DECEMBER 2019 | VOL. 20 NO. 4 | ISSN 1479-2699

microbiologist

sfam society for applied microbiology

microbiologist

Editorial Group

Society for Applied Microbiology
LABS, 90 High Holborn, London
WC1V 6LJ, UK

+44 (0)20 3880 2881
communications@sfam.org.uk
www.sfam.org.uk

Copy dates

Vol. 21 No. 1 March 2020
Wednesday 8 January

Vol. 21 No. 2 June 2020
Wednesday 8 April

Vol. 21 No. 3 September 2020
Wednesday 8 July

Vol. 21 No. 4 December 2020
Wednesday 7 October

Society office staff

Executive Committee

Microbiologist is published quarterly by the Society for Applied Microbiology, a registered charity. ISSN 1479-2699.

Microbiologist starts its digital journey

The time has arrived for *Microbiologist* as this will sadly be the final print edition. At the start of 2020, *Microbiologist* will join the legions of other digital-only publishers. We're losing the paper, the touch, the smell and the romanticism of the finished printed edition. But hopefully, we'll find new ways to communicate and create cleaner and more bite-sized forms of information.

Like *Microbiologist*, almost all magazines will eventually go purely electronic. We made the decision to turn this magazine digital two years ago. Although the physical magazine is well-loved, the distribution numbers just do not justify the cost financially or environmentally. We post between 180 and 230 print copies out to members of SfAM and print just a further 250 for conferences, many of which remain in the boxes they were delivered. The electronic versions of *Microbiologist*, be these downloadable PDFs or those obtained via publishing platforms, are read by up to 11,000 people.

A staggering statistic.

Information transmitted via electronic and print media is consumed differently; there are psychological boundaries to a printed edition. A start and finish. A collection piece. I will miss the satisfaction of creating this – especially receiving the dummy edition before it goes to print. It makes me feel like Meryl Streep in *The Devil Wears Prada*.

But mostly, I am excited to move on to the next thing. The digital reading experience makes one want to connect and expand outward and throughout 2020 we will be looking at ways to take advantage of this. I'm sure most of us have found ourselves in a 'Wikihole', going from one page to the next, prompted only by a sentence or word in the previous page. Only last week I went from Jennifer Aniston to *Dante's Inferno*, via Thor's hammer *Mjölnir*.

We expect that *Microbiologist* will still be consumed as it currently is but will soon provide an additional platform that will include direct links to podcasts, videos, journal articles and further articles. We hope to send you on your own microbiological information journey directed by your own imagination.

For those who do not want to end up in 'holes' and simply wish to dip in and out, we will be introducing 'Most-read' and 'Most-popular' articles via the SfAM website.

As content communication shifts to purely digital, the onus will lie on those working on *Microbiologist* to ensure our website and tablet and smartphone applications are developed in such a way as to provide our readers with the most comfortable reading experience possible.

In this issue I would take a stab at guessing that the 'Most-popular' article will be Patricia Hunter's *Does the placenta have a microbiome?* found on page 22 and the 'Most-read' will certainly be the ECS Symposium 2020 advert on pages 12 to 13. So, have a very happy Christmas and treasure this final print copy, but keep your inbox open for the digital version being delivered in March 2020.

Paul Sainsbury
Editor

We have adopted a more inclusive and transparent approach to all aspects of our work, to ensure we are genuinely involving all the right people

Lucy Harper

Chief Executive of the Society for Applied Microbiology

News

Features

Must-read Articles

People & Places

Education & Public Outreach

Industry

Policy & Public Affairs

Society funding: bridging gaps

For those of us who are in academia, the new academic year is in full swing and the new intake of students have started to settle in. We also need to consider the 'other end' of the process where there are new graduates leaving our learned institutions educated but not necessarily fully trained.

This has long been a point of discussion at the interface of academia and industry, in that the workplaces often make the case that graduates are not fully trained after their degree courses. In contrast, academia might well argue that its role is not to train staff but to educate people in a given subject area and teach transferable skills such as problem-solving and data analysis.

So how can SfAM potentially help with at least part of this problem? Simply put, by offering funding opportunities. This of course will not fully answer the scenario I have laid out but there are ways in which members, both academic and industry based, can apply for funding that can assist people to gain some experience, be trained in new/different techniques and facilitate meeting attendance. There are also grants that provide funding for care support and new lecturer support grants that give new academics the chance to gain some funding to start research in their first substantive academic post.

We also have the ever-popular Student Placement Scholarship, which perhaps comes closest to addressing the points I raised regarding experience and training. Whilst this grant does not facilitate the production of fully trained graduates, nor should it, it does afford the opportunity for undergraduates and recent graduates to gain some hands-on experience in a relevant laboratory. Interestingly, as someone who sits on the awarding panel it is fantastic to see the range of different areas within our discipline of microbiology being offered to undergraduate and graduate microbiologists (regardless of age!). This grant gives the chance for the recipient to work in a microbiology lab on an ongoing project, learning techniques, gaining experience, putting what they have learnt into practice and taking a further step towards being the sort of microbiologist that could be more attractive to an employer or who has potentially developed some skills that will help them progress through their chosen career path.

To finish, I feel we have to mention the SfAM PhD studentship. This was a grant I championed a number of years ago and we are one of the few learned societies that offer this sort of funding opportunity. This grant has recently been renamed the Basil Jarvis PhD studentship in honour and recognition of the passing of the great Professor Basil Jarvis, who was a great supporter of not only the Society but also the younger members and their ongoing development. So, in closing, I think it is important for us to recognise and indeed celebrate the funding the Society can offer to help promote and develop microbiology. Please take some time to navigate to the grants page and see what is available, how it applies to you or your work and see if we can support you.

Mark Fielder
President of the Society for Applied Microbiology

An open door for talent

This year has been another exciting and transformative year for the Society, with much of our activity having one thing in common: inclusivity. We have begun to put into practice the recommendations that came from the Society's 2018 Governance Review.

We have adopted a more inclusive and transparent approach to all aspects of our work, to ensure we are genuinely involving all the right people. This includes the processes we use for the recruitment and appointment of trustees and officers. We had an unprecedented number of nominations to fill our trustee vacancies this year and I've no doubt that this was as a result of a more inclusive approach, which has genuinely encouraged a wide participation.

We continued the theme of inclusivity through our partnership with the Federation of Microbiological Societies at their Congress. Those of you who weren't able to attend will have missed all the elements of the SfAM Annual Conference, within a much larger event. The Congress hosted fascinating science, including Vaccines, a one-health approach to AMR and antibiotic removal during waste water treatment. But of equal importance were the incredibly useful sessions on non-science subjects such as LGBT+ in STEM, STEM in Africa and Diversity and Inclusion.

Many of these sessions were the brainchild of our General Secretary, Dr Clare Taylor, who ensured all aspects of diversity in science were discussed and, at times, strongly debated. Working with FEMS was a very collegiate and supportive experience for us all and a mutually beneficial arrangement highlighting the true benefits of a collaborative approach.

Microbiology is Diverse is the subject of one of the Society's strategic campaigns and during 2019 we have used a diversity-and-inclusion framework to ensure we are widening participation in an authentic way. We have committed to:

- Ensure diversity and inclusion within our staff, trustees and committees by creating equality of opportunity and promoting good practices that support everyone.
- Draw from the widest possible pool of talent when inviting speakers and chairs for our scientific meetings.
- Support our members through the provision of grants, monitoring the accessibility of our meeting venues and through the work of our Early Career Scientist Committee.
- Work with the Royal Society of Biology and our partners in the learned society sector to support and promote schemes for diversity and inclusion.

If you are reading this and wondering whether or not to put yourself forward for any of the positions on our subcommittees, as a trustee or to contribute to any aspect of the work we do, I would suggest you get in touch – the door is always open.

Lucy Harper
Chief Executive of the Society for Applied Microbiology

ECS 2020: beyond the next generation

As 2020 rapidly approaches, I find myself wondering how it came so quickly? It used to seem like a very futuristic date and yet it is nearly upon us. Nonetheless I can now take the opportunity to talk about some exciting new developments within the ECS that keep our future looking bright.

Firstly, the excitement as the committee continues to expand with the introduction of several new roles and four new members. The new members are Kate Bamford (Policy Officer), Nasmille Larke-Mejía (Welfare Officer), Joseph Kirk (Podcast Editor) and Elitsa Penkova (Undergraduate Officer). Additionally, the new role of Social Media Officer has been introduced, and the Policy Officer and Undergraduate Officer roles have expanded to include more than one person. I can't wait to see how everyone gets on in their new roles and I hope they really enjoy them.

With the new roles and members introduced, it's time to focus on our next symposium. On 18 March 2020, we will be running the 9th Early Career Scientist symposium at Mercure Holland House, Cardiff. The ECS event is aptly named *Beyond the next generation* with a workshop to focus on new challenges facing the next generation of scientists and techniques to tackle them. I can't wait for the event, as I'm sure it will help to empower and inspire early career scientists to make a difference and improve the future, similarly to how young people are standing up for the environment.

At the ECS symposium we will also have a number of keynote speakers including Miriam Gifford, who will kick off with a presentation on '*How to fail in academia*' and the synthetic biologist Tom Ellis, talking about his project to build a synthetic yeast chromosome. We will be confirming further keynote speakers on the SfAM website. The programme is set to have a range of different topics and so I hope we will have a record turnout for our event. The symposium will also include the usual ECS presentations and a video from an international member. I would encourage all ECS members to apply and present us with their wonderful work in poster or verbal form.

Reflecting back on 2019 my take-home message is that we can all make a difference; we just need to educate others about what we believe in and hope they will agree and help us spread our message – an opportunity our symposium can provide.

