work.

Why does microbiology matter?

Microbes are crucial within every ecosystem and they influence many aspects of our daily lives. Notably, microbes remain a major infection problem and play significant

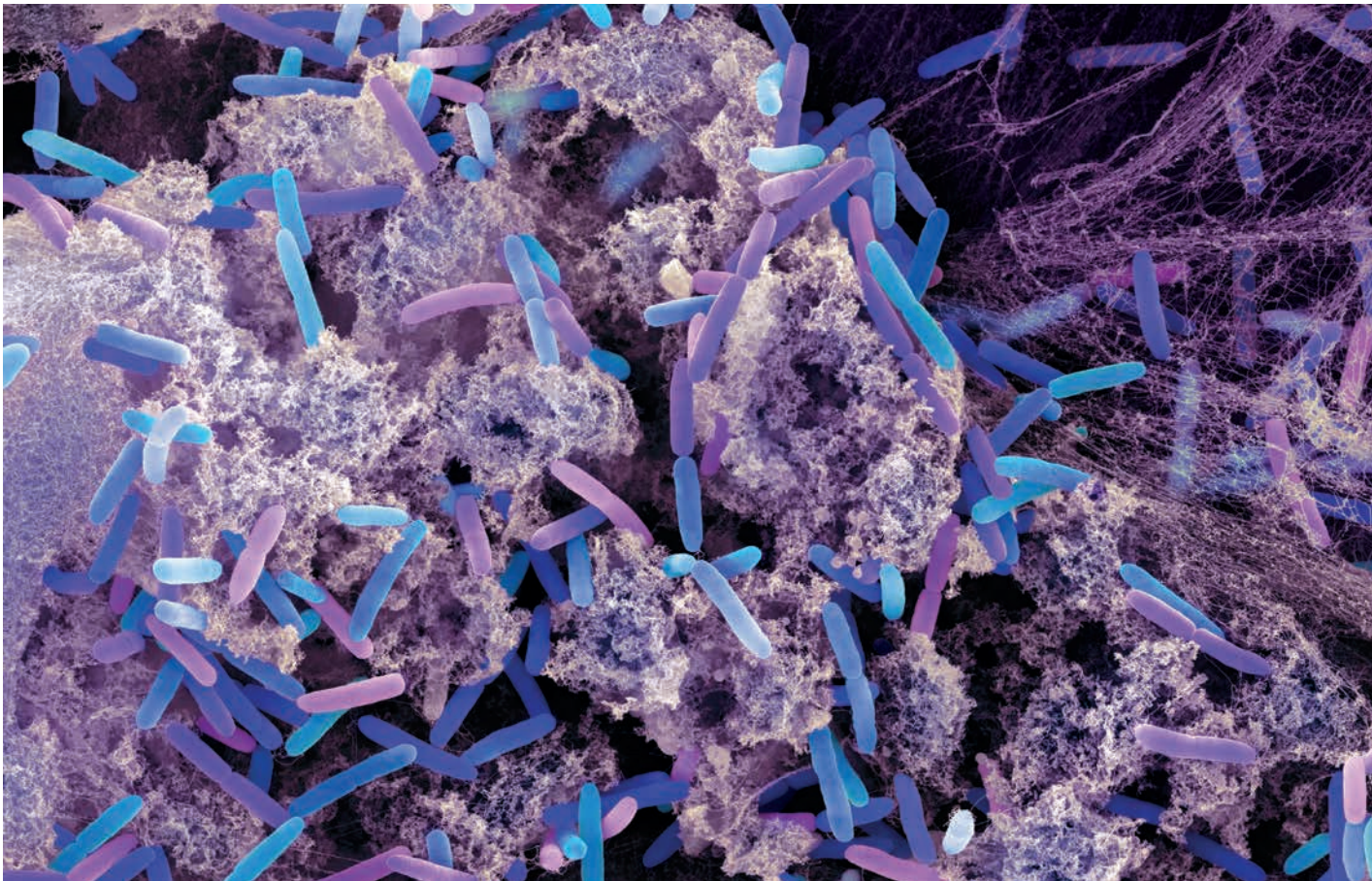
roles in influencing disease outcomes. Antimicrobial resistance is one of the most significant global problems that we face today. Microbiome research is changing the way that we think about certain diseases and human behaviours. CRISPR-Cas, discovered by microbiology researchers, has the potential to change the world. Who knows what new discoveries and technologies will come from microbiological studies in the future? It remains an incredibly exciting field to be involved in and it continues to attract world-leading researchers.

What do you feel is important for early career researchers to consider?

Finding your niche in academia. There are a number of challenges; how do we carve out a career in academia? How do we find our niche? A huge hurdle to getting a Principal Investigator (PI) position is developing an idea that is your

Microbiome research is changing the way that we think about certain diseases and human behaviours. CRISPR-Cas, discovered by microbiology researchers, has the potential to change the world. Who knows what new discoveries and technologies will come from microbiological studies in the future?

Coloured SEM of *Pseudomonas aeruginosa* bacteria. Science Photo Library



Pseudomonas aeruginosa colonies sourced from a cystic fibrosis sputum sample. Dr Sheyda Azimi

own, distinct enough from your previous PI's research, and competitive enough to get funding. You should be open to 'thinking outside the box' and consider collaborating with researchers from other disciplines because they contribute new ways of thinking about microbes.

Publishing papers. Publishing your work is very important for furthering your career. There still appears to be an obsession in publishing in high impact journals (which has been termed 'impactitis'), but it is important that this does not become the main driving force, because this can significantly delay publishing your findings. It may benefit your PI, but it may not always benefit you. There is a balance to be struck here and, ideally, you should be able to discuss this with your PI to allow you to publish findings in a timely manner.

Address diversity and inclusion. I would encourage young researchers to become involved in promoting minority and under-represented groups in science. The UK has taken a lead in this respect with the Athena Swan Program, which recognises good practices in higher education and research institutions towards the advancement of gender equality. Becoming involved in programmes like this promotes diversity in our field, which greatly benefits us all.

Socialise with others in your field. Make sure you attend conferences. Present your work, communicate with your peers and PIs, and take advantage of all the networking opportunities available. Most importantly, be enthusiastic about your work.

Read, read, read! Stay on top of the literature in your field. This can be hard, as the amount of papers published can be overwhelming. Reading the work of others really is one of the most important things you can do in science and it leads to new ideas. A good grasp of the literature also maximises your chances of publishing papers that are conceptually and experimentally novel, because you are less likely to be working on a project that is 'reinventing the wheel'.

Plan for papers. Think ahead about ideas to work on for a paper. It keeps you focused, organised and on task, so that you are able to conduct relevant experiments and publish papers more efficiently.

What is the potential impact of your research in five years?

Our lab is interested in bacterial interactions and how ecology and evolution shape behaviours and influence

infections in ways that we do not yet understand. Determining why bacteria have these behaviours and how they contribute to infection will hopefully lead to the development of novel treatments and improve the outcome for patients.

What have been some challenges in your career and how did you approach them?

The biggest challenge for me was the transition from postdoc to PI. Developing a unique research niche and selling this (and yourself) to employers or fellowship funders is challenging. For me, I overcame this a bit by chance. I attended a talk by an evolutionary biologist who worked on ants. He discussed cooperative behaviours and how we should not assume that bacteria cooperate by quorum sensing for the benefit of the population. It made me realise that few people had delved into evaluating microbial behaviours from an evolutionary perspective. This allowed me to work with evolutionary biologists to develop my own ideas that were distinct from the work I performed as a postdoc.

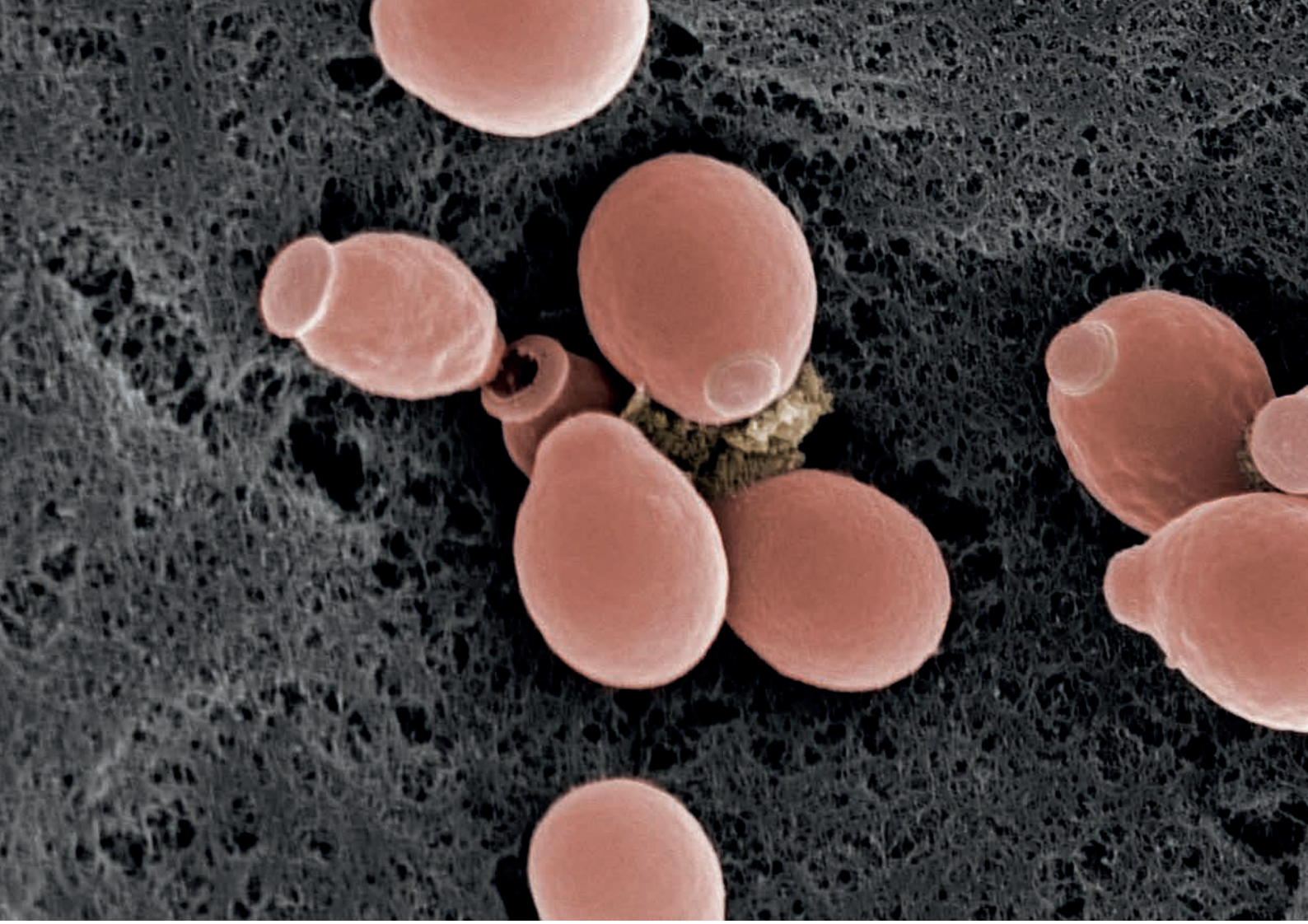
I also feel that it is difficult to get funding for multidisciplinary work. Funding bodies often state they want to see multidisciplinary projects, but they can be hard for reviewers to assess because they are often specialised in one discipline. It is easy to 'fall between the cracks' because you are doing something different. Don't give up!

Moving to another country is not easy. The funding systems, teaching methods and the environment are all very different. There may also be family issues when moving abroad. I moved to the USA in 2017. It has been challenging, but also exciting and I enjoy it. With hindsight, I probably would have greatly benefitted from moving earlier in my career. I recommend a spell in a different country if you get the opportunity to do it.

Interviewer: Madeline Mei

PhD Student, Georgia Institute of Technology, USA

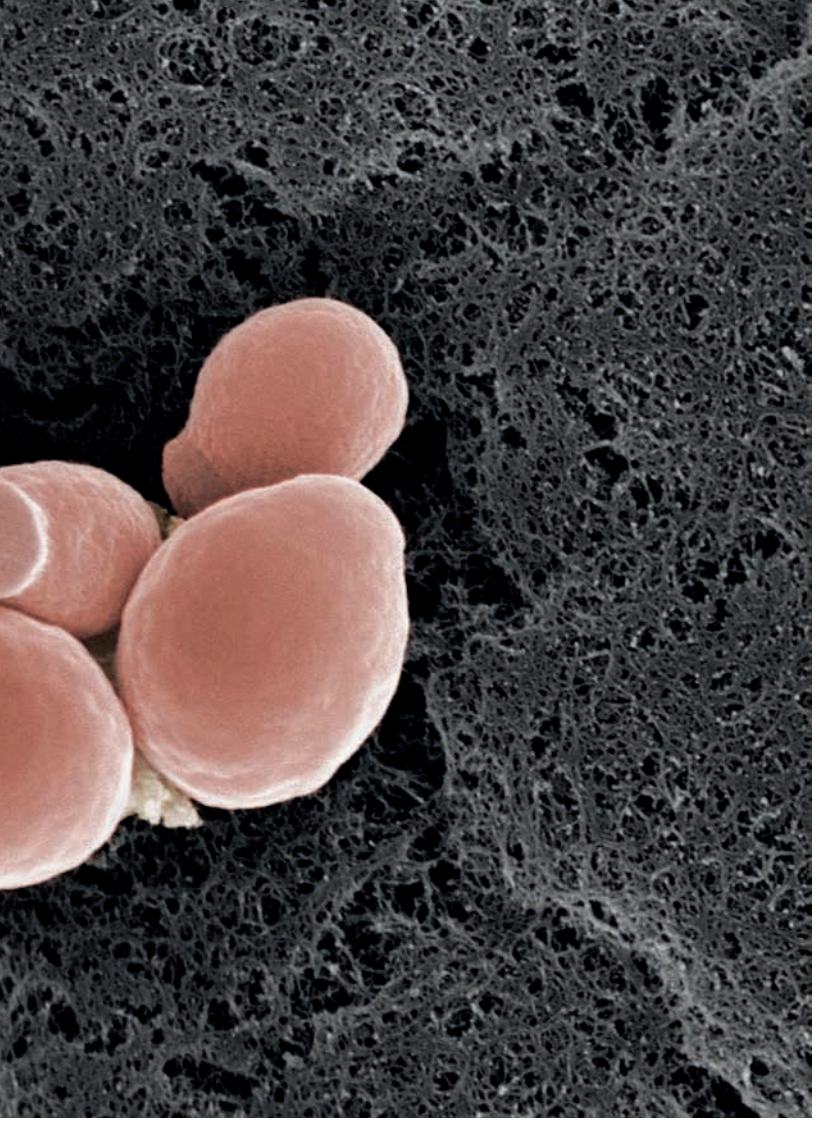
Steve Diggle receiving his Fleming Prize Lecture certificate from President Hilary Lappin-Scott at the Edinburgh International Conference Centre in 2010.