Alli Cartwright
ECS Communications Officer

We would like to warmly welcome the following

New members of the Society

Australia
O. Olukomaiya

Austria
A. Cabal Rosel

Brazil
L. I. Igbojionu

China
F. Hong
T. Ma

Egypt
H. Nassar

France
D. Jurenas

Ghana
A. O. Forson

Iceland
E. M. Ingvadottir

India
G. Mittal
R. Nachimuthu
M. Saraf

Ireland
H. Gibriel
C. Murphy
T. Narancic
A. B. Soro

Isle of Man
S. Chadwick

Malaysia
N. A. Md Noh

Nepal
N. P. Awasthi
B. Dhakal
Y. Metok

Nigeria
O. Adeoyo
A. C. Agbasi
T. Agboola
B. Akinyemi
T. Atanda
O. Bakare
G. Bamigbade
H. Emifoniye
C. Ezebialu
I. Ezeonu
B. Fabunmi
M. Falana
Y. Ibitoye
A. Isirue
E. Njoku
C. Obi
V. Odumu
A. Ogunlade
O. Ojo
C. Okafor
A. Olajide
F. Olisaka
E. Olotu
B. Oluremi
N. Oluyele
S. Opaleye
O. Owoyemi
O. Oziegbe
P. Ozolua
O. Taiwo
B. Thanni
N. I. Usman

Republic of Korea
C. Cha

South Africa
C. Edomaodu
A. Fadiji
O. A. Fasusi
A. Vanya

Sri Lanka
P. Premadasa

Thailand
O. Olatunde

United Kingdom
S. Adu
R. Allan
A. Armstrong
J. Barnett
C. Brown
J. Connolly
T. Currie
S. Dawson
P. Dean
I. Diez
C. Doherty
Z. Dyson
A. Dziegiel
B. Fahnert
C. Frapwell
J. Freeman
C. Ganacias
C. Grantham
J. Henderson
E. Hoynes
C. Ioannou
M. Keith-Baker
T. Klein
C. Lamb
M. Lewis
L. Lloyd-Badham
S. Maleki-Toyserkani
L. Mane
J. Maybin
M. McAteer
E. McStay
A. Midya
E. Mohit
J. Nelthorpe-Cowne
J. Newitt
C. Nwakire
M. C. Ospina
A. Patel
S. Purnell
N. Rahim
S. Rashid
M. Richards
V. Rimmer
K. Robins
S. Salami
V. Sibanda
H. Stuart-Moonlight
J. Taylor
J. von Gerichten
C. Walker
L. Walsh
A. Waterfield
S. Went
T. Wilkinson
Z. Wilkinson
R. Will
C. Wright
M. Wylie

United States
M. Bergkessel
S. Bowden
J. Sivils
G. Zhang

What you get for your membership

Conferences
> Attend and participate in our conferences and meetings

Funding and grants
> Over £265,000 worth of grants awarded last year

Policy and voice
> Have your say on industry issues and stay updated on the latest news

Career development
> Engage with your peers and contribute on one of our committees

Magazine and journals
> Free access to all issues of our five journals and quarterly magazine

Discounts
> Up to 70% off events, books and membership

Community
> Over 2,600 members worldwide

Free gifts
> Receive small tokens of our appreciation

Awards and competitions
> Prizes to celebrate your achievements

Sam Westgate: outside looking in

The phrases I hear the most when asked about my career are 'Wow, that's really impressive' and 'You must be so clever'. Neither are true, unfortunately. I am just 'having a go' and learning from my experiences along the way, just like everyone else.

The early years

My early academic journey and grades were good but not exceptional. I decided on a degree in Animal Science at the University of Leeds but remained unsure about the direction of my future career. Following my degree, I decided to travel! Over 12 months I explored Thailand, Australia, Bali and New Zealand. During this experience, I realised something pivotal. If I could move to the other side of the world, get a job and make a life for myself, I could do an even better job in my home country.

Cutting a long story short

After returning from travelling I completed an MSc in Equine Science and a PhD in Equine Wound Healing at the universities of Aberystwyth and Liverpool, respectively. Still unsure of the career I wanted, I began looking for a 'real job'. My work experience consisted of various hands-on jobs, which proved invaluable to growing my own business.

Finding the opportunities in adversity

Starting my career proved challenging; often overlooked for more commercially experienced candidates, having only academic experience meant my options within industry were limited. I wondered whether I should quit science altogether and pursue other avenues. Fortunately, an opportunity arose with a start-up microbiological research company. It was here I first relished being in the business world and applying my science knowledge.

A new beginning

Noticing a gap in the market, I sat down to write my own business plan. I found investors willing to review my ideas and was pleasantly surprised when, in 2013, they agreed to co-invest in my company – Perfectus Biomed Limited, specialising in commercial biofilm testing (then an untapped niche within microbiology).

To date, Perfectus Biomed has achieved 30–60% financial growth each year and continues to grow by offering new

Samantha Westgate
Perfectus Biomed

services to additional sectors. Hands down, our successes are due to our brilliant team, and the biggest challenge I have faced is learning how to inspire, challenge and lead our ever-growing team. We train and encourage the sharing of knowledge, with internal progression being our objective.

I was fortunate enough to be selected for the Goldmann Sachs *10,000 Small Businesses* programme, which has been integral to my ability to dream bigger, consider multiple business elements and make decisions with growth in mind.

Expelling some myths

You need to be a millionaire to set up a science company

The government is supportive of businesses that commercialise novel science. I was able to set the company up with a modest overdraft.

Setting up a company is difficult

Setting up a company is easy – yes, easy – however, building and growing the company brings the real challenges.

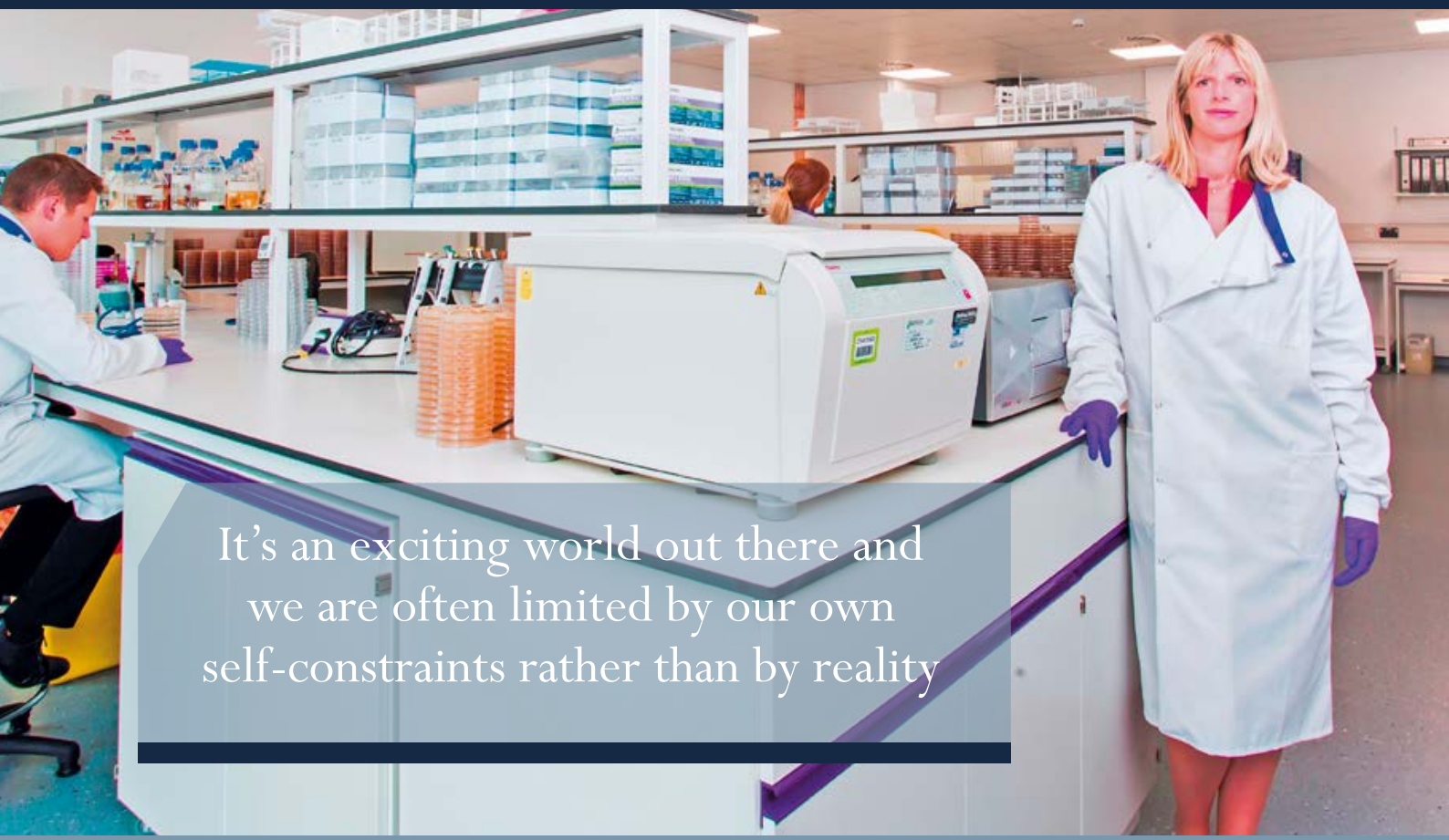
- Being your own boss means you get 'all the holiday you want' or 'to make all the decisions'. Sure, you get to make the big decisions; however, most of the business owners I know work longer hours, take fewer holidays and sometimes even take less remuneration in the early days.