***Candida* fungi.** iStock/Dr_Microbe

An interview with Fleming Prize winner Professor Neil Gow

Professor Neil Gow is the Deputy Vice-Chancellor (Research and Impact) and a Co-Director of the Medical Research Council (MRC) Centre for Medical Mycology at the University of Exeter, UK. He was awarded the Society's 1993 Fleming Prize for his outstanding work in fungal biology. Neil is an expert in the field of medical mycology and his work is focused on understanding how the fungal cell wall is synthesised and how it is recognised by immune cells in order to determine ways to kill pathogenic fungi by blocking cell wall assembly.



Could you provide a brief description of your research and the research you were awarded the Fleming Prize for?

I was reading my published Fleming Prize Lecture for this interview – and it is a good record of where I was in 1993. I was studying a number of different fungi using a wide range of different methodologies including microscopy, biochemistry, molecular biology and electrophysiology. My primary interest and work to that time was focused on fungal growth and morphogenesis and its relationship with pathogenicity. At that time, the application of molecular genetics was just beginning to impact the field of medical mycology and I was one of the first to create a gene-knockout mutant in *Candida* (I say 'I' because this was an experiment I actually did myself – happy days). I mentioned in my Fleming Prize Lecture that studying *Candida albicans* mutants in glycosylation would enable new ways to study how the fungus interacts with host cell surfaces – and this has turned out to be the main focus of the work we currently do in my lab.

What first attracted you to this field of research?

I was originally going to be a marine biologist. I've always been attracted to the mystery of what lies beneath the surface. I look at the surface of the ocean and wonder what is swimming underneath, or a loch and wonder where the biggest trout is. To me, microbiology and marine biology satisfy this curiosity in a similar way. Microscopic creatures can't be seen because they fall beneath the resolution of the eye – but there are amazing things in that invisible world. As an undergraduate student at Edinburgh, I had a close relationship with mycologist Jim Deacon. He first inspired me to think about fungi. Then I went on to do my PhD, focusing on *Candida albicans* and cell walls, with Graham Gooday, who became a mentor and friend. My postdoctoral supervisor Franklin Harold was also an inspirational thinker who liked to challenge dogma and made you defend your ideas and hypotheses very carefully.

Could you tell us about any discoveries you've made in fungal research that continues to excite you?

I find it very easy to get excited about the discovery process – turning the pages of the unread book of life is a romantic and fascinating activity. When I gave the Fleming Prize Lecture, my group were also working on how the swimming zoospores of oomycete plant pathogens locate roots by sensing the electrical fields that plants generate as a consequence of the segregation of ion transport processes. Plant roots can act as anodes or cathodes, whilst zoospores are drawn to the different poles. I was delighted to be contacted just a few weeks ago by a PhD student who is taking this work up again. The first figure of my Fleming Prize Lecture also reminds me of the discoveries my group have had by looking carefully in the microscope at living cells. My second publication (published in the *Journal of General Microbiology*, now *Microbiology*) described how vacuoles are distributed in *Candida* hyphae and how this affects how they grow. Many years later, one of my postdocs generated a series of mutants that had altered patterns of vacuole biogenesis and used this to show how vacuole volume regulated branching frequency. I also remember making a chitin synthase 2 mutant, only to discover that, after elimination of dominant chitin synthase activity, this had little phenotype in terms of growth. This has created a puzzle and has led my group to systematically dissect the roles chitin synthases play in fungal biology and antifungal drug responses.

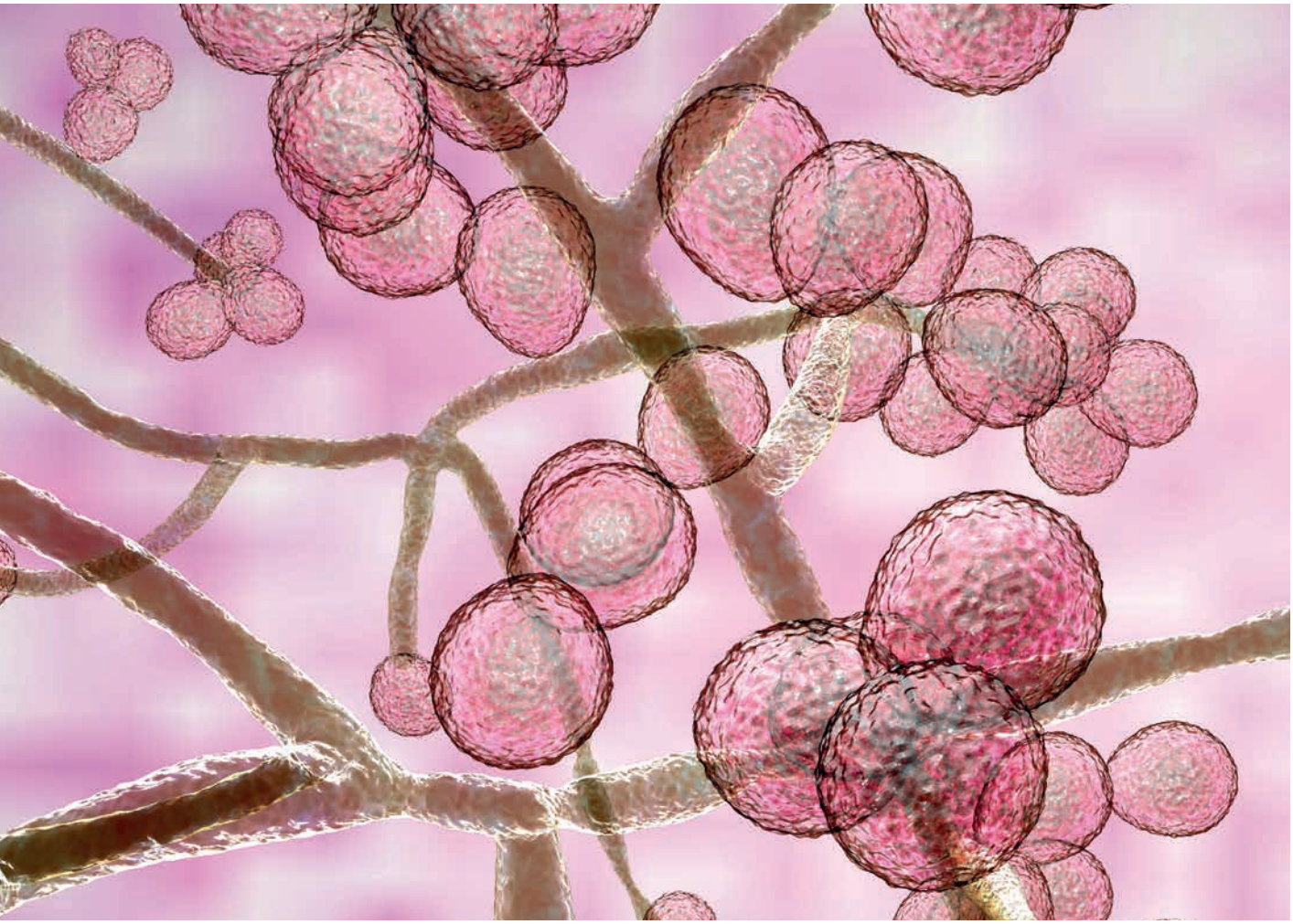
What do you wish you had known when you won the Fleming Prize?

Retrospective wisdom doesn't count for much. Perhaps, if I had been better in anticipating some of the pitfalls of my research programme, I might have avoided them better. But I realise I learnt a lot from our failures. In my Fleming Prize Lecture for example, I described a hypothesis that a bioelectrical proton current flowing into a hyphal tip was critical in establishing the axis of polarity for growth. We had shown that new currents could predict exactly where new tips would emerge. Many experiments later we proved this hypothesis was simply wrong. But the work we did to demonstrate this helped frame better hypotheses – and some of these are still holding water!

What did it mean to be awarded the Fleming Prize?

I remember being very excited and humbled at the same time. This was a very special experience for a number of reasons. The first Fleming Prize awardee was my PhD supervisor Graham Gooday. Many of our Fleming awardees have had major influences in the field of microbiology and I felt truly honoured to be nominated for such a prestigious award. I was incredibly lucky to be promoted by people and the microbiology staff at Aberdeen who had supported me. I will always be thankful for the mentorship that I benefitted from. I also enjoyed going on, many years later, to become the President of the Society and to have the honour of

Candida albicans. iStock/Jannicke Wiik-Nielsen



awarding the Fleming Prize in turn to other microbiologists. The Fleming Prize winners who gave their talks during my time as President (David Grainger, Stephen Baker and Sarah Coulthurst) were all outstanding scientists – and fantastic communicators.

Why does microbiology matter?

I'm biased but microbiology is clearly one of the most important disciplines in biology. Microbiology is important to global ecology, global health, biotechnology, and in the food and pharmaceutical industries. Microbes have also been amongst the most important general models for cell and molecular biology, providing quick and precise insights to so many fundamental questions. There is also more biodiversity in microbiology than for any other form of life, so we have really only scratched the surface of our discipline. There are more phages in a cup of seawater and more bacteria in a gram of soil than there are people in the world. Microbes started the tree of life and they will be the last survivors on the planet. In between, they influence every aspect of society (as appreciated only too well in these days of COVID-19 lockdown).

Interviewer: Dhara Malavia

Postdoctoral Research Associate, University of Exeter, UK

Neil Gow, President of the Society 2016–2018, presenting Sarah Coulthurst with the 2018 Fleming Prize.

An interview with Fleming Prize winner Professor Lynne Boddy

Professor Lynne Boddy, MBE, has spent her career researching the ecology of wood decay fungi. During this time, she has pioneered work on fungal communities and the decomposition dynamics of twigs, branches and trunks. Lynne is also an expert in fungal interactions and the manifold influences which affect the outcome, including three-way interactions with other organisms such as invertebrates and bacteria. More recently, her work has used transcriptomics, metabolomics and the production of volatile and diffusible organic compounds to dig deeper into the mechanisms of interaction. Lynne has boundless enthusiasm for sharing her love of fungi, be that through hands-on engagement events, media appearances or tirelessly mentoring early career researchers. She spoke to Sarah Christofides about winning the Fleming Prize in 1991 and her career since.

Lynne Boddy

Could you provide a brief description of your research and the research you were awarded the Fleming Prize for?

The work was on the ecology of wood decomposition, which had received relatively little attention previously. For my PhD I worked on wood decay processes as a black box, but I wanted to open the black box and look at the role of organisms in decay – not exclusively fungi, but mainly fungi, as they are the major agents of wood decomposition. I wanted to look at fungal communities because of the variation they cause in wood decay. Also, during my PhD I was working on the forest floor, but I realised that decay starts in the canopy, so we were starting in the wrong place. I wanted to look at fungal communities in the canopy.

When I worked at Bath with Alan Rayner, we started to look at communities in oak branches attached to the tree and found that very long fungal individuals develop very rapidly. It was hard to envisage how they could grow as quickly as they did, so we started to think that maybe they were already there. This is where the idea of latency came from; at the time, most people thought that trees were sterile inside. Our hypothesis was that the fungi were present as propagules and only developed when the water content in the wood declined and conditions were right. In Cardiff I went on to test those hypotheses. We chopped living branches into sections and let them dry down at different rates. In the 'Goldilocks' conditions where the water content was just right, there the fungi grew out. That came as a great surprise to many people and it took a lot of additional experiments to convince them that these weren't just contaminants.

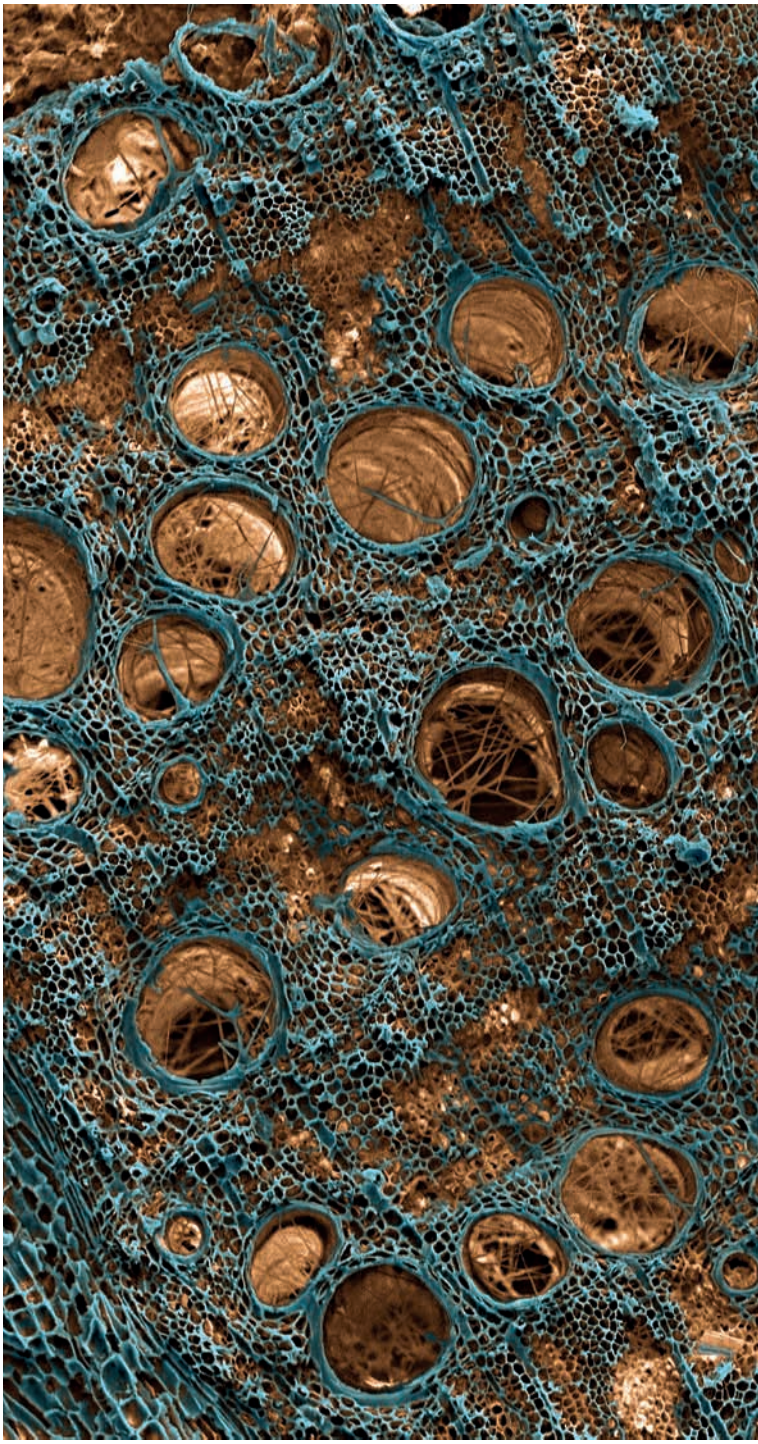
Around this time, we started some projects on cord-forming fungi using colonised wood blocks on soil trays,

looking at foraging, fractal geometry, network analysis, translocation of nutrients and interspecific interactions. Those were new and exciting things, and I've carried on doing it for 30 years. It has produced exciting finds, such as that fungi have memory, and has revealed amazing things about fungal behaviour.

The canopy work has also set up 30 years of work on decay in standing trees, in all sorts of wood components. Lots of this was baseline data as no one had looked at it before: it was exciting because we didn't know what we would find. In some ways, it was a tiny bit frustrating, as you had to get this baseline data before you could do anything more clever. Throughout my career people have said, "Surely we knew that already!", but although it might seem obvious now, we *didn't* know it at the time. I think that was why these things, which might seem simple, were so exciting and why I was lucky enough to be awarded the prize.

What questions arising from that do you still really want to answer?

Where do I begin? I still really want to know about cord formers: behaviour, memory, how messages are sent around the mycelium. I want to know the mechanisms of decay and how a fungus changes the wood so that incoming fungi experience altered conditions. To what extent do other wood decay fungi succeed brown-rot fungi and, if it is often limited, could this be a way of sequestering carbon? I want to know about tree root decay, as almost everything on decay so far has been done above ground. That's important from both ecological and safety perspectives, to know whether a tree's roots are sound. I've started working on heart rot in the centre of trees, which has been discussed since the 1800s, but is still not well understood. I still want to know much more about communities; we don't really know anything about the end stages of community development, the late stages of decay. We have studied communities by isolating fungi from wood onto agar, which is easy for wood decay in the middle stages but can't easily be done for late stages. Now we can use sequencing to start finding out what happens at the end stages when nutrients are released. That's something else I want to know about: decomposer fungi sequester nutrients.



Colour-enhanced SEM of a rotten oak branch. Ted Kinsman/Science Photo Library

Black rhizomorphs or fungal cords of honey fungus *Armillaria mellea*, formed on the diseased and dead core of a rotten tree.
Niigel Cattlin/Science Source/Science Photo Library

But when are those nutrients released to the soil? There are some hints on how this happens, but so much more to know. In all, there's enough for another lifetime or two!

How do you think public/scientific appreciation of fungi has changed over the course of your career?

I think things are improving. Fungi have got a bad name because people think they rot our food, our clothes and our homes, kill our crops and even have the cheek to grow on us and cause a lot of deaths in immunocompromised patients. Indeed they do, but without them the ecosystems of planet Earth would not work. In Britain, I think we are a mycophobic nation. We're scared of fungi and don't want to eat them (there's nothing wrong with not wanting to eat fungi as it's better to leave them *in situ* anyway, but it's symptomatic of how mycophobic we are). I think that in the last few years the media has at last started to grasp the importance of fungi. They're still regarded in second place to plants, whereas they are equal in driving terrestrial ecosystems, but I think it's getting better. Several TV and radio

> Things are just beginning to change, but I think fungi still are – wrongly – regarded as the poor relatives of plants.

programmes have devoted time to considering fungi, and I've just been asked to write a children's book on fungi. Things are just beginning to change, but I think fungi still are – wrongly – regarded as the poor relatives of plants.

What do you wish you had known when you won the Fleming Prize?

Well, I think that the playing field and goal posts have changed since then. I knew a lot of things, like how hard it was to get grants, but I didn't know it was going to get harder. Lots of things for me have got easier; at the time I didn't realise how hard it was being a woman in science, but hindsight shows it was very hard. Things have got so much better for women.

Scientifically, there are masses of things I wish I'd known! I'm not sure I would have approached things very differently though. I would still follow up the alleyways and exciting little directions, even those that proved dead ends, because at the time you don't know where they will lead and it is all part of the scientific process.

What did it mean to you to be awarded the Fleming Prize?

It was important to me that fungi were appreciated as not just a 'poor man' to plants and – particularly for microbiologists – to other microbes. At the time fungal ecology was often regarded as going round with a collecting basket and making lists. My sort of fungal ecology was not like that at all. I don't want to know just lists of what grows where, but what they're doing, why and how they're doing it.

Why does microbiology matter?

I think we've answered that! Without fungi, the terrestrial ecosystems of planet Earth wouldn't exist!

Interviewer: Sarah Christofides

Research Associate, Cardiff University, UK

A majestic old oak giving shade to a spring meadow. iStock/makasana

An interview with Fleming Prize 2020 winner Professor Edze Westra

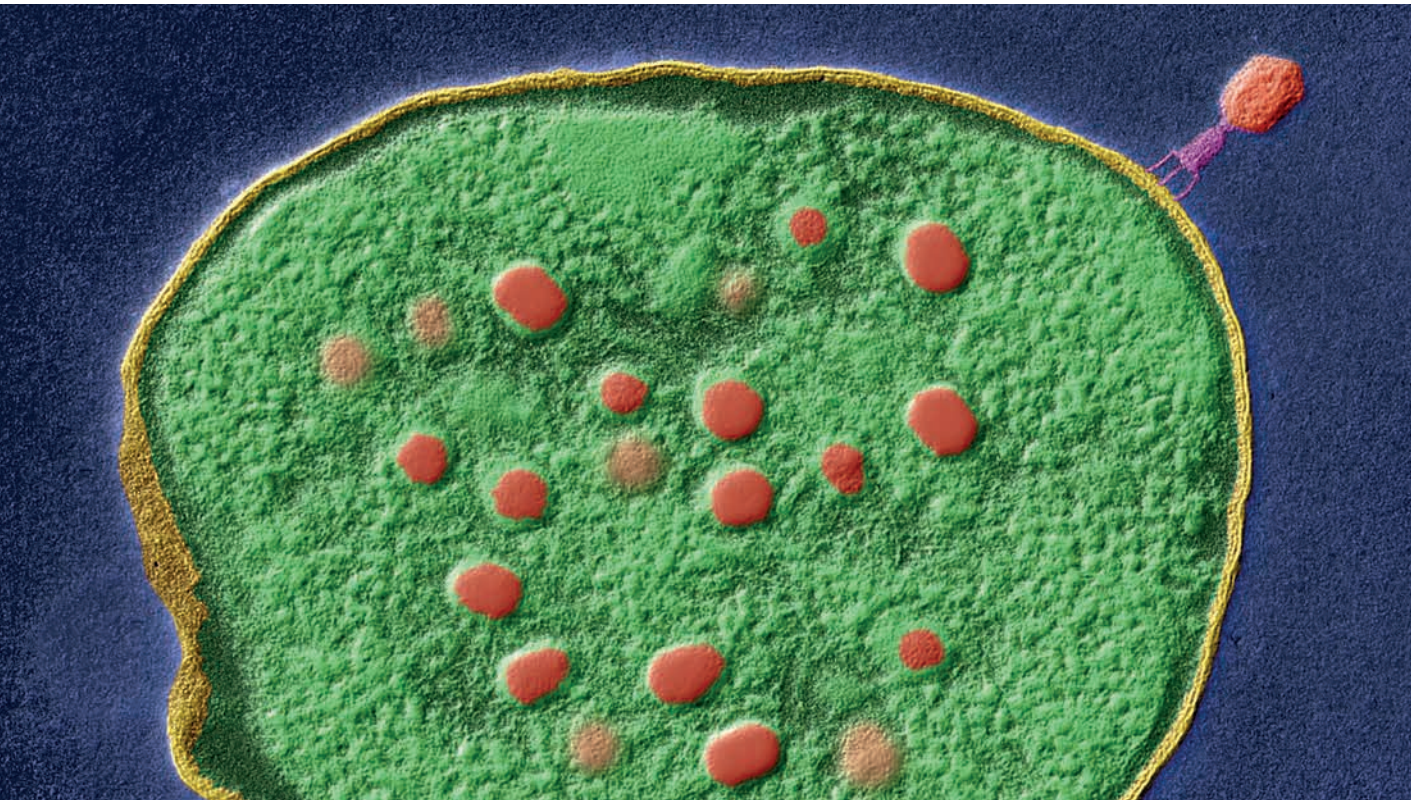
Professor Edze Westra, University of Exeter, was awarded this year's Fleming Prize for his work on the molecular mechanisms and evolutionary ecology of CRISPR-Cas systems. He spoke to Dr Rebecca Hall about what winning the prize meant to him and where he sees his field in the future.

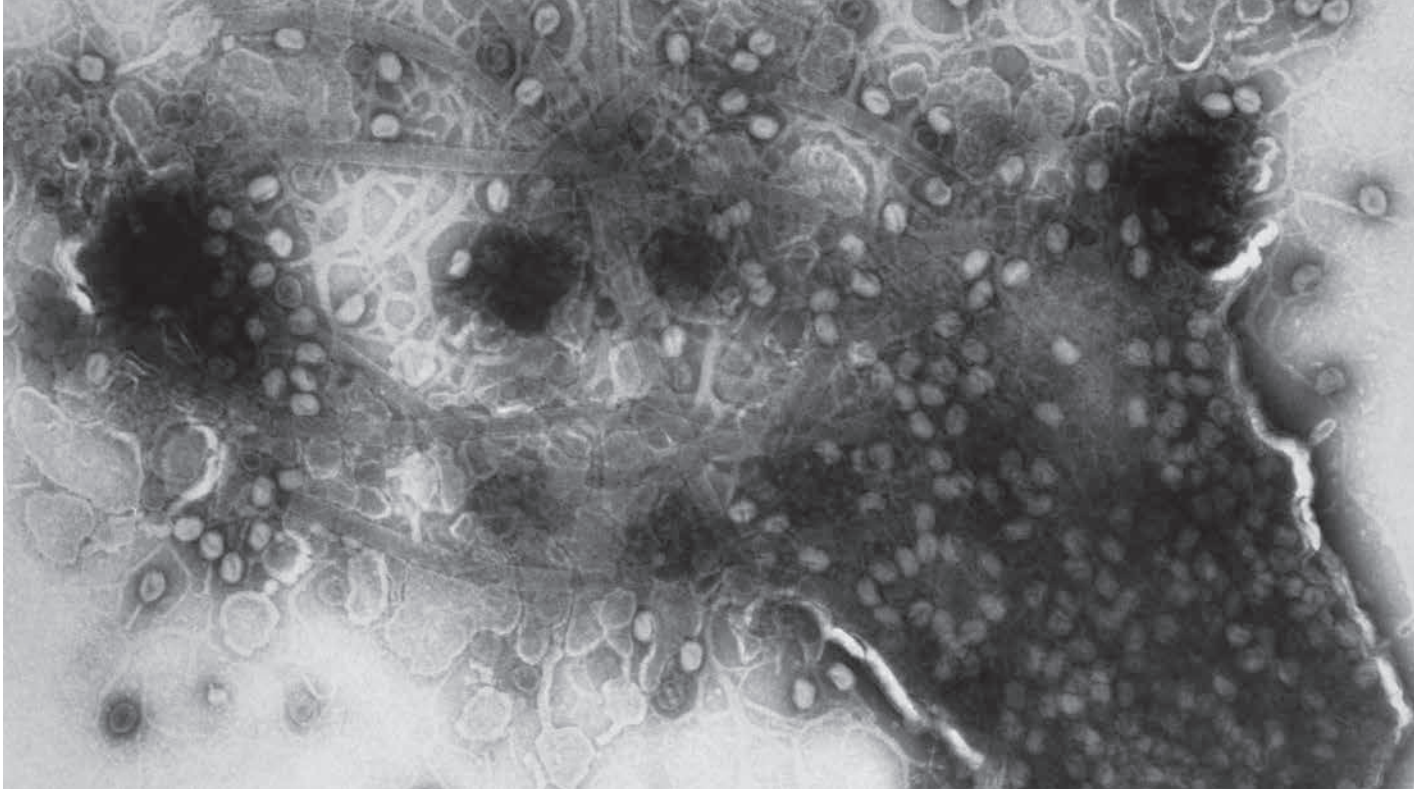
Jussi Puikkonen

Could you provide a brief description of the work that you were awarded the Fleming Prize for?

I study the interactions between bacteria and their viruses. My PhD research was on the molecular mechanisms of CRISPR-Cas and then my first postdoc position moved into a slightly different area to focus on when these defence systems are important and why these systems are there in the first place, the impact of communities and cooperation, and the importance of ecological variables. Cells tend to defend themselves against phage infection by mutating the receptor that the phage uses to get into the cell; rarely do the bacteria use CRISPR systems instead. Why is this? I moved on to a NERC Independent Research Fellowship in 2015 to start answering these questions, looking at the evolutionary consequences of CRISPR-Cas systems and the ecological conditions that favour these defences. Recently, many more

Coloured TEM of a section through an *Escherichia coli* bacterium infected with T4 bacteriophage. Eye of Science/Science Photo Library





Transmission electron micrograph showing lysis (destruction) of a rod-shaped bacterium by T4 bacteriophages. Biozentrum, University of Basel/Science Photo Library

bacterial defence mechanisms have been identified. The overarching question that my group is trying to answer is "when do all these different systems come into play, and when they do, what is the consequence of this?"

> It's fantastic! The Fleming Prize is the most prestigious award in microbiology for anyone at my career stage. Looking at the list of previous winners, it is an absolute honour to join them.

Given unlimited funding, what direction would you take your group in?

We recently found that the presence of certain bacterial species in the environment increases the likelihood that other bacterial species evolve CRISPR immunity against phage. The bacteria we used in this study are opportunistic human pathogens and we found that this change in phage resistance evolution has important knock-on effects for the virulence levels of these bacterial pathogens. This is an exciting, novel area of research, which I will continue to explore in collaboration with medical microbiologists. Another area that I am super excited about at the moment is the idea of viruses communicating with one another to make decisions about their infection strategy; whether they enter the lytic or the lysogenic lifecycle. I want to understand how common this communication mechanism is, and when it provides a clear advantage to the phages.

What does it mean to you to be awarded the Fleming Prize?