Three things I think we have done well

- I think having a science PhD has been a huge help. When the company was starting out, I was able to be the chief executive, the business development manager and the credible technical specialist.
- Focusing on company culture – I consciously decided to recruit on culture over skills. Obviously, a certain educational level is a prerequisite for a career in science; however, we believe that developing skills in the right individual is much more effective than trying to change an individual's inherent values.
- Questioning the norm. Just because something has been done in a certain way previously doesn't mean that it's the best way to do it. We encourage progressive thinking and continual improvement throughout the company.

My words of wisdom

Hard work and honest reflection are paramount in realising the goals you set out to achieve. I didn't begin with a huge investment, just a concept. I had a willingness to learn and a drive to succeed. It's an exciting world out there and we are often limited by our own self-constraints rather than by reality.



18 MARCH 2020 | THE MERCURE HOTEL | CARDIFF

Early Career Scientist RESEARCH SYMPOSIUM 2020

The Early Career Scientist (ECS) Research Symposium is a popular microbiology conference organised by the SfAM ECS Committee. The symposium is an encouraging environment of mostly student and early career scientist delegates, specifically catering to those who may have not experienced a conference before. This symposium is for all early career scientists with applied microbiology-related occupations and studies.

Early Career Scientist Oral Presentations

60-second Flash Presentations

Poster Sessions

The annual event, which started in 2010, hosts keynote speakers, workshops, student talks and poster presentations. Keynote talks highlight current issues and the latest microbiological developments. The symposium is also a forum to meet potential employers and for those who wish to exchange and share their experiences, ideas and research.

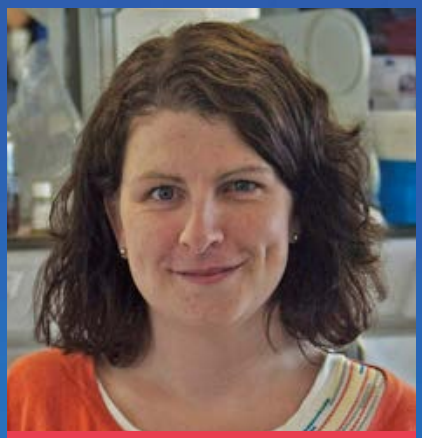
THE SfAM ECS COMMITTEE LOOK FORWARD TO SEEING YOU – AND YOUR SCIENCE – IN CARDIFF NEXT YEAR!

Professor Julian R Marchesi
Cardiff University

Denver Russell Memorial Lecture

Professor Tom Ellis
Imperial College London

A synthesis-based library approach to engineering gene regulatory networks



Dr Miriam Gifford
University of Warwick

How to fail at academia

Workshops

Delegates will be split into four different groups and given a microbiology issue. They will then rotate around four different stations to learn how to communicate this issue in four different contexts. The stations are:

Making an impact: when microbiology and policy collide

Dynamic presentation skills for microbiologists

Sci Comm: don't just dumb it down

Writing the perfect science press release

Registration Fees

SfAM ECS undergraduate members	FREE
SfAM ECS members	£25
SfAM members	£50
Non-members	£95

The symposium will offer a light lunch and refreshments for all delegates. Please help ensure the symposium's success by registering as soon as possible.

Submit your abstracts now via www.sfam.org.uk and apply for up to £100 travel grant.

Undertaking research in difficult-to-reach locations

Elaine Cloutman-Green
UCL Great Ormond Street Institute of Child Health, London, UK

I've recently been spending time putting together a large clinical trial to be undertaken in West Africa. It's the first study of this scale that I've been involved with and it's big! We're looking at recruiting all children born over a three-year time period. We are also trying to set up not only a research lab to process the samples but a clinical laboratory to support local diagnosis within study patients.

During this process a lot of things have been involved that I had never thought about in the same way when working in the UK; for one, I've never been on a grant that included costs for 200 motorbikes and 6 jeeps! Here are a few items that I have spent some time thinking about that I may not have been aware of before this process began:

Ethics

Within the NHS we spend a lot of time discussing ethics but there is definitely a different dimension when undertaking studies that include a whole country. Is the work going to benefit the country where that work is being undertaken? Or are you merely undertaking the study there because it is cheaper or easier to recruit than it would be to undertake the same study in the UK? One of the very interesting issues is about reimbursement for additional patient samples and whether in a resource-poor setting you are effectively buying recruitment. I'm far from an ethics expert but this is an area that if you are designing a study needs expertise and preferably from the country that you will be working in.

Transportation

As a clinical microbiologist, I'm used to being concerned about the amount of time samples take to reach the laboratory and what that does to test validity. When taking samples in a village six or more hours from a local transport hub this issue becomes so much more complex. Not only do you need to move samples around in an appropriate temperature-controlled fashion, but you also need to get all of your equipment and consumables out to where you are working. Even buying a –80°C freezer to store your samples becomes less easy as it needs to be bought and shipped, raising the cost from £8,000 to £25,000.

This process has raised important questions for me as a microbiologist. We spend a lot of time in the UK setting standards for sensitivity, specificity and specimen quality. What happens if you cannot deliver testing to the same standard because of the conditions? When choosing your

> I've never been on a grant that included costs for 200 motorbikes and 6 jeeps!

testing algorithms and sample selection it is essential to choose methods that are robust to the challenges that transportation will impose. Choosing reagents that are stable at room temperature, if possible, or that will be stable until they can reach a centre that will have the equipment to store more appropriately. It is also important to consider whether you will set up a system so that local teams will deliver sampling packs, where everything has been put together in single-patient packs. This means that items are assembled and then shipped ready to use to make local logistics easier to manage.

Security

Not every country that would benefit from a clinical trial is considered to be safe by the Foreign & Commonwealth Office. One of the challenges in the current study I've been involved with is how much time you allow for periods of unrest that mean the study has to be halted until it is safe for staff to resume. I've also never had to investigate the cost of kidnapping insurance or having a security team during visits. As someone who will be hiring postdocs and PhD students to undertake work in this environment it is

incredibly important to be aware of the situation you will be asking staff to work in and to have strategies in place to manage security risks. Not something I usually face when planning a study in Camden.

Resources

One of the issues I was aware of before getting involved with planning a study overseas was that there might be resourcing issues. I had thought a lot about issues with power that might affect freezers, fridges etc. What I hadn't really thought about was issues with water. It was only when trying to plan a clinical laboratory that I suddenly started to think about how I would undertake Gram stains without access to a staining sink. How do you undertake cleaning of lab equipment or even make up reagents?

The other resource I hadn't given enough thought to was people. We often don't think of people as a resource but they are, and they are essential. If you are planning a project overseas then it becomes apparent that you don't necessarily know what skill sets scientists may have. If, like me, you've only worked in the UK you know what the healthcare science training includes and what a PhD is like. When considering working with overseas teams you have to learn what that local training is going to have included so that you can develop protocols appropriately, or develop training programmes.

Legacy

Finally, legacy planning. One of the big problems with laboratories that were set up during the Ebola outbreak in Sierra Leone was that the legacy planning for equipment in those laboratories was not central to the planning process.

This meant that a lot of the equipment could not be used long term, after teams left, due to consumables being too expensive to import or requiring maintenance that could not be undertaken locally. It is crucial when planning to develop a project outside of emergency settings that the legacy of the work is planned into the project.

Legacy planning can undertake many different forms. It may be the skills that are developed locally or it may be related to infrastructure; ideally it should be both. It's not as easy as it sounds however. If you have a team of three local scientists that you train during the project you need to give thought to how they will train and embed that knowledge with others before the end of the project, so that the knowledge doesn't move on if they do at the end of the work. For infrastructure, if you are buying generators to run the laboratories, how do you ensure that there will be enough spare parts and the knowledge to maintain them once the study ends? Do you plan your study as a one-off, or is the plan that you develop the infrastructure with the primary round of funding, with a legacy plan of continuing to work in the area and encouraging others to do so?

My experience so far has been that planning a research project in a difficult-to-reach area has many unique issues that make the process challenging but also enriching to be part of. It has been fascinating to work in an area where the science and clinical aspects are critical but far from being the sole aim of developing the project. Rethinking your science to ensure high-quality delivery outside of your normal work setting enables you to think outside the box and rethink your normal practice and why you do things in specific ways. This reflection has huge benefits and I would highly recommend stepping out of your comfort zone to get involved in this kind of work.

We spend a lot of time in the UK setting standards for sensitivity, specificity and specimen quality. What happens if you cannot deliver testing to the same standard because of the conditions?

The difficulties of shipping to and from countries experiencing infectious disease outbreaks

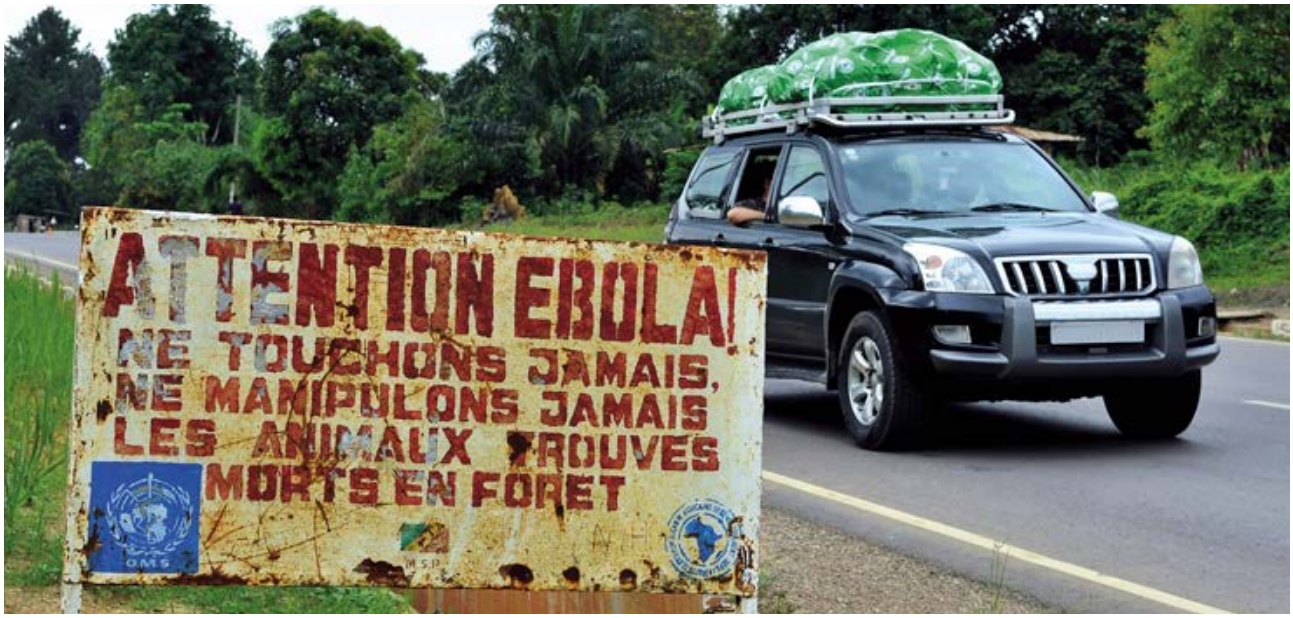
Sue Lee
Hexagon Supply Chain, UK

I have been shipping dangerous goods including patient samples for over 30 years, to or from 191 countries, so far. She is a fully qualified dangerous goods trainer with experience of cold-chain shipping, hazardous waste management, security and quality systems. She is passionate about supporting developing-world technology initiatives and committed to finding better ways for patients to become educated about clinical trials.

According to the World Health Organization (WHO), the current Ebola outbreak in the Democratic Republic of Congo (DRC) is the second largest on record. In the last 14 months there have been more than 3,000 cases and two-thirds of patients have died.

The transport of patient samples within domestic borders during an outbreak can be extremely challenging and there are many misconceptions about how samples need to be treated, particularly in rural areas. This lack of knowledge has led to unsafe but pragmatic practices that have seen local coordinators sending blood samples packed in plastic bags, crisp packets and Tupperware boxes, breaking all the regulations for transport. Inappropriate packaging and handling exposes personnel to substantial risk and increases the chances of exposure to the virus itself.

International and domestic regulatory requirements exist to keep everyone in the transport chain safe. However, arranging the transport of materials into and out of outbreak regions is problematic at best. Flight schedules may be reduced into affected areas, as was seen during the outbreak in 2014 in Guinea, Liberia and Sierra Leone. According to the Official Airline Guide (OAG), out of 590 monthly scheduled flights to the three countries, 216 were cancelled at the height of the outbreak. The lack of



available flights, particularly from Europe, created significant issues for the supply of medicines and the transport of patient samples to international labs. The DRC is currently experiencing similar problems accessing supply. The difficulties of domestic distribution of measles vaccine and other factors have led to a measles epidemic, and deaths exceed those from Ebola.

When international cooperation and testing is needed, the reliable and time-critical transport of samples is vital. Samples from, and materials that have been in contact with, patients confirmed or suspected of suffering from Ebola and similar diseases need to be sent as Category A (an infectious sample, which is transported in a form that, when exposure to it occurs, is capable of causing permanent disability, life-threatening or fatal disease in otherwise healthy humans or animals). An indicative list of relevant diseases is published by the United Nations and utilised by all modes of transport. Infectious substances meeting these criteria, which cause disease in humans or both in humans and animals, must be assigned to UN 2814.

Moving infectious materials needs planning to ensure everything is in place before drawing blood, or collecting

More information is available from the author

sue@hexagonsupplychain.com

or from the International Air Transport Association

https://www.iata.org/publications/store/Pages/infectious-substances-shipping-guidelines.aspx

This lack of knowledge has led to unsafe but pragmatic practices that have seen local coordinators sending blood samples packed in plastic bags, crisp packets and Tupperware boxes, breaking all the regulations for transport

and processing sera and excreta. Samples are packaged following packing instruction 620. This employs a triple leakproof layered system, including cushioning and absorbent materials. The packaging is required to undergo extensive tests, including a nine metre drop test, water conditioning, temperature adjustment, stab tests, pressure tests and stacking tests. These are the most extensive requirements for any dangerous goods shipping. There are no local manufacturers and no local testing facilities. All packaging needed for shipping patient samples, environmental samples, clinical waste etc. has to be imported. These supplies must be distributed and clinical staff must be instructed in their use. Full personal protective equipment (PPE) must be used to pack all the samples, taking into account imposed quantity limits, based on whether they will fly on a passenger or cargo aircraft. Detailed content lists, export paperwork and dangerous goods notes all need preparing by trained staff. Boxes need to be fully labelled with compliant hazard labels, and checks made as to whether relevant permits are in place at the destination. Temperature control media, liquid nitrogen, dry ice, gel packs and phase-change materials are either scarce or non-existent locally. Fridges and freezers are likely to be under extreme pressure at clinics and hospitals, so storing samples prior to shipping, even if the required packaging is in place, is rarely straightforward.

Assuming that all these challenges are met, the boxes prepared and the paperwork finalised, finding a courier or freight service to transport the samples is no easy matter. There is an intrinsic fear of the word 'Ebola' amongst the general public, and drivers and airline handlers are no exception to this, to the extent that the name of the disease is no longer marked on packages. Speciality couriers and airlines have become increasingly risk-averse since the 2014 Ebola outbreak, in no small part because of the perceived threat of bioterrorism, and both are concerned about the possible ramifications of an incident happening (a spillage and contamination) and rapid reactions of the world stock markets and their corporate shareholders. Their reticence to ship extends to any shipment originating in an outbreak country and is not restricted to biological materials.

Many shipments end up waiting for charter flights arranged by agencies like the Centers for Disease Control and Prevention (CDC) and WHO. There is a misconception that they are somehow exempt from the regulations if they travel under these circumstances, but this is not the case. Holding shipments to await charter flights is generally not an option. Shipments need to travel on regular flights, using specialist freight options. It can be useful to involve (where appropriate) the WHO, CDC or big pharma to expedite consignments as they are likely to have more influence with the airlines and speciality providers than academic institutions or individual hospitals.

Does the placenta have a microbiome?

Patricia Hunter
University College London, UK

The most common complications of pregnancy involve developmental and functional abnormalities of the placenta. Pre-eclampsia (PE) is thought to be the maternal response to signals released by a stressed placenta.

Foetal growth restriction leading to the small for gestational age (SGA) infant is thought to be a consequence of placental insufficiency. Spontaneous preterm labour leading to birth may have arisen as a mechanism to deliver the foetus from an unfavourable environment. Histological examination of preterm placentas and membranes from early (<34 weeks completed gestation) spontaneous preterm births (SPTBs) has found that 80% have chorioamnionitis, which is the infiltration of the chorionic (foetal) layer of the placenta and extraembryonic membranes by maternal neutrophils.

In the premicrobiome era, culture of placental samples produced a link between histological chorioamnionitis and the presence of bacteria that was tenuous at best. Histological detection of bacteria using Gram and other staining methods also lacked sensitivity and specificity for pregnancy complications except for known placental pathogens such as those causing malaria, listeriosis and toxoplasmosis.

High-throughput sequencing has enabled the concept of a microbiome where organisms that share regions of DNA sequence identity can be identified and their abundance and diversity relative to each other can be quantified. The great boon of this technique was that organisms that couldn't be cultured or seen under the microscope could now be studied over time and in relation to their environment and the health of their host. However, even within the bacterial kingdom, no sequencing strategy of a single gene was able to capture all relevant taxa. Furthermore, the influence of other microbes such as viruses, yeasts and parasites were excluded from the picture.

FURTHER READING

Redman CW, Sargent IL, Staff AC. Making sense of pre-eclampsia – two placental causes of pre-eclampsia? *Placenta* 2014; 35, S20–25

Al-Adnani M, Sebire N. The role of perinatal pathological examination in subclinical infection in obstetrics. *Best Practice & Research: Clinical Obstetrics & Gynaecology* 2007; 21(3), 505–521

Brabin BJ, Romagosa C, Abdelgalil S, Menéndez C, Verhoeff FH, McGready R, Fletcher KA. The sick placenta – the role of malaria. *Placenta* 2004; 25(5), 359–378

de Goffau MC, Lager S, Sovio U, Gaccioli F, Cook E, Peacock S. Human placenta has no microbiome but can contain potential pathogens. *Nature* 2019; 572, 329–334

Nevertheless, much has been learned about bacterial communities in human mucosal sites such as the gut, the skin, the mouth and the vagina. The difficulties arise when the niche of interest harbours very little or possibly no bacteria at all. Gene amplification and sequencing methods are very sensitive and will detect traces of DNA in the air, reagents and container surfaces. The placenta has an added source of contamination through contact with the vaginal mucosa during vaginal delivery. The search for the true placental microbiome becomes the search for a needle in a haystack of potential contaminants.

A number of researchers have attempted to systematically strip away the contributions of the many sources of contamination that interfere with the molecular detection of bacteria in the placenta and concluded that even in complicated pregnancies, the placenta is probably sterile. Bacteria are unlikely to be involved in the aetiology of PE or SGA. However, studies support the concept that spontaneous preterm birth, preceded either by preterm labour or preterm membrane rupture, is associated with

placental bacteria that may be the causative agent. The leading candidate of placental pathogens are *Ureaplasma* species.