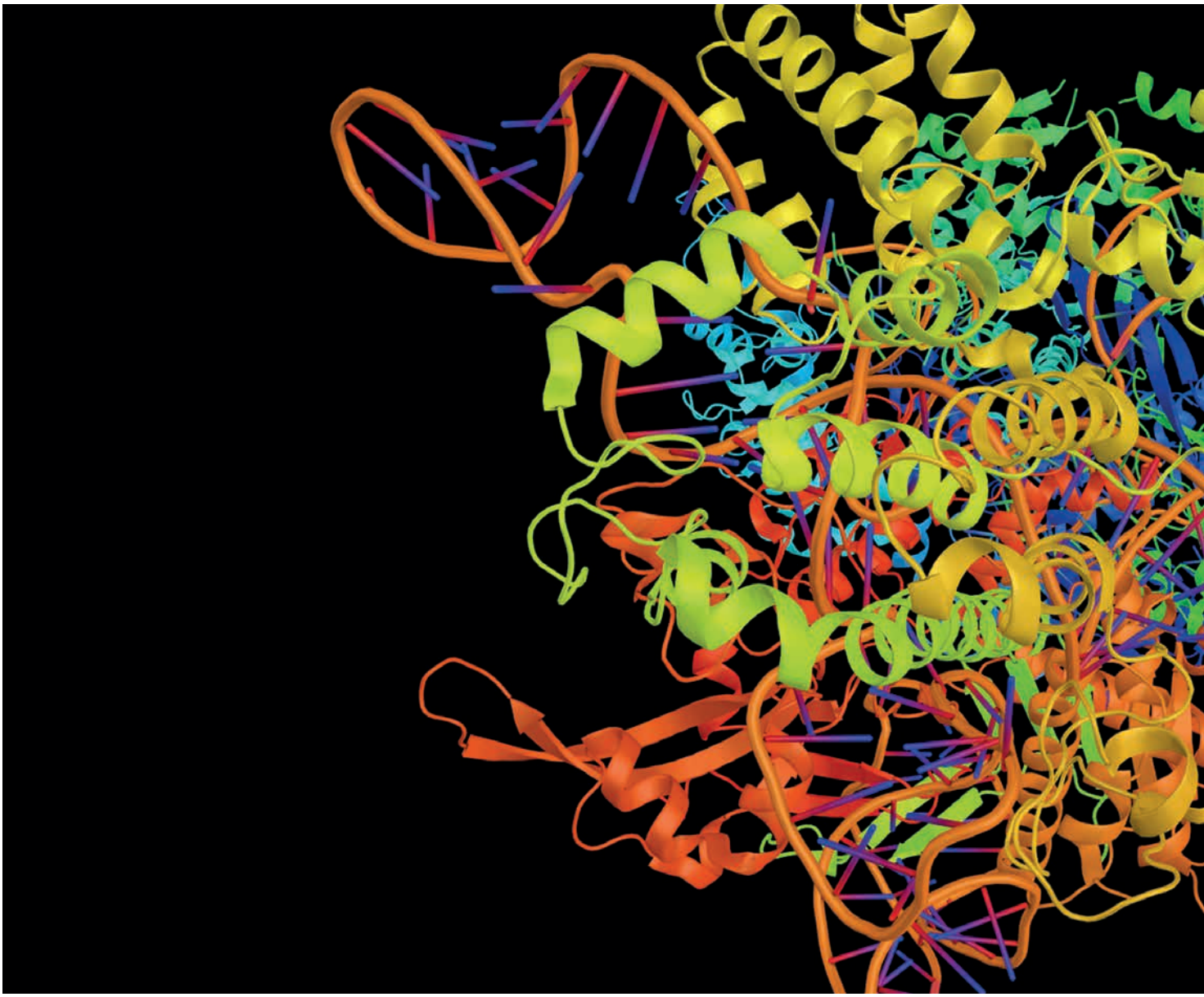
It's fantastic! The Fleming Prize is the most prestigious award in microbiology for anyone at my career stage. Looking at the list of previous winners, it is an absolute honour to join them. I am also really excited to provide the lecture to go along with this prize (find out more on page 40).

Why does microbiology matter?

For so many reasons. The human health perspective is the most obvious, but there are also applications in industry and the economic interest in, for example, determining crop yields. Arguably the most important role that microbiology plays is in keeping the planet alive by maintaining the important nutrient cycles.

What advice do you have for early career researchers looking to build a career in academia?

Maximise your outputs by not sitting on your data for too long. Understand your field so that you are in a good position to obtain fellowships. Your PhD should hopefully expose you to a lot of training and mentorship so that at the end you are in

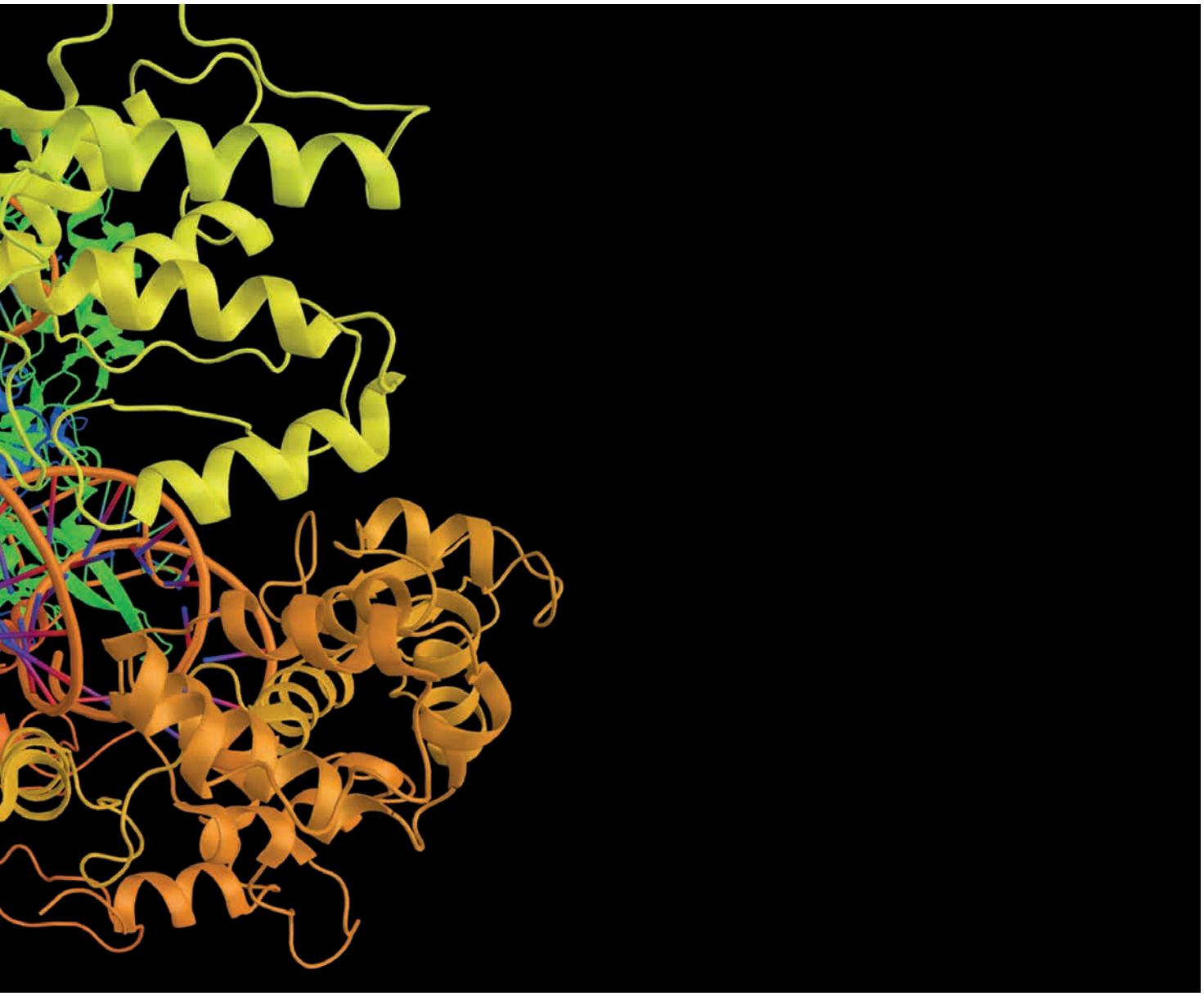


Three-dimensional structure of CRISPR-CAS9. iStock/ibreakstock

a good position to tackle a really unique piece of work. The most important thing is to choose a postdoc that you are super passionate about; that will give you the energy and resilience that you need to deal with the hard work and the disappointments that come with the job. What are you most interested in? Think about your one really big idea, then break it down into achievable projects that can span a postdoc or two. Consider your advisor carefully. Do they have the infrastructure and research environment to support you in achieving your goals? I was fortunate to have a great postdoc supervisor in Professor Angus Buckling for my Marie Curie Fellowship and I'm still learning so much from the people around me. Good mentorship is so important at all career stages.

Do you have a favourite paper that you are particularly proud of or that has been pivotal for you?

I am really excited about the work we published last year on how natural selection can favour the loss of CRISPR immune systems. We expected that having CRISPR systems can be maladaptive in certain conditions, but were not sure why. We found evidence that when a phage integrated its genome into that of the host during lysogenic infection, the CRISPR system can still recognise this. This then causes cells to destroy their own genomes, which in turn results in strong selection for bacterial mutants that lost their CRISPR-Cas immune system. I really like this work because it finally provided a mechanism for why bacteria



get rid of their immune system. We also had another exciting paper that showed a positive-feedback loop can occur in the dynamics of phage infection. Phages can carry anti-CRISPR genes, but these are imperfect because they take time to act. Infections are removed by the immune systems before the anti-CRISPR products can block the complexes, but they still produce immunocompromised bacterial cells and the numbers of these cells will build up as the number of phage particles increases, eventually leading to a threshold above which we can observe successful viral replication. We realised the phages need to cooperate to overcome the CRISPR immunity of their host, which is really exciting.

Finally, what do you particularly enjoy about your current career stage?

I am super excited about the science that we do, of course, but I am also particularly excited by seeing the people in my lab have really fantastic outputs and moving on to establish their own groups. I have always benefitted from amazing mentors and I am really proud to think that I might be starting to pay that back.

Interviewer: Rebecca J. Hall

Research Associate, University of Nottingham, UK

An interview with Fleming Prize winner Professor Frank Sargent

Frank Sargent is a Professor of Bacterial Physiology at Newcastle University, having relocated from Dundee in 2018. Half of his group studies bacterial anaerobic hydrogen metabolism – and nickel-dependent hydrogenases in particular. The other half are interested in protein secretion pathways used by bacteria. It is a molecular microbiology laboratory taking reverse genetics approaches, combined with biochemical and structural characterisation of gene products. Current research projects in the group are sponsored by BBSRC.

Frank Sargent

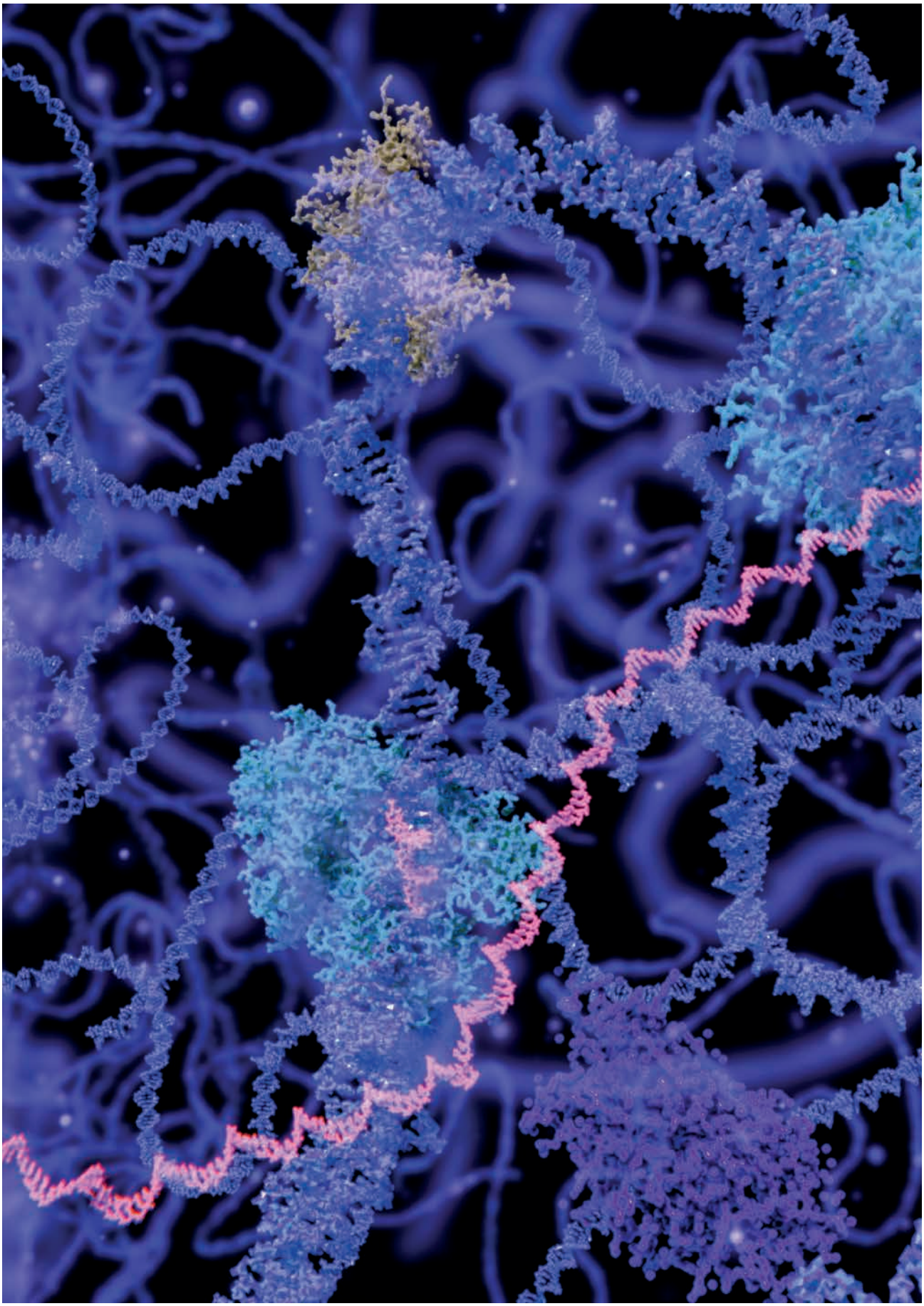
Could you provide a brief description of your research and the research you were awarded the Fleming Prize for?

I was awarded the Fleming Prize a long time ago and back then I was working on quite different things than I am today. I started my own research group in 2000 after I was awarded a Royal Society University Research Fellowship. I had been working on the Tat export pathway as a postdoc and, as it was a brand new discovery, there was absolutely loads more to discover about it. I had this hypothesis that some bacterial twin-arginine signal peptides must have soluble binding-proteins that assist their function, so we had set about looking for some, finding some and figuring out how they worked. Because the research headed down an avenue of protein–protein interactions, we ended up doing loads of biophysical experiments – including nuclear magnetic resonance (NMR) spectroscopy and isothermal titration calorimetry (ITC). I really liked that level of protein biochemistry (no gene regulation in sight) and making new discoveries about the natural world is the best feeling in science. A couple of years after the Fleming Prize, external funding appeared to be drying up for that type of biochemistry, so it was a case of adapt or become an admissions tutor or something like that.

I therefore took a sideways step from bacterial Tat substrates, to Tat-dependent proteins involved in bioenergy – hydrogenases. I was lucky to find some enthusiastic collaborators in this area as well, and we are still working on bacterial hydrogen metabolism today. Hydrogenases are older than the dinosaurs and some can perform hydrogen-dependent carbon dioxide reductase activity. Harnessing this biological activity for carbon capture is our current biotechnology venture. Also, a few years ago I took a gamble and started a new project starting with a fishing trip (by the way, never an advisable approach for an early career researcher or anyone else for that matter). Luckily, we did catch something and ended up finding an unusual mechanism of protein secretion in *Serratia marcescens*. So back to protein targeting once again...