This year may be the dawn of the post-microbiome era, or at least the end of the era where the microbiome is defined by sequencing a single gene. For researchers like myself who want to know what causes SPTB, this work has enabled us to focus on placental pathogens. It is not known when they arrive in the placenta. They may be present in the uterus and begin their colonisation from implantation. Are there deficiencies of the maternal immune system in affected pregnancies that permit colonisation? *Ureaplasma* species are likely ascending the cervix from the vagina. Studies are required to show whether vaginal carriage of *Ureaplasma* species correlates with placental colonisation.

Can SPTB be prevented by screening and treating for it? Should this be done before or during the pregnancy? We may be saying goodbye to the placental microbiome as a concept, but we are now much closer to understanding the cause of prematurity with high hopes for reducing the incidence.

Environmental Microbiology

Temperature dependence of parasitic infection and gut bacterial communities in bumble bees.

Palmer-Young EC, Ngor L, Nevarez RB, Rothman JA, Raffel TR, McFrederick QS. Temperature dependence of parasitic infection and gut bacterial communities in bumble bees. *Environmental Microbiology* (accepted author manuscript 2019).

Available from

https://doi.org/10.1111/1462-2920.14805

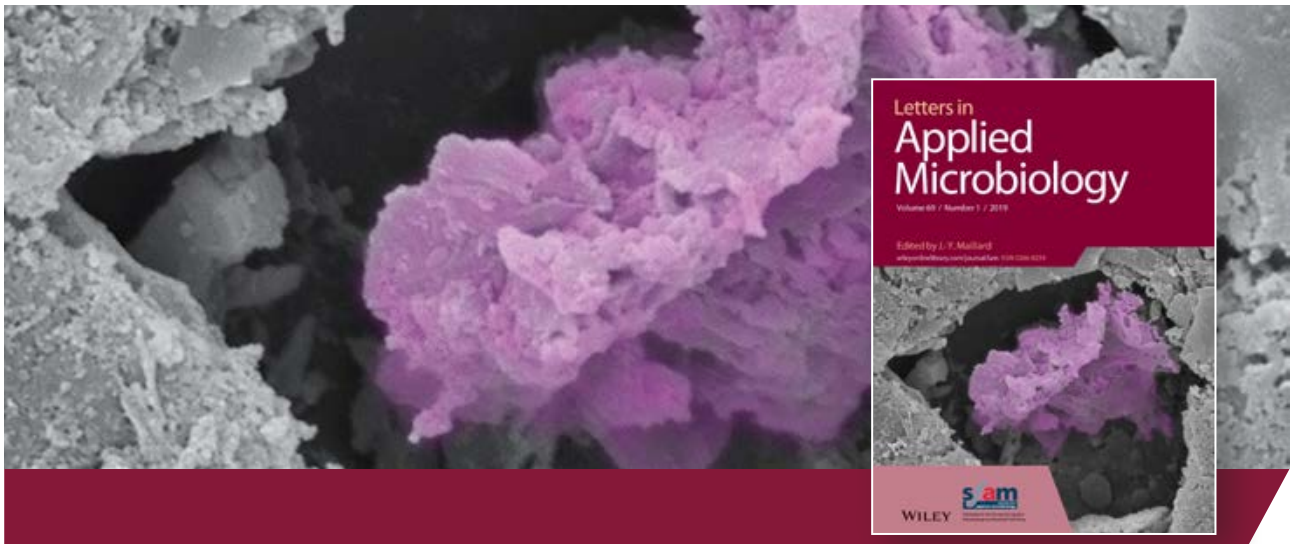
It's common to run a fever and to crave a cup of hot tea and a pile of warm blankets when you're ill. Many animals also look to raise their body temperature when infected, either by generating their own metabolic heat or by basking in the sun. Among these are insects, which like other animals can be beset by a variety of viral, bacterial, fungal and protozoal parasites and pathogens.

Few insects can rival the thermoregulatory capacity of bumble bees, which are thought to have evolved during the last ice age, and can warm their bodies and nests above 30°C, even when ambient temperatures are near freezing. The benefits of this endogenous heat generation for flight and brood development are well known – but how do high temperatures affect the bee gut microbiome and ability to fight parasites?

Entomologists at the University of California, Riverside, USA, infected bumble bees with the trypanosomatid gut parasite *Crithidia bombi*, then reared the bees across a range of temperatures to ascertain the effects of host temperature on resistance to infection and non-pathogenic gut microbes. They found that compared with bees reared at the lowest temperature (21°C), bees reared at a temperature typical of nest-building queens (37°C) exhibited an 80% reduction in gut infection. Moreover, populations of non-pathogenic gut bacteria were relatively stable across the entire temperature range, indicating that high temperatures could lend a competitive advantage to non-pathogenic bacteria that play an important role in host immunity. However, the authors point out that maintenance of such high, parasite-inhibiting body temperatures would likely require abundant access to nectar-rich flowers, which provide bees with fuel for flight and thermogenesis.

The results raise questions about the relationship between hosts and their microbiota under conditions of infection and periods of fever, and the extent to which non-pathogenic gut microbes are adapted to – or favoured by – episodes of high temperature. The study also highlights the need to know more about the interactions between fever, infection and the gut microbiome in species of conservation concern, many of which are threatened by simultaneous exposure to novel climates and diseases.

Evan Palmer-Young
University of California, Riverside, USA



Letters in
Applied Microbiology

Dental caries vaccine: are we there yet?

Patel, M., Dental caries vaccine: are we there yet? *Lett Appl Microbiol*. (accepted author manuscript 2019).

Available from

https://doi.org/10.1111/lam.13218

Dental caries, a multifactorial disease, is a very prevalent oral disease affecting 60–90% of children in industrialised countries and 100% of the adult population worldwide. It is not a life-threatening disease but has a major impact on people's daily lives and well-being due to pain and problems with eating, chewing and smiling. In addition, it restricts activities at school and work causing millions of hours of absenteeism. Treatment is expensive and has, therefore, become a public health problem. Immunotherapy with caries vaccines has also been explored because vaccines are powerful tools for public health applications, especially when there is a lack of a universally accessed healthcare system.

Caries vaccine has been under investigation for the last 40 years. Many *in vitro* and *in vivo* studies and some human clinical trials have determined many pertinent aspects regarding vaccine development. Most of these studies were conducted in the early years and showed only short-term protection. Based on these findings, research expanded to DNA/recombinant vaccines. This review publication has summarised these vaccine developments and provides future direction.

For future studies, two paths have been suggested. Firstly, to search for new target virulence genes or antigenic proteins and to develop and enhance vaccines using nanotechnology. Secondly, the best existing animal trial vaccines can be improved to the required level. Multi-expert multi-centre studies are required where the different vaccines can be discussed and compared. For example, monomeric vs. dimeric, type of adjuvants and immune promoters. Collective efforts should be placed on the most promising vaccine rather than researchers working in isolation. Further to that, human trials and further research can be conducted to establish efficacy, dosage and the protection time period. It is further proposed that to overcome the economic hurdle, funders and public health interest should be stimulated.

Mrudula Pateli

University of the Witwatersrand, South Africa

An interview with

Professor Dame Sally Davies

On 18 June 2019, Professor Dame Sally Davies was awarded the SfAM Fellowship at BMA House. Dame Sally's efforts to place the UK at the forefront of the fight against antimicrobial-resistance have been second to none, influencing government policy, helping to commission the O'Neill report and championing antibiotic stewardship.

Members of the SfAM Early Career Scientist Committee had the nerve-racking opportunity to quiz Dame Sally on a range of topics.

Phil: ***You've been instrumental in bringing AMR to the front of government and healthcare policies, and since then we've reduced the amount of antibiotics that we use. Are there any other methods you can think of as to how we can slow down AMR development?***

Sally: We have to prevent infections, so infection prevention and control, or biosecurity in the animal sector. We have to use vaccinations, both the ones we've got and develop more. There's a role for better diagnostics, clearly a role for new drugs. But I'm learning more about this. I was at a meeting in Hong Kong last week; we need to control our effluent from factories and hospitals, and run-off from farms because animals, including us, pee out 70–90% of antibiotics. So, someone was telling me they found ciprofloxacin in our Thames water that we're drinking. We've got rather a lot to do in this country, but generally across the world.

Rob: ***What's been the biggest challenge of your career so far would you say, and how have you overcome it?***

Sally: Apart from the difficult people?

Rob: Of course.

Sally: I think it is always about people; how do you engage them in the things that you think matter when there are so many issues around and, for them, how do they prioritise? You have to make it personal and make it matter to them. So that's one side – how to engage politicians to get the political push and support and impetus. But then when you're trying to make change, whether in the health system or the veterinary system, who can really help it happen? How do they do that? Where do they find the space, the resources, the money? I want to give credit to Pete Borriello here because he worked with the animal industry to have voluntary targets. I said, "I don't think it'll work, Pete". He said, "Leave me to it, it will", and blow me, they've delivered! I'll quote the poultry: 71% reduction in antibiotics over four years, an 11% rise in protein and they've done even better with the latest data we've just got. So, it is about the people. How do you persuade them they want to change; how do you incentivise them? But the world is full of difficult people.