During your time in the field, how has technology helped it advance and where do you see it going next?

Technology development and discovery research go hand in glove. I'm much more of a user of technology than an inventor, but without collaborators' development of software for automatic cross-peak assignment, my solution NMR experiments may not have been successful. Without



Molecules in the cell nucleus during interphase. iStock/selvanegra

Samples for analysis by NMR spectroscopy. Colin Cuthbert/Science Photo Library

> … stay curious and follow your nose as a scientist – and keep working at the bench as long as possible.

miniaturisation of ITC instruments, then the amount of protein and ligand needed for this type of analysis would have been a barrier. Full automation of molecular microbiology should be next. There is some automation already, but it should take off properly over the next few years. Postdocs stood at the bench pipetting, cloning, sequencing and plating out might soon be a thing of the past. Design and order a mutant library from your armchair and inspect the results from the same.

What do you think the biggest unsolved mystery of the field really is?

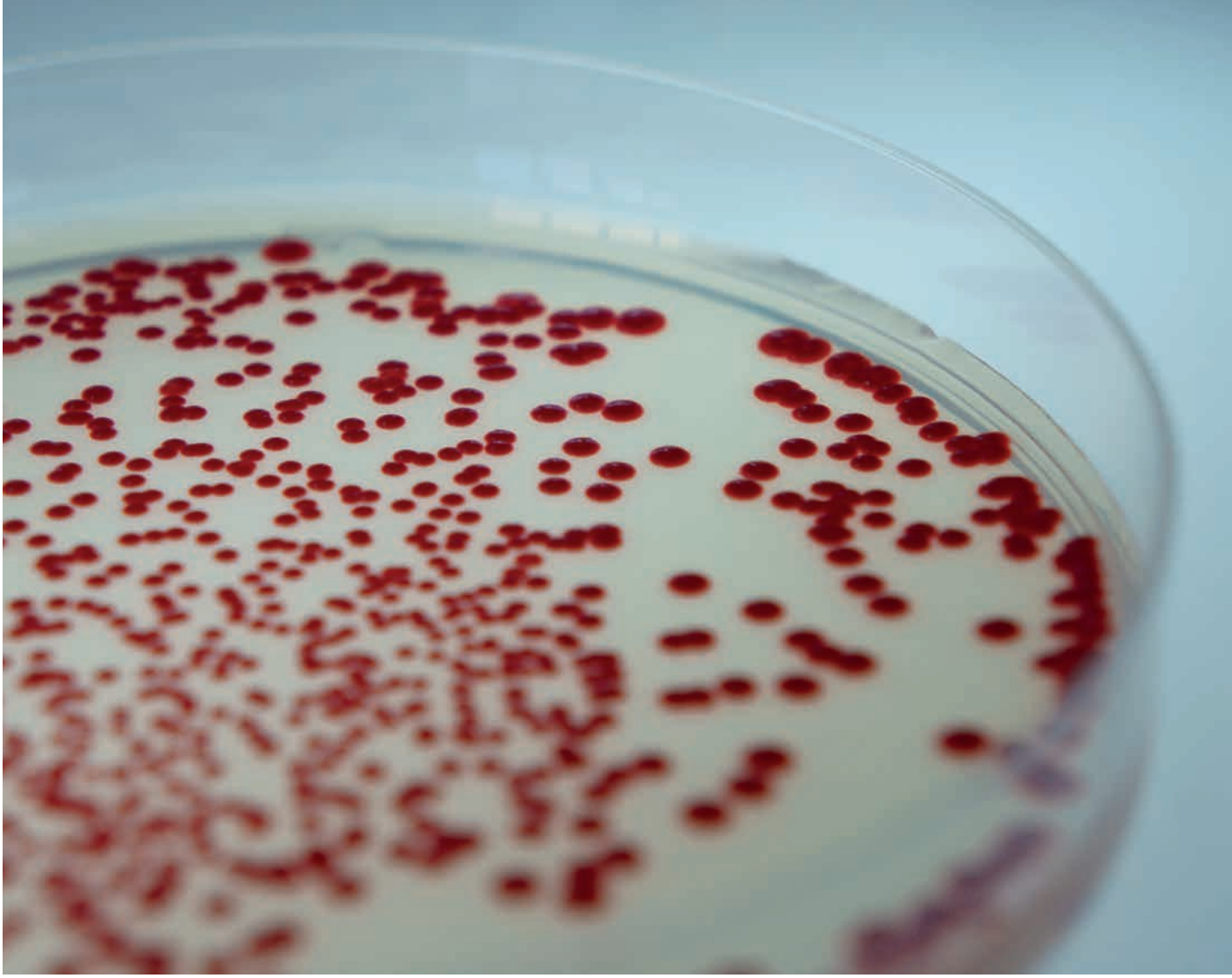
It's all a mystery to me still. In the metalloenzyme field you will find a cluster of four iron atoms and four sulfur atoms held together in a protein shell. How the midpoint potential (reduction potential) of that metal cluster can be controlled by the protein is not fully understood, not by me anyway. For bacterial genetics in general, there is still loads to be discovered. There must be at least 25% of all bacterial genes with no known function. That's a lot of (automated) PhD projects.

If you were an early career researcher now, which emerging sub-field do you think you'd focus on?

I'd be studying synthetic biology and working at the interface of engineering, maths, biology and science fiction. Natural microbes made this planet, engineered microbes might save it.

What do you wish you had known when you won the Fleming Prize?

That is almost a "what would you do differently?" question. I'm not sure I would have done anything differently career wise, before or after the Fleming Prize. Early career scientists should remind themselves why they like science in the first place: stay curious and follow your nose as a scientist – and keep working at the bench as long as possible. Research



***Serratia marcescens* spread on an agar plate.** iStock/LamiadLamai

culture in the UK has moved on, or tried to move on, considerably since those days though. I think some Active Bystander training would have come in handy.

What did it mean to you to be awarded the Fleming Prize?

This was a really big deal at the time, but comes with a big dollop of imposter syndrome and general trepidation. The Microbiology Society was part of the culture of the lab where I did my PhD. As soon as I arrived as a student I was told, "join this society"; mainly because my supervisor didn't have many travel funds, I think. So for years you've got the feeling that "better scientists than me have never won the Fleming Prize". Looking down the list of previous winners, and seeing that they were all successful still, meant that maybe I too would actually have a future in scientific research. It also added some pressure. Looking back, it was also a lesson in how to be a decent mentor. I didn't nominate myself. Bringing through the next generation of microbiologists is so important and I am grateful for the bosses and mentors I had in 2006 who took the time and effort to tap me on the shoulder and then nominate me. It's important to support the best microbiologists you can find in your department – nominate them for everything from undergraduate prizes to the big Prize Medal.

Why does microbiology matter?

Microbiology is the greatest of all the biological sciences, obviously. There is something there for all biologists, and beyond. Interested in the evolution of life on Earth? Or life on exoplanets? What are these infectious diseases anyway? And what are they doing to plants, animals and people? How do plants grow in soil again? And what do you mean your gut is controlling your mind? How can something so small generate such big data? Can we recycle all this waste or find new energy sources instead? Never mind all that for now – anyone for cheese and wine?

Interviewer: Alex J. Finney

Postdoctoral Research Associate, Newcastle University. UK

Digital Events

Why Microbiologists Matter: a digital celebration of the journeys of our members

#WhyMicrobiologistsMatter #FlemingShowcase #YoungMicro20

23–26 November 2020
Digital event

The Microbiology Society will be hosting a series of online events and meetings in November 2020 entitled '**Why Microbiologists Matter: a digital celebration of the journeys of our members**'.

The online events take place between Monday 23 and Thursday 26 November 2020 and the event series is designed to explore the impact of microbiologists' past, present and future.

Join us by streaming the week's content, which includes short lectures, panels, training workshops and debates from some of the leading scientists around the world. The events include our Fleming Prize Lecture 2020 and the Microbiology Society Outreach Prize Lecture, as well as our Annual General Meeting.

The week's activities will also span every career stage, from established senior scientists to early career microbiologists, and will host the final of the Sir Howard Dalton Young Microbiologist of the Year Competition.

The week will include presentations from this year's Fleming Showcase to celebrate the Society's 75th anniversary. These lectures are organised by an appointed committee of previous Fleming Prize winners, chaired by Nobel Prize winner Sir Paul Nurse, in commemoration of the Society's first president, Sir Alexander Fleming.

The week will feature presentations from a global line-up, including the following speakers:

Aziveet Halder

- **Luke Alphey** Pirbright Institute, UK
  Genetic control of mosquitoes
- **Bonnie Bassler** Princeton University, USA
  Quorum-sensing communication: from viruses to bacteria to eukaryotes
- **Stirling Churchman** Harvard University, USA
  Orchestrating gene regulation across the genome and across the cell
- **Eddie Holmes** University of Sydney, Australia
  The expanding virosphere
- **Grant Jensen** CalTech, USA
  Visualising bacterial nanomachines in situ *by electron cryotomography*
- **Mark Pallen** Quadram Institute, UK
  Palaeomicrobiology: what ancient DNA can tell us about pathogens from the past
- **Liz Sockett** University of Nottingham, UK
  Predatory Bdellovibrio *bacteria – 58 years of understanding them as allies against AMR infections*

Registration

'Why Microbiologists Matters' is free to Society members. Registration is now open for those wishing to book a place at the meeting (**microbiologysociety.org/WhyMicrobiologistsMatter**)

Annual Conference Online 2021

26–30 April 2021
Digital event

The Society recently made the decision to cancel Annual Conference 2021 as a physical meeting and to replace it with an online event whose symposia and activities are designed to achieve the same scientific and networking objectives.

The result – **Annual Conference Online 2021** – is designed to celebrate the impact of microbiology and microbiologists everywhere. It will be run as a week-long meeting between Monday 26 April and Friday 30 April 2021.

Programme

Annual Conference is the UK's largest annual gathering of microbiologists and we are working hard to ensure that this online iteration will be every bit as valuable to our broad scientific community.

The programme for the week is currently in production. As ever, the science is designed to demonstrate the impact and potential of microbiology to address important global challenges. The event will also offer meaningful engagement and networking opportunities for both early career and established microbiologists.

Further programme details – including a list of the invited speakers and their abstracts – will be available online closer to the event.

Abstracts

As with the traditional live Annual Conference, there will be a public call for abstracts later this year. The final digital event in April 2021 will host offered abstracts from these submissions to showcase the latest scientific research.

For those giving offered orals, the event will be an excellent digital platform for emerging scientific research. So don't miss out on this opportunity to showcase your microbiological work to the widest group of microbiologists in the country. Further information about specific abstract submission categories will be published via the website (**microbiologysociety.org/events**). To get the latest news and updates for this flagship digital meeting from the Society, follow us on Twitter **@MicrobioSoc**.

Focused Meetings 2021

The Society organises a varied programme of Focused Meetings each year. These events bring together those with shared scientific interests in a broad range of microbiology topics.

Following the cancellation of our 2020 events programme due to the outbreak of COVID-19, the Focused Meetings that were scheduled to take place this year have been postponed and many have been incorporated into our 2021 programme.

Our Focused Meetings calendar next year will now feature an ambitious and varied programme of predominantly digital events, but we will deliver in-person events when it is appropriate and safe to do so.

We are continuing to adapt to the complex and changing set of challenges posed by the pandemic and will provide unique opportunities for scientific communities to strengthen relationships, share knowledge and hear about the latest research within their fields, while ensuring the safety and accessibility of all event participants.

Candida and Candidiasis 2021

#Candida2021

21–27 March 2021
Digital event

Following the postponement of the *Candida* and Candidiasis meeting, which was scheduled to take place in Montréal, Canada earlier this year, the meeting will now be delivered as a digital event. This vital online forum will bring together the *Candida* research community to present the latest advances and ideas to empower major ongoing efforts to understand, treat and prevent *Candida* infections.

The submission **deadline for new abstracts is Friday 8 January 2021**.

Other Focused Meetings taking place in 2021 include:

- Anaerobe 2021
- Avian Infectious Diseases
- British Yeast Group 2021
- Cell–Cell Communication in Bacteria – Fundamental and Applied Aspects
- Microbial Cycling of Volatile Organic Compounds Biogeochemistry to Biotechnology
- Mining the Microbiome for Antimicrobials and New Therapeutics
- What's New in *Cryptosporidium*?

iStock/Dr Microbe

You can find information about abstract submissions, registration and other details on our entire events programme at **microbiologysociety.org/events**.

Have you got an idea for an event?

Our busy programme of activities is developed through event proposals from the Society's members and we're currently calling for suggestions for our events programme in 2022 and beyond. All Society members are invited to submit proposals covering any topic relating to microbiology, which will be considered by the Scientific Conferences Panel. The deadline for proposals is **14 December 2020**. Visit **microbiologysociety.org/events** to find out more.

Increasingly Open: half year results

Gaynor Redvers-Mutton

2020 has been a transformative year for the Society's journal programme. Publish and Read (P&R) was launched to facilitate more open access (OA) publishing. It is a model that repurposes institutional subscription fees, covering both OA publishing under CC-BY licence, together with access for faculty and students to **microbiologyresearch.org** under one annual fee, paid by libraries. Major funders like UKRI and Wellcome backed the model and encouraged uptake. In this article we tell the story of the results and impact of Publish and Read in the first half of this year.

ACCESS MICROBIOLOGY

JOURNAL OF **GENERAL VIROLOGY**

INTERNATIONAL JOURNAL OF **SYSTEMATIC AND EVOLUTIONARY MICROBIOLOGY**

MICROBIAL GENOMICS

JOUNAL OF **MEDICAL MICROBIOLOGY**

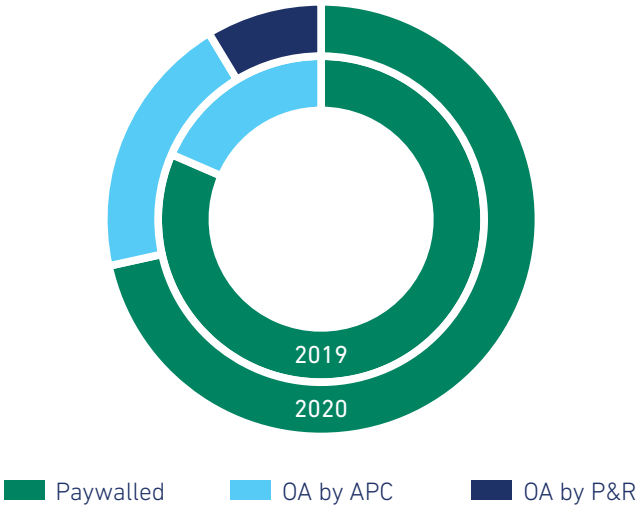
MICROBIOLOGY

Impact

The timing was extraordinary. Just as we were launching P&R the pandemic bought lockdowns around the globe and a sudden, urgent need for our content to be easily accessible by vast numbers of researchers outside of their institution's network. In March, Council decided to make all Society journal content free to read until September 2020. That ease of access has meant a 23% increase in usage, with an average of 263,500 sessions per month.