Lucky: ***You're an inspiration to many women, being the first female Chief Medical Officer (CMO) and now the first female Master of Trinity College. What advice would you give to females starting out their career in science?***

Sally: Oh, go for it! I was interviewed for The Times about this and I talked about the imposter syndrome, and even now occasionally I think, "Oh shit, can I really do this? Will I be able to?" But someone told me after that article the

expression 'fake it 'til you make it' because the problem is in our brains, it's not in us. In general, men don't suffer from it. Though I did get a very interesting set of texts from people saying they suffered from it, and they were male. But, fake it 'til you make it, get on with it, go for it and I often say to young women 'hold your nose and jump'. If there's an opportunity, try it! What can you lose? You make a mess; you learn from the mess.

Caleb: As CMO you've been involved in plenty of policy discussions. Are there any policies that you struggle to practise what you preach?

Sally: Yes, all of them! I would love to be a couch potato, boozing good wine all the time and eating really nice food. That said, I do try and practise what I preach so I go out twice a week jogging as much as my tendons will allow (I have some tendonitis). I eat healthily and I try to eat the right amount. I do drink within the CMO low-risk guidelines, generally! I like a glass of good wine, but I've always been open about that. Living a healthy life in our environment is not easy; our environment pushes us towards unhealthy lives. I try and practise what I preach; it'd be pretty rotten if I didn't, wouldn't it?

Lucky: What do you believe is the biggest threat to human health?

Sally: After AMR?

Lucky: After AMR.

Sally: I think I'd probably go for obesity, actually. If only because the tsunami is there and it's really pushing forward. It's associated with a lot of mental ill-health; it's associated with so many other problems. So, for us I think it is the non-communicable diseases and I would put obesity at the top. I suppose you could talk about how are we going to feed the ever-increasing population, but we're going to have to change how we live, both to protect our environment but also to protect our health, and I think sustainability is going to go hand-in-hand. We should eat less meat as a population, we should eat more vegetables as a population. Doing that will be good for our health and good for the environment. I think there's a coming together about planetary health where the threats are great and only if we respond will we get better lives.

Phil: Have you come across many conflicts with scientific evidence and political ideologies?

Sally: Oh yes! It's quite interesting that early on I wanted to know what the politician's philosophy was because I thought it would make life easier. But I think politics at the moment is not philosophy-driven, so you just have to get on with trying to work through. What I've tried to do with this role is make it very evidence-based. I've tried to make my USP that it's evidence-based, what I advise. But to recognise that I can give advice, but the politician takes the decision and therefore it's evidence-informed policy, not evidence-based. I don't think evidence-based really exists, except in a nirvana. Evidence is a social construct so what you'll find is not just ministers but all sorts of people saying 'but my auntie – this happened' or 'they said this to me' or 'I read in a newspaper' and for them, that's evidence. Whereas for me, randomised controlled trials or carefully controlled lab studies is evidence and so somehow we have to work with that, and that's why I talk about evidence-informed policy. Yes, I have disagreed with ministers, I try and do it behind closed doors because for me it's important they know what I think based on the evidence. I did once threaten to resign, so it shifted but only once, you can't play that very often.

London's microbiota: squirming in Southwark

Martin Adams
SfAM President 2011–2014

It seems unlikely that an interest in the history of microbiology would bring one to the roof garret of an 18th century church in Southwark. St Thomas's Church, however, is the somewhat bizarre location of Europe's oldest surviving operating theatre, providing visitors with a chilling glimpse of the days before anaesthesia and antiseptic surgery.

In 1821, the church adjoined the end of the women's block of St Thomas's Hospital (which had been in Southwark since the 12th century), when it was decided that a new operating theatre for women would be built in the attic of the church. Until then, surgery had been performed on the ward. The attic was readily accessible from the hospital since it was already being used by the hospital apothecary for the storage and drying of medicinal herbs. Conversion to a modern operating theatre replaced part of the church roof with a large skylight and a tiered gallery was installed allowing spectators to view operations.

Surgery without anaesthesia almost defies imagination, though the novelist Fanny Burney gives a vivid picture of the ordeal in a harrowing account of a mastectomy she underwent in 1810. In such circumstances, speed was of the essence and virtuoso surgeons capable of performing an operation in minutes or less became celebrities – clearly doing rather more to merit celebrity status than appears the norm today.

One such surgeon was Robert Liston. A Scot, Liston had studied and worked in Edinburgh, at the Royal Infirmary, but he was an opinionated and abrasive man who quarrelled with the authorities and was expelled from the Infirmary, heading south to England where he became Professor of Clinical Surgery at University College Hospital, a few miles from St Thomas's.

Liston was able to amputate a leg in as little as 30 seconds and would challenge his students to time him

Liston was able to amputate a leg in as little as 30 seconds and would challenge his students to time him. Unlike many of his contemporaries, he would remove his frock coat, wear a clean apron and wash his hands before surgery and this was probably a factor in ensuring that 85% of his patients survived amputations compared with 75% at nearby St Bart's. His record, however, is not one of unalloyed success: in one amputation it is said that he severed the fingers of an unfortunate assistant holding the leg; the assistant and the patient both later died of infections, and a spectator succumbed to a heart attack brought on by his close proximity to the action, thereby achieving an unenviable 300% mortality rate in a single procedure.

In 1846, Liston was one of the first surgeons in England to use ether as an anaesthetic. Unwilling or unable to change his approach, he still performed the amputation in 30 seconds and had to show the revived patient his severed leg to convince him that the operation had taken place. One of the students in his audience at University College that day was Joseph Lister, destined to achieve even greater fame as a pioneer of antiseptic surgery.

Lister was born into a Quaker family at Upton House in West Ham. His father was a wine merchant by trade but was elected a Fellow of the Royal Society for his work on the optics of microscope design. After studying medicine in London, where he published papers on gangrene and the use of the microscope in medicine, Lister went on to become Professor of Surgery at the University of Glasgow. It was here that he was introduced to the work of Pasteur by Thomas Anderson, a professor of chemistry. Lister immediately saw the impact this would have on his own research and sought ways of destroying the organisms responsible for post-operative infection. For this, he adopted carbolic acid (phenol), a coal tar distillation product with known antiseptic properties already used in the disinfection of sewage. In an 1867 paper, Lister described treatment of the wounds in compound fractures with his new antiseptic methods and lauded 'the flood of light' Pasteur's work had shed upon the problem. He continued to promote and modify his antiseptic technique, later abandoning, for instance, his famous carbolic spray having been convinced that the principal sources of infection were the surgeon, the patient's skin and the dressings, and that the adverse effects of the caustic spray on breathing and the eyes outweighed any advantage it offered.

For his pioneering role in developing antiseptic surgery, Lister was deluged with honours ranging from a baronetcy and the Order of Merit to a proprietary mouthwash bearing his name. Perhaps the most novel tribute is a small flask of Lister's urine (passed circa 1868) on permanent display in the Hunterian Museum in Glasgow – clear and uninfected to this day, though a decidedly unhealthy-looking brown colour.

The St Thomas's operating theatre saw the introduction of anaesthesia but closed before the advent of antisepsis when, in 1862, the nearby railway into London Bridge was allowed to extend its lines across the Thames to Charing Cross and Cannon Street. St Thomas's had to move, eventually to its present site two miles upstream in Lambeth, opposite the Palace of Westminster.

At St Thomas's Church, however, with the repurposing and demolition of surrounding buildings, the operating theatre in the loft was largely forgotten. It was 'rediscovered' in 1956 when Raymond Russell, researching the history of the hospital, decided to investigate the church's attic. His only access was by placing a ladder up to an opening 15 feet above the floor of a second floor chamber in the tower. Climbing into the dark void (the glass in the skylight had been replaced with slates) he found that though some features had been removed much remained in place. Sufficient, in fact, for the theatre to be expertly reconstructed, enabling those prepared (and able) to climb the 52 steps the chance to visit a poignant reminder of how the study of microbiology has contributed to human well-being.

The Costerton Biofilm Center: exploring the field of chronic bacterial infections

Thomas Bjarnsholt [1], **Tim Tolker-Nielsen** [1] and **Michael Givskov** [1]

[1] *The University of Copenhagen, Copenhagen, Denmark*

Increasing evidence suggests that biofilms are central to many microbially induced infections, and biofilms develop on the basis of complex interactions between the microbes themselves, their surrounding environment and their hosts. In nature, bacteria often appear as sessile, matrix-embedded aggregates commonly referred to as biofilms. There is accumulating evidence that when pathogenic bacteria succeed in forming biofilms within the host the infection develops into a chronic state. The important hallmarks are development of persistent inflammation, host tissue degradation, extreme tolerance to the action of conventional antimicrobial agents and an almost infinite capacity to evade the host defence systems. The problem is growing in pace with demographic changes and the increased use of implants and medical devices. There have been profound scientific difficulties in producing new antibiotics to prevent and control biofilm infections. One major limiting factor is that the study of free-living, autonomic bacteria has provided the basis for our general understanding of microbial life. This approach does not target bacteria in their natural habitats in biofilms. Chronic infections caused by biofilm-growing bacteria are hard to diagnose and treat with the methods available. The research at the Costerton Biofilm Center (CBC) aims to increase our knowledge about biofilm infections, in order to provide knowledge-based solutions to the grand societal challenges they are posing.

The story of CBC takes its beginning when Professor Michael Givskov was hired by the medical faculty of the University of Copenhagen in 2008 with the aim of strengthening the Bacteriology Unit in the Department of Immunology and Microbiology. Before that, he and Professor Søren Molin had worked together for almost two decades to shape biofilm research at the Department of Microbiology, DTU (Danish Technical University). During the 1990s and until its break-up in 2008, the department had become an internationally recognised environment for biofilm understanding, nailing down what have later become generally accepted biofilm concepts. During that time the unstable variants of the green fluorescent protein (GFP) were developed, building a wide range of sensors that, for the first time, allowed real-time studies of cellular activity levels and gene expression at the single-cell level. Another hallmark was the first clear demonstration that quorum-sensing blockers would work as antimicrobials to attenuate pathogens and clear biofilm infections, work that was done in close collaboration with Professor Staffan Kjelleberg at the University of New South Wales (UNSW), Sydney, and initiated in the mid-1990s during Givskov's extended stays at Kjelleberg's lab. Dr Bill Costerton and Professor Niels Høiby knew each other from the mid-1980s and had become close friends and colleagues, uniting and developing their view of bacterial biofilms from their environmental and medical backgrounds. Høiby had a shared Professor/Chair position between the Department of Immunology and Microbiology (the Bacteriology Unit) and the Clinical Microbiology Department at the University Hospital of Copenhagen. Back in Copenhagen, at a biofilm meeting organised by Høiby in 1998, the Givskov–Molin team at DTU joined forces with Høiby and Costerton in what became a significant driver for promoting biofilm science in Denmark and worldwide. Costerton had an appealing way of interpreting and a lively way of explaining his understanding of the biofilm life-mode to other scientists; after-session get-togethers and dinners truly (as he used to phrase it) lubricated this. At the end of 2008, Givskov moved 18 of his employees from DTU, including Tim Tolker-Nielsen and Thomas Bjarnsholt, to the Bacteriology Unit.

In 2011, Givskov was headhunted as a research director at Nanyang Technological University in Singapore, where he was one of the movers (in an endeavour headed by

Kjelleberg) behind attracting a major grant from the Singapore National Research Foundation for the establishment of the Singapore Centre for Environmental Life Science Engineering (SCELSE) that focuses on bacterial biofilms in the environment as well as in health. Costerton got involved in SCELSE too and was in the process of accepting a 50% engagement when he was struck by a medical condition that turned out to be terminal. At the same time, Givskov was also the promoter of establishing the CBC, which was inaugurated in March 2013 with Givskov as the managing director. Shortly before Costerton passed away, Givskov received his support for naming the centre in honour of this unique scientist and friend. The key players of CBC are the Faculty of Health and Medical Sciences at the University of Copenhagen, the Department of Chemistry at DTU and the clinical departments of Copenhagen University Hospital. The main international partner is SCELSE and increased collaboration with the National Biofilms Innovation Centre (NBIC) in the UK and the Center for Biofilm Engineering (CBE) at Montana State University is in progress. Several leading biofilm experts have visited CBC as visiting professors; recently Professor Marvin Whiteley (Georgia Institute of Technology) and Professor Phil Stewart (CBE). The

collaboration between SCELSE and CBC has continued since 2011 and is highly productive, mainly due to the shared positions of Givskov as chair of CBC and Research Director for the Public Health & Medical Biofilms cluster of SCELSE. Tolker-Nielsen and Bjarnsholt have both become full professors at CBC and they are key faculty personnel and project PIs together with Høiby and Professor Oana Ciofu.

In addition to that, CBC employs approximately 30 scientists and various short- and long-term bachelor's and master's students. A wide range of expertise and skills are available at CBC and the scientists have unlimited access to experimental techniques such as state-of-the-art Zeiss confocal microscopes, both in-house and at the Core Facility for Integrated Microscopy and experimental animal facilities, situated approximately 50 metres from CBC. Facilities are also available for next-generation gene expression analysis and chemical biology approaches with high-throughput screening of chemical libraries and chemical informatics tools, which are within the wider framework of research and development related to biofilm drug discovery. With regard to that, two CBC inventions are currently in the pipeline for clinical trials in collaboration with Neem Biotech (UK) and SoftOx (Norway). CBC also plays an active role in training undergraduates, PhD students and postdocs, both national and international. CBC offers a number of courses including those available as e-learning: **https://www.coursera.org/learn/bacterial-infections**.

CBC has developed into a world-leading, microbial biofilm research facility that distinctively and progressively bases its approach on a unifying research theme, that is, to explore the field of chronic bacterial infections that are a major health challenge with large global economic and societal implications. Since the very beginning of CBC, research has focused on the interplay of bacteria with the host immune system in health and disease, including characterisation of skin and oral microbiomes in health and disease.

CBC also features a chemical biology facility including a high-throughput screening (HTS) platform for screening and biological testing of chemical compounds with the aim of developing novel antimicrobial leads that target bacterial biofilms. In close collaboration with DTU, the HTS platform is currently under expansion as an international chemical library-screening platform under the EU-OPENSCREEN initiative. Based on research of the biofilm lifecycle and c-di-GMP control, the aim is to identify novel antimicrobial targets, develop biofilm-dispersing drug candidates to dismantle biofilm-based infections, and in the long run to increase efficacy and subsequently reduce the usage of conventional antibiotics with the help of biofilm-dispersing drugs. In relation to this, CBC conducts molecular work on identifying mechanisms involved in biofilm-associated antimicrobial resistance.

CBC aims to deliver new approaches to address key challenges within medical biofilm research to generate fundamental insights into the biology of chronic infections. The research activities at CBC include basic as well as clinical research in order to generate cutting-edge and profound knowledge about biofilms.

The overall objective is to elucidate molecular mechanisms of the biofilm lifecycle, and identify novel diagnostic methods and bioactive chemicals to guide the development of biofilm-controlling drugs that can help reinstate the proper action of the immune system and promote efficient clearance of the chronic biofilm infections. The ambitious goals require novel integrative approaches that involve the joint effort of leading researchers and clinicians from complementary research fields. The knowledge gained forms the basis for the development of novel means of diagnosis, prevention and treatment of chronic bacterial

infections with the intent of improved public health and economic gain. CBC's unique infrastructure and international networks make it an international key contributor to the creation of a new generation of scientists to address the research questions of tomorrow.

John William (Bill) Costerton, in whose honour CBC is named, studied biofilms for more than 40 years. He was a man of the mountains and spent hours climbing in his beloved Canadian Rockies. His PhD was in microbiology and he wanted to combine his passion for his two hobbies – climbing and science. His first observation was when he tackled an alpine stream in the Bugaboos in eastern British Columbia, Canada. While climbing he noticed that the rocks were slippery and he observed that whereas the free-flowing water contained only a few bacteria the slippery rocks were covered with bacteria stuck in slime. In close collaboration with Høiby, Costerton pioneered the development of the biofilm theory, in which bacteria grow enclosed in a protective, biopolymeric matrix forming a 'film' that is adherent to solid surfaces (a sessile organism). He strongly promoted the view that bacteria in biofilms differ from their planktonic (free-living) counterparts. Costerton published over 700 peer-reviewed papers that provide a solid basis for the understanding of bacterial processes in environmental, dental and medical microbiology. The research led to many industrially and medically relevant breakthroughs, confirming that biofilms cause chronic infections and implant-related infections that represent one of the most difficult-to-treat types of infection in humans. He passed away on 12 May 2012.

The study of free-living, autonomic bacteria has provided the basis for our general understanding of microbial life. This approach does not target bacteria in their natural habitats in biofilms

A biofilm of interested kids: a new approach for engagement

Tracy Young
The University of Glasgow, Glasgow, UK

Career event days used to be aimed solely at high school students, aiming to re-engage teenagers in their own learning and future. However, as a STEM ambassador I have discovered that this is now a thing of the past. The new curriculum for excellence aims to challenge kids and allow them to develop as well-rounded adolescents and, as such, career days are now being given to children as young as six. When asked the cliché question of 'What do you want to be when you grow up?', kids will often dream big with doctors, engineers and scientists being common answers. The concept of a career means very little to these young kids; however, one thing remains true in their answers – they want to make an impact. Whether they want to help others and cure cancer or follow in the footsteps of their parents, they aspire to be successful.

This new approach to engage kids from a young age seems to be helping to spark enthusiasm early but is it enough? I pose this question as someone who has had the opportunity to engage with kids in both affluent and deprived areas. When speaking with kids about microbes, specifically biofilms in the context of oral plaque, I have found a stark difference in the knowledge base from each of these areas. I have been asked by young kids to talk about the impact of antimicrobial resistance to our future and whether a recent visit to the dentist to get a tooth removed now meant that they were open to infection from the 'good' bacteria in the mouth turning 'bad'. Conversely, I have also had little engagement from the same age range. The curriculum material remains similar, so where does this divide come from? Is it a confidence issue or lack of engagement from those around them, both at home and at school? Perhaps we are failing to find microbes and biofilms in this hard-to-reach place simply because we forget to 'inoculate our knowledge' there, which would allow it to 'mature' into something more.

The new curriculum for excellence aims to challenge kids and allow them to develop as well-rounded adolescents

Increasing the public's knowledge of biofilms with the aim of capturing the inquisitive nature of kids is imperative to sparking this interest. I can say, from my own experience growing up in a more deprived area, that I didn't encounter microbiology properly until I reached university. This led me to become a STEM ambassador; I wanted others who might be able to explore new interests to find them long before reaching this critical stage of their career. Widening this engagement is also critical. School visits are great but sometimes lack wider discussion. Bringing science to public spaces, demonstrated recently with a University of Glasgow IKEA event is a great way to extend participation. The public could engage with stalls in a friendly space with no pressure, which we found was an amazing way to share information with the whole family. Often the parents and older kids were just as interested as the younger ones. Perhaps, as scientists, it is our responsibility to increase public engagement so that we can start to find biofilms forming, in the shape of interested kids, in these hard-to-reach places, and inspire the scientists of the future.

Environmental Microbiology Lecture 2019

BAKERS' HALL, HARP LANE, LONDON EC3R 6DP

Robert G. Millar
Society for Applied Microbiology

Juan Luis Ramos
Estación Experimental del Zaidín

This year's Annual Environmental Microbiology Lecture, titled 'The double life of *Pseudomonas putida*: ubiquitous soil bacteria and useful microbial chassis' was delivered by Professor Juan Luis Ramos from the Estación Experimental del Zaidín (EEZ) of the Spanish National Research Council in Granada.