This demonstrates the underlying need for broad-based access to our scientific content. The fast pace of scientific research into SARS-CoV-2 contributed to the numbers of articles published under P&R. There was also an urgent need for quick widespread communication amongst scientists.

Shift towards OA



Essential reads such as the review of humoral immune responses following SARS-CoV-2 infection by Paul Kellam and Wendy Barclay, and an explanation of the dynamic linkage of UK Biobank to PHE's Second Generation Surveillance System, attracted record numbers of shares, downloads and tweets. P&R authors have been active on social media, boosting Altmetric scores and helping their articles rapidly accrue citations.

P&R in numbers: the first six months

61 institutions over **3** continents

2 essential SARS-CoV-2 papers

65 articles

20 cited

28% articles published OA

60 active on social media

Extent

National library consortium groups helped hugely to promote P&R to their members and account for the high concentrations of opt-ins within the UK and Australia/New Zealand. We share with them an overall aim to achieve open access to research for societal benefit, in compliance with mandates from national funding bodies.

In the first half year we have delivered on goals of P&R which were for a higher proportion of what we published to be OA, 28% of articles published this year so far are OA, and to offer an administratively easy, alternative to author paid APCs.

Help us help you

One of the easiest ways to support the Society is to publish in our journals. Check to see if your library has signed up at **microbiologyresearch.org/fee-free-open-access**, and if they haven't please get in touch: we have resources to help you advocate for P&R with your university librarian and OA office.

Further reading

Kellam P, Barclay W. The dynamics of humoral immune responses following SARS-CoV-2 infection and the potential for reinfection. *J Gen Virol*;101:791–797.

Armstrong J, Rudkin JK, Allen N, Crook DW, Wilson DJ. Dynamic linkage of COVID-19 test results between Public Health England's Second Generation Surveillance System and UK Biobank Open Access. *Microb Genom*;6:mgen000397.

Gaynor Redvers-Mutton
Head of Business Development and Sales

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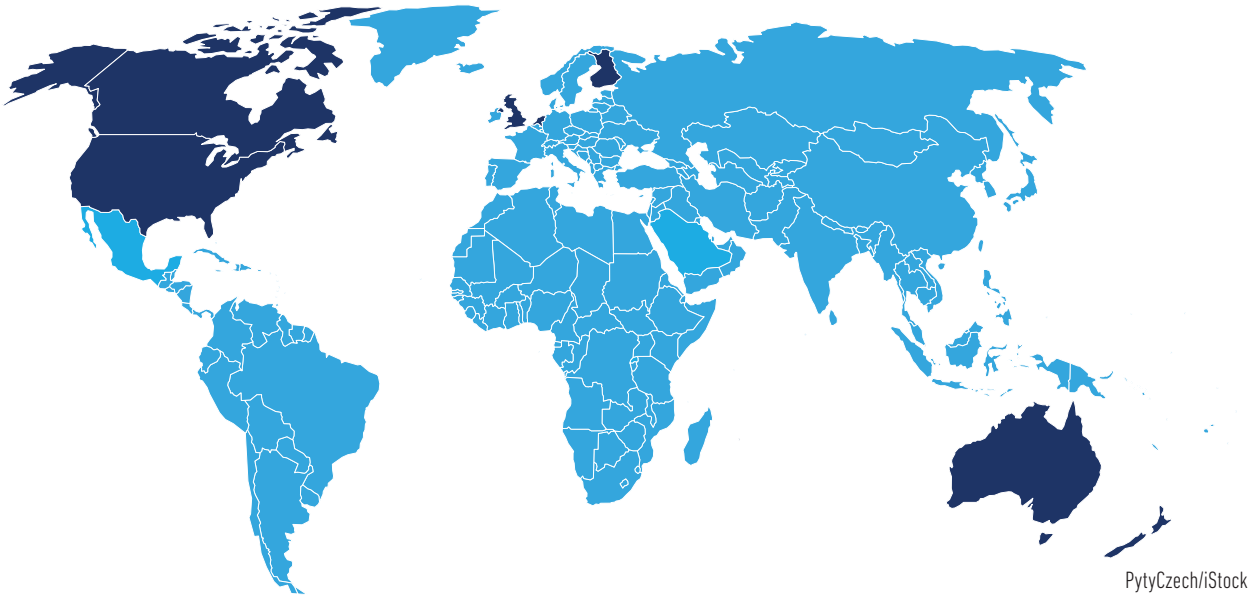
Countries with P&R Institutions



PytyCzech/iStock

Recently Independent Virology Researchers – networking for beginners

It is without doubt that, as a discipline, virology is strong in the UK. For anyone that attends the Microbiology Society Annual Conferences and goes to the virology talks and workshops, this is clear. Our research is cutting edge and world leading; moreover, our sense of community is tangible. Indeed, we think the latter is an essential part of UK virology's success. But how is this fostered?

We're frequently told that being part of this community and having a well-established network is paramount to success. However, for a junior researcher, whether a postdoc yearning for independence or a newly established independent researcher, breaking into this community can be daunting. Despite this, one can look around the room at a Microbiology Society event and see several tight-knit gatherings of 'established' virologists.

Recognising this, two newly independent virologists, Rachel Fearns (now Associate Professor, Boston University, USA) and Julian Hiscox (now Professor at the University of Liverpool, UK) took steps. Around 15 years ago, they established the annual Young Virologists' Meeting, now known by the more inclusive 'Recently Independent Virology Researchers' (with the catchy acronym, RIVR) as a way of accelerating the network-building process. The premise was, as it still is, that virology researchers in their first years of launching an independent research career would come together for a small and welcoming symposium (in both the scientific *and* ancient Greek sense of the word). The aim was to provide a platform for discussing novel research, promoting new collaborations and exchanging experiences to successfully establish a career in virology. As recently said by Julian Hiscox, RIVR means, "You get to know what each other is doing and, importantly, to promote each other's work." Another highlight that continues with RIVR meetings is the keynote address by a well-established virologist who, in addition to summarising their significant contributions to virology, provides honest insights into their own career path and offers invaluable advice for managing the transition to successful independence.

There are two RIVR events each year: an evening meal during the Microbiology Society Annual Conference and the flagship meeting that takes place in January – the next RIVR meeting will be the sixteenth. Meetings are held over two days and are usually attended by 20–25 delegates and an established virologist (whose attendance is regularly sponsored by the Microbiology Society). Each RIVR presents their research, and because all delegates stay at the conference venue, there are plenty of opportunities for networking and establishing new collaborations. Indeed, over the years, casual conversations at RIVR meetings have led to several collaborative grants and numerous publications. Proudly, RIVR has been commended as being unique and a model that should be emulated in other fields, on platforms such as Twitter (#newPI) and Slack. From personal experience, RIVR meetings have proved to be transformational. At the Microbiology Society Annual Conference following your first RIVR meeting, you find yourself, quite naturally, part of those 'tight-knit' gatherings.

In recognition of the benefits of RIVR, we now encourage participation from researchers on the path to independence, such as researchers applying for independent fellowships or equivalent positions.

We are mindful of the barriers that carers and those with childcare responsibilities face when deciding to attend meetings. For these groups – including early career researchers who may not have their own grants – this decision can have a financial baring; so, we are extremely grateful to our previous sponsors (including Society journal, *Journal of General Virology*) for generously providing funds that go some way to overcoming these barriers.

If you think RIVR will benefit you, or if you would like advice on how to start a similar network, get in touch.

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Spotlight on Grants: Research Visit Grant

Research Visit Grants support a variety of short visits to host laboratories with the aim of supporting innovative projects within established collaborations and to develop new collaborative initiatives.

Last year, British Heart Foundation (BHF)-funded Postdoctoral Research Associate Dr Sylviane Yoba (University of Bristol, UK) was awarded a grant to support her research visit to the Royal College of Surgeon's Cardiovascular Infection Research Group in Ireland. The aim of this visit was to investigate the interactions between *Streptococcus gordonii* and human vascular endothelium. It was hoped that these studies would provide a better understanding of how the progression of infective endocarditis may occur if infectious microbes in the bloodstream attach to damaged areas of the heart.

Sylviane said that the visit benefitted her professional development as she developed new scientific techniques, as well as non-scientific skills, such as laboratory management. "Acquiring these experiences are beneficial as they are always attractive in terms of collaboration and recruitment."

Over the course of the visit, Sylviane was able to develop a range of new skills, as well as advancing her knowledge of working with endothelial cells. By challenging human aortic endothelial cells with bacteria under shear stress conditions that mimic those of the cardiovascular system, and visualising their interactions via fluorimetry, immunocytochemistry and confocal microscopy, Sylviane was able to determine the molecular mechanisms exploited by *S. gordonii* for binding to the luminal layer of the cardio vasculature and understand how this process can subsequently enhance interactions with blood platelets, with potential to exacerbate infection of the heart.

Sylviane said the highlight of her visit was "being able to develop a model that brought together bacteria, cardiac endothelial cells and platelets under shear stress, thereby closely mimicking the conditions that enable infective endocarditis to occur. Given the complexity of the model, we were not sure whether our experimental plan would work, and so we were delighted when we were able to observe platelets attaching to infected endothelial cells."

Sylviane outside of the Royal College of Surgeons in Ireland. Sylviane Yoba

The studies Sylviane completed during her visit allowed for the identification of potential endothelial cell receptors and, going forward, Sylviane would like to investigate the role of these receptors in detail.

Applications for the Research Visit Grant open twice a year, in January and June, with deadlines in April and October, respectively. To find out more about the wide range of grants available to support Microbiology Society members, visit the grants area of our website (**microbiologysociety.org/grants**).

Microbiology and the UN Sustainable Development Goals: scientific approaches to the Global Challenges

Ludmila Derevyankina/iStock

The year 2020 should have focused on climate action and biodiversity; instead, the COVID-19 pandemic naturally dominates, with virology and microbiology centre-stage.

Paul W. O'Toole and Max Paoli

Coincidentally, a prominent study about spill-over risks for human zoonoses from endangered mammalian species was completed just before the current pandemic. Indeed, pandemics are associated with global environmental changes and lack of sustainability, with COVID-19 likely linked, at least in part, to anthropogenic activity. Meanwhile, the future of human life and Earth's ecosystems are threatened by the 'Global Challenges': biodiversity loss, climate change, energy demands, population growth, etc. Attempts to address some of the challenges started over 30 years ago, but with progress limited to particular topics in selected countries.

In 1987, the World Commission on Environment and Development (WCED), also known as the Brundtland Commission, laid the foundations for the Millennium Development Goals (MDGs) for 2000–2015. Released by the UN in 2015, the current set of Sustainable Development Goals (SDGs) seeks to re-address increasingly critical challenges with new impetus. The application of science and technology is essential for delivering the SDGs. Scientific research helps us to understand problems as well as identify implementable solutions. However, despite the efforts of UN agencies to bring the SDGs to the top of the international agenda, many scientists know little about the Global Challenges and the aims of the SDGs. Academics, including some microbiologists, are often unaware of whether or not their research is even related to the SDGs or if they could do more to support the goals. Here we advance several reflections for consideration by the microbiology community.

1. Knowledge of the Global Challenges and the SDGs is poor among scientists. Awareness and understanding of sustainability are essential to drive transformational research and to develop solutions. If researchers are not informed about the SDGs and the Global Challenges, they cannot position their project in the context of sustainability. It would therefore be worthwhile to deliver a series of lectures plus workshops on the SDGs.
2. Knowledge of specific SDG targets would enable researchers to draw appropriate connections and describe their research in the context of the SDGs. Examples relevant to microbiology include SDGs #2 (Food), #3 (Health), #6 (Clean Water and Sanitation) and #9 (Industry, Innovation and Infrastructure).
3. Basic research also supports the SDGs. Firstly, it contributes directly or indirectly to quality education (SDG #4) by favouring an academic environment of high standard, providing cutting-edge training. Secondly, it helps build and consolidate institutions (SDG #16).
4. Any interdisciplinary research is potentially a basis for Goal #17 on partnership. Microbiology offers excellent opportunities for collaborative work because it often involves trans-disciplinary issues. Examples include microbial metabolism and biogeochemical cycles; microbial genomics, antibiotic resistance and clinical microbiology; diet–gut microbiome–health interactions.
5. Microbiologists are typically well aware of the importance of a matrix of interacting biological processes and should therefore have a natural receptiveness to the understanding of ecosystem balance and environmental resistance. They can quickly grasp 'ethical' SDGs, such as #12 on 'Responsible Consumption and Production', and are well positioned to inspire young people with respect to

universally relevant Goals such as #13 on climate action and #7 on energy, both of which have microbiology links.

6. Studies on the microbiome of humans, animals, plants and physical environments provide a platform for microbial ecology relevant for health, sustainable food production and environmental protection. Human microbiome function involves a life-long mutualism with the host, a relationship sculpted by co-evolution for mutual benefit, but sensitive to habitual diet, medication and lifestyle. Appreciation of these aspects of human health should foster a more sensitive approach to the planet's supporting systems.
7. Universities can play a huge role in driving society towards sustainable development: education is essential for understanding and embracing sustainability. Using the WCED report and the MDGs as a springboard, in 2005 the UN launched the Decade of Education for Sustainable Development (ESD). This project was spearheaded by UNESCO and prompted the inclusion of sustainability in education systems. In the developing world, Chile embraced these novel ideas. Internationally, the Sustainable Development Solutions Network (SDSN) developed some excellent courses. Regardless of the degree subject, any student would benefit from the inclusion of a module on sustainability in their study programme.
8. Greater scientific involvement in pursuing the SDGs would erode the gap between science and policy, which is compromising progress towards implementing solutions. Sustainability-literate scientists could exert influence on decision making, even if this were 'only' at the level of their department or university, for example by supporting a sustainability charter. Scientific input can help prevent decisions being dominated by political and economic considerations, and scientists versed in technical language and theory can bridge the science–policy gap.
9. In the Anthropocene, human societies have lost balance and perspective: perhaps because of their over-reliance on technology, they no longer possess that impalpable but essential understanding of nature and its laws, an understanding that underpins the Scientific Method. Microbiologists as global citizens have a role in discussions on ESD and science-based policy and they can promote reconnection with nature and respect for the planetary boundaries.
10. Science and science-based advice must play a leading role in ensuring a sustainable future for societies. Because of the multiple mutual interactions between climate and micro-organisms, it is not possible to tackle the global challenges on climate change without microbiological knowledge. Unless an authentic and rational conversation on sustainability takes place involving the scientific community, we will continue along the 'business-as-usual' path instead of working towards the sustainable development path; we must use knowledge to lead the way away from complacency and apathy.

It is hoped that these reflections may be considered by the community of microbiologists and researchers at large, although it is likely that more in-depth awareness needs to be raised in a properly structured forum for sustainability principles and sustainability science to be genuinely embraced.

Further reading

Johnson CK, Hitchens PL, Pandit PS, Rushmore J, Smiley Evans T *et al.* Global shifts in mammalian population trends reveal key predictors of virus spillover risk. *Proc Biol Sci* 2020;287:20192736. DOI:10.1098/rspb.2019.2736.

Bedford J, Farrar J, Ihekweazu C, Kang G, Koopmans M *et al.* A new twenty-first century science for effective epidemic response. *Nature* 2019;575:130–136. DOI:10.1038/s41586-019-1717-y.

Cavicchioli R, Ripple WJ, Timmis KN, Azam F, Bakken LR *et al.* Scientists' warning to humanity: microorganisms and climate change. *Nat Rev Microbiol* 2019;17:569–586. DOI:10.1038/s41579-019-0222-5

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*"*The author is responsible for the choice and the presentation of the facts contained in the article and for the opinions expressed therein, which are not necessarily those of UNESCO and do not commit the Organization."*

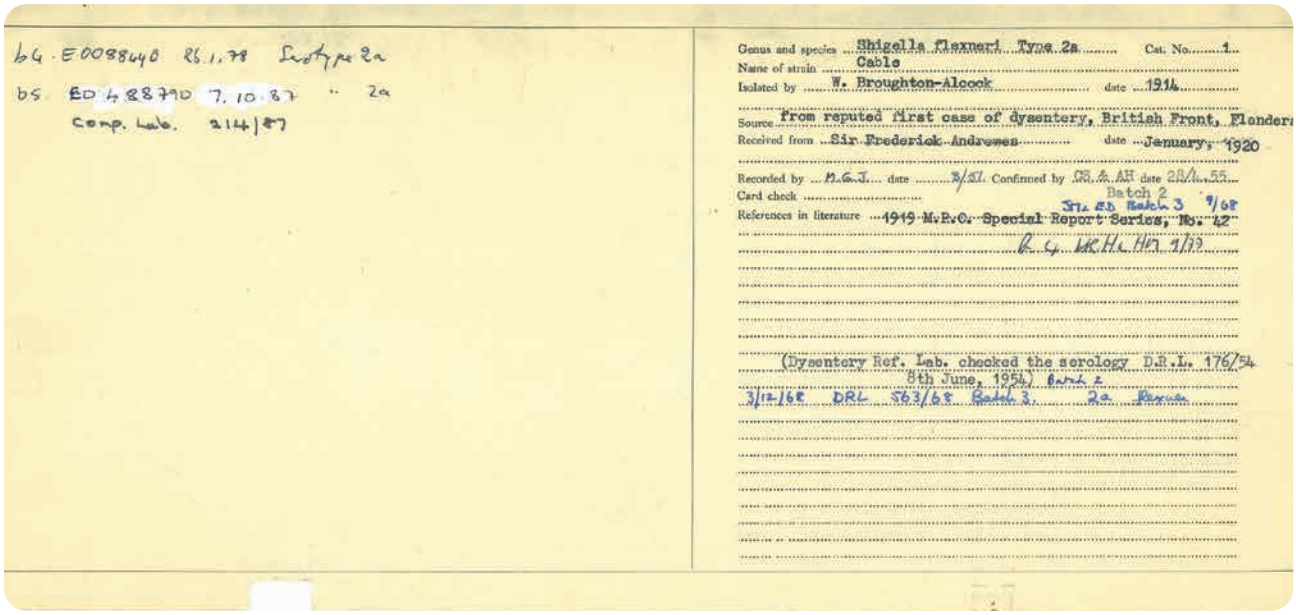
The National Collection of Type Cultures Centenary: 100 years of supporting science

The National Collection of Type Cultures (NCTC) is the custodian of bacterial strains that represent the work and collaboration of numerous scientists spanning almost 150 years. Consisting of almost 6,000 strains from over 850 bacterial species, each strain has its own unique history.

The majority of the NCTC collection is composed of clinically and veterinary relevant type and reference strains, such as controls recommend by international bodies (World Health Organization and the European Committee on Antimicrobial Susceptibility Testing, EUCAST) for use in diagnostic assays. However, many of the NCTC strains see a great multiplicity of uses and some are cultural artefacts that reflect and contextualise human history throughout the 20th century.

NCTC was founded under the direction of the Lister Institute of Preventative Medicine and Medical Research Committee in January 1920. Set up to support the provision of micro-organisms, the initial nucleus of the collection was composed of a private collection already established within the Lister

NCTC 1 entry card. NCTC



NCTC staff past and present at the NCTC Centenary Symposium, PHE Colindale, March 2020. NCTC

NCTC ampoule store. NCTC

Institute; however, NCTC soon saw additional strains being donated by other bacteriologists from within the UK and abroad. Early recipients of NCTC strains were scientists who were eager to understand the nature of infectious disease, but who were disadvantaged by the lack of availability of authentic strains upon which to conduct studies and a reliance on serendipitously finding other bacteriologists with which to collaborate. Whilst some older, 19th century, privately owned strain collections had provided this function in part, such collections were vulnerable to extinction due to retirement, departure or death of key individuals such as their curators, as happened to the Kral Collection, based in Prague.

The remit of NCTC over the last 100 years has remained largely unchanged: the provision of authentic bacterial strains to scientists and to ensure the preservation of the strains for future generations. The conservation of strains donated by NCTC depositors is of paramount importance, not only because changes affected by repeated passage can cause the strains and functions to deteriorate, but also because they often represent significant scientific achievements on the part of the depositor. This is perhaps best reflected in the dozen or so strains deposited by Alexander Fleming in his lifetime. These strains include NCTC 2665 *Micrococcus luteus*, the type strain on which the description of the species is based, and NCTC 6571 *Staphylococcus aureus*, a strain originally adopted into use during the penicillin trials of the 1940s and subsequently distributed as a test organism to assay concentrations of therapeutically viable penicillin. That these strains were made available to others is invaluable in its own right, while the scientific legacy of Fleming (and indeed numerous others) has been preserved in NCTC.

Some of the older strains within NCTC serve as both a biological and anthropological historical record. *Vibrio cholerae* NCTC 30 and *Shigella flexneri* NCTC 1, both from soldiers who fought in the first world war, have been relatively recently re-examined using whole genome sequencing, and both tell interesting stories of what human and microbiological life was like, more than 100 years later. Curatorial bias, as with almost any collection of anything, has certainly shaped the make-up of NCTC; from microbial systematists concerned with the classification and discovery of existing and new bacterial species, taxonomic dissection of the genus *Propionibacterium* (now *Cutibacterium*), to clinical microbiologists curating in advocacy of research into emerging and more neglected infectious disease, evidenced in the variety of strains that compose NCTC's repertoire of contemporary *Neisseria gonorrhoeae*, Enterobacteriaceae and antimicrobial resistant isolates. Alongside a host of collaborators and depositors, it is the enthusiasm and expertise that fuel these predispositions that enable NCTC to realise its potential in healthcare science and beyond.

NCTC is operated by Public Health England and is celebrating its centenary year. We, the current staff and prior custodians of NCTC, feel immense pride in having played our part in maintaining this living library of cultures, and in facilitating collaborations between depositors and other microbiologists in all avenues of science and industry, as diverse as the collection itself, throughout the next 100 years.

Jake Turnbull

NCTC Data Manager, National Collection of Type Cultures, Public Health England, 61 Colindale Ave, London NW9 5HT, UK

@HotchPotchJake

Sarah Alexander

NCTC Curator, National Collection of Type Cultures, Public Health England, 61 Colindale Ave, London NW9 5HT, UK

Careers Focus: online resources and networking

During a time of reduced face-to-face meetings, many of us have found new and innovative ways of gaining information, learning, and networking with those working in the field of microbiology. While the current climate may present new challenges, it has also led us to develop new skills and tools to keep up with our day-to-day demands, many of which we can take with us moving forward.

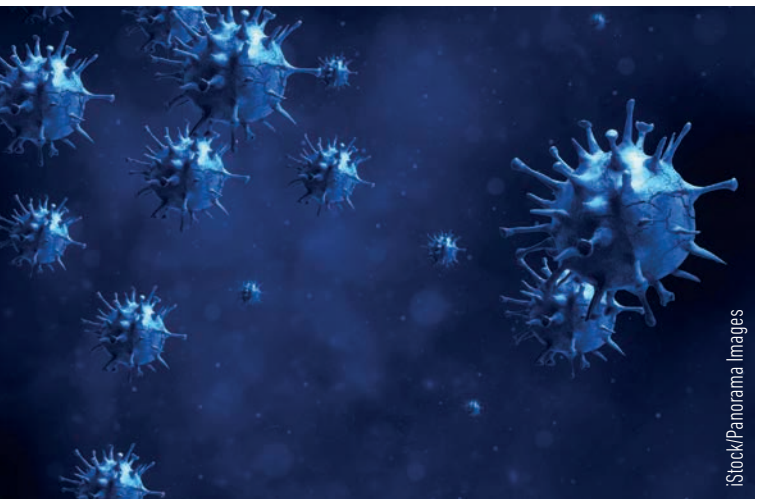
There are several ways you can maintain your professional networks and engage with research: here are some activities and initiatives that the Society has developed to continue to support your professional development during the lockdown period and beyond.

1. Virtual events

With a 71% increase in demand for digital learning, many people have turned their attentions to online events and conferences. Virtual activities can be convenient, practical and useful to those wishing to gain and share information. The increased use of virtual meetings has not only allowed us to connect with likeminded individuals, but also continue to make progress in research and other work-related projects remotely.

SARS-CoV-2

In light of the COVID-19 pandemic, the Microbiology Society continues to offer support to the microbiology community.



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Earlier this year we were able to offer a platform to the virology community to facilitate the gathering of those working on the virus at the SARS-CoV-2 meeting.

As well as sharing valuable information, this meeting demonstrated the importance of building and being part of a community.

ECM Forum Online 2020

The Early Career Microbiologists' (ECM) Forum hosted its first virtual event for its LinkedIn group members. The novelty of sharing posters and short videos of research online provided a great opportunity for early career members to share their scientific research, express their creative skills and gain new professional contacts.

The ECM Forum Committee continues to provide activities directly serving Forum members, so if you're not yet a member, join the Forum (**microbiologysociety.org/ECMForum**) and look out for upcoming events and opportunities.

2. Online Platforms

Engaging with material online has always been a fail-safe way of gaining knowledge and enhancing our research skills. Webinars, online documents and YouTube, just to name a few, have proven that different online platforms serve as useful banks of resources for many purposes.

Teaching resources

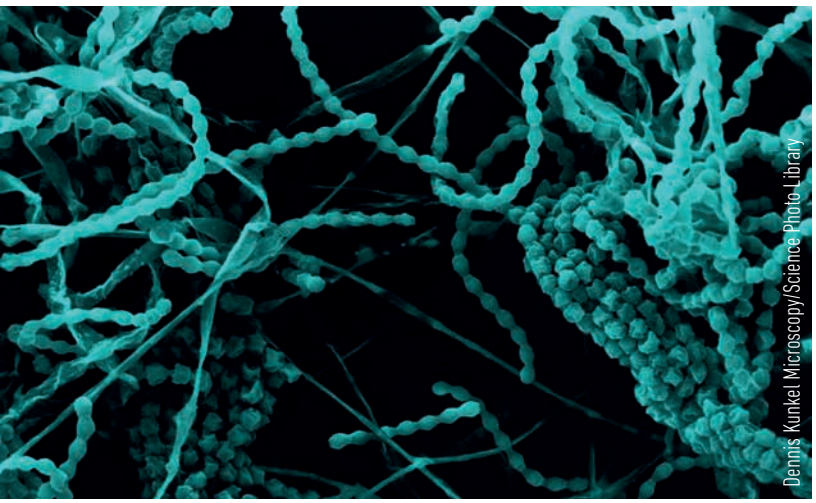
Following the success of the annual Teaching Microbiology in Higher Education Symposium and the demand for a network of microbiologists who are actively teaching, the Society launched a dedicated online area of resources on **microbiologysociety.org** to help educators teaching remotely and more generally.

It is important for members in teaching roles to keep up to date with current teaching practices and many have used different online platforms to communicate with each other as well as with students. You can explore the resources shared by Society members by logging into the members area (**microbiologysociety.org/login**) of the Microbiology Society website. You can also get in touch with contributors and share your own resources in the Teaching Resources area (**microbiologysociety.org/TeachingResources**).

Why Microbiology Matters hubs

To celebrate the Society's 75th anniversary we launched a collection of digital resources on the Society's website. The series of hubs focus on different topics and consists of animated videos, expert contributions from our members and resources from further reading.

Visit our website (**microbiologysociety.org/WhyMicroMatters**) and check out our most recent hub 'New frontiers in microbiology' (more information on page 8).



Dennis Kunkel Microscopy/Science Photo Library

Microbiology Society journal developments

An important development in the way our journals display content was launched to include a new Side-by-Side feature, allowing readers to keep in view the Figures, References and other items, as you scroll through the text. Visit **microbiologyresearch.org** to view the new features.

The more we use online platforms, the more our demands for user friendly interfaces become a top priority and we remain committed to supporting the communication of microbiological research.

Microbe Talk

Podcasts have been a great way to communicate and receive information in an informal way on demand. The Microbiology Society's podcast, Microbe Talk, continues to showcase the work of members with interviews concerning all areas of microbiology. Our A Sustainable Future project series offered great insight into areas such as circular economy and soil health, all of which were informed by the work of our members. You can follow the Microbiology Society account on SoundCloud or wherever you get your podcasts (Spotify, iTunes, Stitcher, Podomatic) to get the latest edition of Microbe Talk.

For some of us, many of the existing tools that we have previously overlooked have now become part of our daily lives. You can experiment with different methods and tools to maintain and grow your professional network and keep up to date with current research. It is important to remain flexible and learn from new ways of doing things, whether it be a positive or negative experience.

While you continue to settle into new ways of doing things, make sure you take advantage of all the member resources available online, including the Members' Directory (**microbiologysociety.org/membersdirectory**), which enables you to take the networking experience to the virtual realm and connect with other members with similar interests.

Further reading

fosway.com/research/next-gen-learning/covid19-research

Early Career Microbiologists' Forum update

Welcome to the ECM Forum update; it has been quite a year so far. Firstly, I echo the gratitude due to all our members, early career or otherwise, who have put their work and often lives on hold to help with COVID-19 efforts. It was a monumental thing to watch and follow, from those helping with testing, to groups expanding our knowledge of this novel disease. Thank you to all of you out there.

Robert Will

It has also been a time of incredible social demonstrations, such as the Black Lives Matter movement, a reminder for many to think about the privileges we take for granted every day, and to realise how different life can be for so many. Racism, and discrimination in general, is always wrong with no exception, and despite what some may say, science is inherently political. It remains as imperative as ever to strive for an equal future, where barriers no longer exist. Please take a moment to think about your colleagues, friends and neighbours, and how you can help empower those around you to make your environment a fairer, more welcoming place for all. We'd like to hear your thoughts on how the Society can support you and other early career members to do this. Send your suggestions to **ECM@microbiologysociety.org**.

Congratulations to the new members of the ECM Forum Executive Committee:

Jo Kite University of Surrey, UK
Sustainability Committee Representative

Rebecca McHugh University of Strathclyde, UK
Impact and Influence Committee Representative

Yinka Somorin Queens University Belfast, UK
Building Communities Committee Representative

Rebecca Hall University of Nottingham, UK
Finance Committee Representative

They will take office from January 2021. We are all really looking forward to working together and hearing their thoughts about better representing early career microbiologists across the Society. The ECM Forum holds elections every year, so please keep an eye out for open positions in the future to be part of our committee. Representing your fellow ECMs is a really rewarding experience and opens up what it is like to sit on top-level decision-making groups of a scientific society. For those that are interested, I highly recommend keeping a look out this time next year.

iStock/inspired_by_the_light

The LinkedIn group is still going strong, and we have welcomed many new members this year. If you haven't already, visit **microb.io/ECMForumLinkedIn** and join the conversation! Thank you to everyone who has taken part in our 'Coffee and Chat' Zoom catch-ups; they have provided great opportunities to meet other members and to hear how everybody has been doing. It was also great to be part of 'ECM Forum Online 2020' in July, and well done to all who shared their research. It was a new format for most of us, but I think it was a success all round!

We can all look forward to meeting up in person again soon, but in the meantime keep an eye on the LinkedIn group for the next digital catch up. Hope to see you there!

Robert Will
Communications Representative,
ECM Forum Executive Committee

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Public perceptions of medical mycology

Mycology is an area of urgent medical need, with more than 1.5 million deaths worldwide each year caused by fungal infections, yet the number of researchers working in the discipline is very small in relation to the scale of the problem.

The Medical Research Council Centre for Medical Mycology (MRC CMM) at the University of Exeter is one of the most ambitious strategic investments in medical mycology worldwide and is building critical mass to tackle this issue. Increasing awareness of the disastrous impact of fungal infections on human morbidity and mortality is essential to this challenge, enabling us to build support for our work and raise the profile of our research.

There is always a challenge when communicating unwelcome messages, such as a high death toll caused by infectious disease. We believe that public awareness is an important part of this picture and suspected that there is very little knowledge of our discipline amongst the general public, given that of all microbial pathogens of humans, fungi are the least well studied and understood. To find out how large this knowledge gap is, we conducted a small-scale public survey, which yielded interesting perceptions and misconceptions.

Out of all the respondents, 73% told us that they had never heard the term 'medical mycology', and when asked what they thought it might mean, responses varied from "holistic wellbeing" to "alternative therapies" to "study of medicine practices in small environments" and "Goodness, no idea!". This survey confirmed to us that, as suspected, public perceptions of medical mycology are somewhat erroneous.

This paucity of knowledge presents a challenge for us and our field, and changing awareness will involve not only correcting misconceptions but countering misinformation. For example, misinformation about 'candida syndrome' is rife online and perceptions of fungal infection start with – according to our survey – toes, 'strangeness', and a distinct 'ick' factor.

In our survey, we asked what people think of when they hear terms such as fungal and whether fungi have positive or negative connotations. Most people reported mixed feelings about the terms fungi and fungal – describing positive associations, such as a mushrooms, and many more negative ones such as rot and infections. Descriptions included mould, damp, hallucinogenic, poisonous, earthy, colonising, thrush, athlete's foot, infection, germs, bad smell, rashes.

When asked specifically about fungal infection, the majority of responses focused on thrush and athlete's foot and had negative connotations. The majority of fungal infections are indeed superficial, with 25% of the world's population suffering from infections including thrush, athlete's foot and dandruff, and this has huge treatment cost implications.

Most tellingly, no responses associated 'fungal infection' with the possibility of fungi in the bloodstream, travelling to the brain and kidneys, growing inside them and severely affecting organ function. No responses indicated an understanding that although these invasive infections primarily affect immunocompromised individuals, they have extremely high mortality rates, with some taking the lives of up to 90% of the people they infect. The implications, particularly in relation to the weakened immune systems of those living with HIV, are much larger for those living in low- and middle-income countries.

Our survey indicates, then, that there is something of a mountain to climb to change public perceptions of fungal infection and the work of medical mycologists. Nonetheless, as optimists, we are enthused by the strong feelings and associations that 'fungi' and 'fungal infection' evoke, as this at least gives us something compelling to connect to. And when asked "what might make you curious to learn more about fungal infections?", a total of 53% of survey respondents reported that they were most interested to learn more about the global medical impacts of fungal infection. This tells us that there is a space for engagement with some of the bigger repercussions of our work. By starting with what people *do* know, we can begin to create a narrative about medical mycology that makes it relevant to people's lives, whilst rapidly expanding and advancing public knowledge about even stranger aspects of fungi, and their devastating global impact.

Follow us and keep in touch on Twitter via **@MRCcmm** to see how we achieve this.

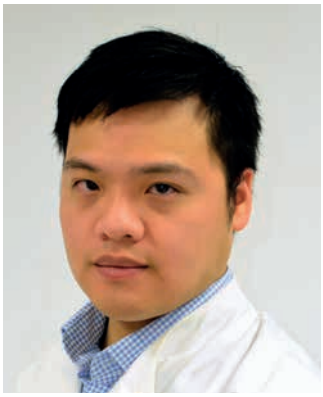
Lorna Hosler-Barnes, Alberto Muñoz and Gordon D Brown

Medical Research Council Centre for Medical Mycology, University of Exeter, UK

L.J.Barnes@exeter.ac.uk

Member Q&A: Fritz Ka-Ho Ho

This is a regular column to introduce our members. In this issue, we're pleased to introduce Fritz Ka-Ho Ho.



Fritz Ka-Ho Ho

Where are you currently based?

I was just awarded a PhD this summer in Pharmacy and Pharmacology at the University of Bath in the UK, and I am currently working as a Student's Union Sabbatical Officer (postgraduate) with part-time research posts.

What is your area of specialism?

Pharmaceutical microbiology.

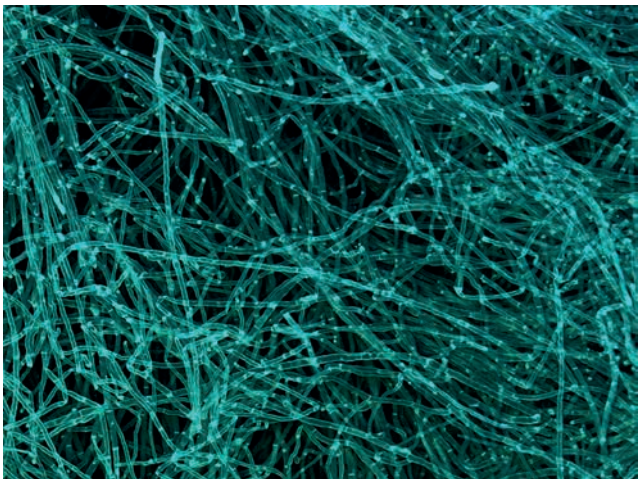
And more specifically?

My PhD project focused on developing the use of film-forming agents that provide a film barrier on the skin to prevent and treat fungal skin infections, without the intervention of standard antifungal agents, to avoid the development of antifungal resistance and prevent cross-contaminations.

Tell us about your education to date.

Interestingly, I do not have much educational experience in microbiology, except understanding the drugs they can make. I graduated with my BSc in Pharmacology and MSc in Forensic Toxicology at the University of Glasgow. At one time I planned to be an Analytical Technician because I doubted my research ability during my final year project. However, at the end of my master's course, I felt more interested in drug development for relieving humans from disease, instead of improving forensic analysis.

Microcolony imaging of *Trichophyton interdigitale*. Fritz Ka-Ho Ho



Where did your interest in microbiology come from?

My father gets dermatophytosis on one foot but not on the other. Since I started my life science degree, he has discussed his observations and assumptions with me regarding the reasons this could be the case. This experience instilled my interest in whether these ideas would work to explore a new treatment method for fungal skin infection.

What are the professional challenges that present themselves and how do you try to overcome them?

It is not hard to think outside the box, but difficult to expand the box we have. I inspire new ideas by reading articles from different fields of science.

What is the best part about 'doing science'?

Filling the gaps of knowledge.

Who is your role model?

I have no role model but a pipette. It is accurate and responsible.

What do you do to relax?

Feeding happy ducks at the lake at my university.

What one luxury item would you take to a desert island?

A writing kit to record my life's experiences.

Tell us one thing that your work colleagues won't know about you!

Sleeping in the lab to complete overnight experiments.

If you weren't a scientist, what would you be?

An historian. I love studying history because it is a mirror that reflects the vicissitudes of society.

If you would like to be featured in this section or know someone who may, contact Paul Easton, Head of Membership Services, at **p.easton@microbiologysociety.org**.

Log in to Mi Society to access resources, networking opportunities and much more

Mi Society is a part of the Society's website that enables you to manage your membership, including events and grants. Did you know that this exclusive members' area also hosts several resources and opportunities just for you? By logging in (**microbiologysociety.org/login**) you can access special discounts, opportunities to get involved in Society activities and opportunities shared by other members. It's a great place to find out how we can support your professional development.

Mi Society also hosts our Members' Directory, a great way to network and connect with other members who work in the same field of interest as you, or with whom you share similar interests.

Creating and updating your own profile enables you to increase your visibility on the directory, showing people what you're about and creating opportunities for others to get in touch with you.

Update your profile by logging onto Mi Society today. It just takes a few minutes and could lead to a great new connection! If you're interested in sharing an opportunity with other members on Mi Society please contact our team (**members@microbiologysociety.org**).

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Comment: The importance of becoming intelligent consumers of scientific information and COVID-19

For many years, *Microbiology Today* has been a beacon of truth in a confused world. I have personally benefitted from the range of articles and new knowledge. My horizons were widened and in turn I used the new knowledge to inspire and influence the minds of the students I help mentor.

University of Virginia student, Ms Ciara Smith, and I wish to address an important issue that has surfaced as a result of the recent pandemic that has and is impacting all of our lives.

Arthur P. Guruswamy and Ciara Noelle Smith

The effects of the current pandemic are staggering, and it is difficult for one to wrap one's head around just how extensive the implications of the disease will be. Our society and our own mental processes have become seriously addicted to social media and false news. It is a fact that the average person's trusted advisors are news outlets that are not accurately representing the disease. A frenzy of undocumented statements that you could get infected by contracting the virus from dry surfaces, the air we breathe in wide open areas, implying that the virus is flying around, is reminiscent of the early days of HIV when people, even in low-risk areas, left their jobs in healthcare-related fields for fear of getting infected. It took several years for the learning process of the facts to settle in that you could only get infected with HIV through sexual contact and blood. Unfounded COVID-19 fears have led to panic purchases of gallons of hand sanitiser by little known companies, regardless of alcohol content and irrational behaviour patterns. There has been no pause and focus on educating the public on the basic germ theory of disease. Our society has become paranoid with the frenzy of false statements – "...he said, ...she said". As a result of the daily bombardment of inaccurate statements, people have

grown to be suspicious and cynical of respected medical authorities of the likes of Dr Anthony Fauci, Dr Deborah Birx, the Centers for Disease Control and Prevention (USA), the London School of Hygiene and Tropical Medicine (UK) and the Johns Hopkins Coronavirus Resource Center global data map updated every hour (24/7) – a gold standard. Our health should be a higher priority than TV views and ratings. The fastest way to get close to normalcy will involve sacrifices by all and a trust in those who have spent their lives studying past pandemics, epidemiology and viral virulence.

In the face of this barrage, the desire to let our minds and our thinking be influenced by accurate information pales in comparison. Maybe it is time to ask ourselves the questions, "is the source of this information credible? Are statistics being used to draw in consumers and create an illusion of truth?" After all, all of us professionals are aware that a lie repeated enough times would make you believe it is the truth. For example, that COVID-19 resulted from a secret bioterrorism plot that originated in the US and then moved to Wuhan by secret agents.

We are encouraged by the fact that a mission of *Microbiology Today* is to teach all of us (who have open minds) to become intelligent consumers of scientific information to reason and understand why we believe what we believe – now more than ever before. Perhaps we should consider distancing ourselves from individuals, news outlets and so-called 'journalists' who try to instill fear in us with undocumented irrational statements that cannot be proven so all of us could become intelligent consumers of scientific information.

Arthur P. Guruswamy

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Reviews

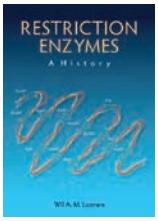
Read excerpts from the latest book reviews below. To read the full reviews, and for more reviews, please visit our website: **microbiologysociety.org/MTOct2020Reviews**

Bats and Viruses: Current Research and Future Trends

Edited by Eugenia Corrales-Aguilar & Martin Schwemmle
Caister Academic Press (2020) £159
ISBN: 978-1-912530-14-4

This book was a very interesting read, especially during the current SARS-CoV-2 pandemic. There are around 1300 species of bats covering all parts of the world (expect Antarctica), carrying more than 200 known viruses. I believe this book would be most useful to students, undergraduate and postgraduate, in both medical and veterinary backgrounds, although at £159 I doubt many would be able to purchase it.

Lauren Kerr
University of Cardiff, UK

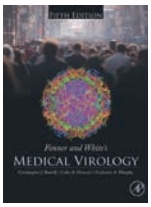


Restriction Enzymes: A History

By Wil A.M. Loenen, Leiden University Medical Center
Cold Spring Harbor Laboratory Press (2019) Free
ISBN 978-1-621821-05-2

Last year I published a book on R-M systems and their impact on molecular science and society. Restriction enzymes scan the DNA via sliding or "hopping, jumping or looping", and cutting is under very tight control. These studies revealed surprising mechanisms for DNA recognition, restriction, methylation, but also "molecular motor" activities (DNA translocation), and finally, usage of the cofactors ATP and S-adenosylmethionine (SAM) with their myriad functions in health and disease.

Wil A.M. Loenen
Leiden University Medical Center, The Netherlands

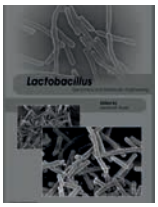


Fenner and White's Medical Virology (5th Edition)

Written by C. J. Burrell, C. R. Howard & F. A. Murphy
Published by Academic Press (2016) £69
ISBN 978-0-123751-56-0-5

The medical virology field is very fast moving, so it is surprising that it has taken 22 years to publish this new edition. However, it was well worth the wait. There have been several virology textbooks published recently, but this one stands out for me because, as the title indicates, it focuses on medically important viruses and, despite it containing a large amount of detail, it is presented in a very clear and attractive way.

Christopher Ring Middlesex University, UK



Lactobacillus Genomics and Metabolic Engineering

Edited by Sandra M. Ruzal
Caister Academic Press (2019) £159
ISBN: 978-1-910190-89-0

Chapter one discusses how this genus interacts with different environments. The next chapter focuses on the genetics and genomes of meat fermentation starter (*L. sakei* and *L. crispatus*), describing their biotechnological potentials. The ability of lactobacilli to utilise complex carbohydrates gives them advantages. The pathways of complex glycan dissimilation are colourfully illustrated in chapter three, enhancing the readers' comprehension.

Omololu Fagunwa University of Huddersfield, UK

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