Professor Ramos studied at the University of Seville where he obtained his bachelor's degree, followed by a PhD on the subject of *The bioconversion of solar energy into chemical energy*. After spending several years abroad – in the Nitrogen Fixation Unit at Brighton and the Department of Medical Biochemistry in Geneva, where he started to work on the metabolism of aromatic hydrocarbons in *Pseudomonas* – he returned to Spain in 1987 to join the EEZ. From 1990 to 1995 he was Head of the Department of Plant Biochemistry and Molecular Biology and, from 1997 to 2008, Director of the EEZ. From 2013 to 2017 he was Director of the Biotechnology Programme of Abengoa Research, after which he returned to the EEZ. In 2012 he was awarded the prestigious King Jaime I Prize for his achievement in environmental research and in 2013 the Lowff Medal of FEMS for accomplishments in environmental microbiology.

Professor Ramos is an extraordinarily dedicated and enthusiastic Editor of SfAM journals: of *Microbial Biotechnology*, since its launch in 2007, and of *Environmental Microbiology* and *Environmental Microbiology Reports*, since 2008. He is also Minireview Editor and Special Issue Editor of all three journals. We were delighted to host him for this year's annual EMI Lecture on 15 October.

The lecture began by describing *Pseudomonas* – a 'cosmopolitan' bacterium that is found all over the world. *Pseudomonas putida* in particular is found in the rhizosphere and is well known for its ability to degrade hydrocarbons and aromatic molecules, which has pushed it into the forefront of the minds of academia and industry alike.

Here, Professor Ramos introduced us to his three main research themes: genomic (and pangenomic) analysis of *P. putida* strains, *P. putida* as a model system in agriculture and *P. putida* for the production of goods.

We were quickly introduced to the concept that there are many strains of *P. putida*, and they fill a variety of ecological niches. To look at the genetic variety of all these different strains, Professor Ramos employed pangenomic analysis – a way of comparing multiple genomes from similar organisms and finding what they have in common (the 'core' genes) and what they have that makes them different (the 'accessory' genes). The core pangenome contains much of what you'd expect – genes for survival, housekeeping and stress resistance, but also contains genes for adhesion and chemotaxis. What this means is that all *P. putida* strains so far characterised form biofilms and are mobile.

The accessory pangenomes of different strains are what make them unique – and this is where we often find genes for the degradation of hydrocarbons and aromatics. An exciting feature of these accessory pangenomes is that with every new *P. putida* that's discovered, the list of accessory genes keeps growing – so we're nowhere close to knowing all we can about this species yet!

For agriculture, *P. putida* is known to live on and in the roots of plants, and in the soil surrounding them. These environments are rich in nutrients for the bacteria, and Professor Ramos showed that the bacteria also give a helping hand to the plant, promoting growth and root branching and outcompeting plant pathogens. It does this by using chemotaxis to travel towards the plant root, and expressing adhesion genes to form a biofilm, then secreting signals useful to the plant, or attacking pathogens with a type VI secretion system.

Because of *P. putida*'s 'dual life' as both a plant symbiont and a degrader of organic molecules, Professor Ramos investigated how these two could be used together. He developed a process known as 'phytorhizoremediation' – a method of introducing a strain of *P. putida* that degrades a toxic compound on to the seeds of plants, and growing these plants where this compound needs to be removed. The example given was using a strain that degrades TNT, grown on corn around a munitions plant, where they were able to demonstrate a noticeable decrease in TNT contamination in the soil.

Industrially, *P. putida* has long held an interest for its degradation of organic compounds, but more recently attention has been given to its ability to generate useful products. Professor Ramos highlighted some examples generating metabolites from tryptophan, before exploring his own work generating alcohols such as hexanol and butanol from sugars.

SfAM would like to warmly thank everyone who made it to the event, and any who didn't manage to make it on the day can find the video on our website at **https://sfam.org.uk/resources/emi-lecture-2019-prof-juan-luis-ramos.html**.

The Bad Bugs Bookclub: tenth anniversary celebrations

Joanna Verran
Manchester Metropolitan University, Manchester, UK

In 2009, I set up the Bad Bugs Bookclub, a group for scientists and non-scientists to get together and talk about books of fiction in which infectious disease forms part of the plot. The aim was to engage all participants in discussion, to consider the accuracy of the science, its relevance to contemporary issues and the value of fiction in science literacy. SfAM supported the first event, which combined a screening of the movie *Outbreak*, and a book club meeting discussing *The Hot Zone* by Richard Preston.

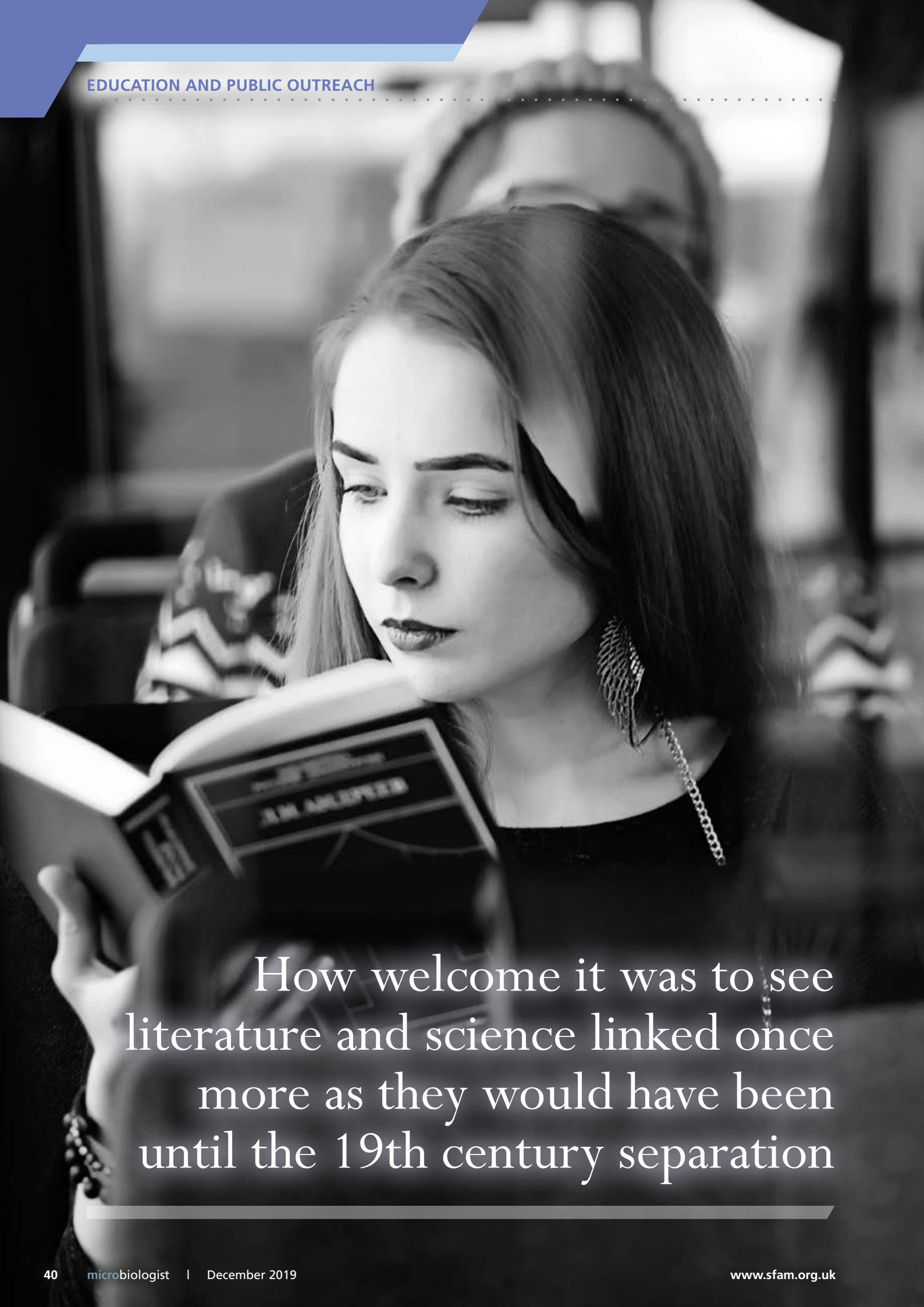
Since then, we have read almost 60 books, and the website (**https://www2.mmu.ac.uk/engage/what-we-do/bad-bugs-bookclub/**) contains meeting reports and reading guides for all of these events. I applied to SfAM for a public engagement grant in 2019 so that I could better promote the book club and the website as a resource for those wishing to start their own reading group, who wanted to read some of our books in an existing group, or who just wanted to read the books and think about the science within.

The funding from SfAM focused primarily on bringing the book club to relatively isolated communities: the Penzance Literary Festival and the Orkney International Science Festival were approached, and were delighted to accommodate sessions in their programmes.

In Penzance, the focus was on introducing the audience to the book club, and the value of using literature to bring science to new audiences. My Litfest contact said, "How welcome it was to see literature and science linked once more as they would have been until the 19th century separation – the Litfest was delighted to help bring the two sides back together for the 21st century". As a result of the well-attended and well-received talk, the local comprehensive school set up their own book club for years 10 and 11, focusing on one novel discussed at four meetings each term, and with specific reading/researching targets set for each meeting. The first book is *Nemesis* by Philip Roth (I purchased 10 copies for the school from my funding), and the final meeting (which I attended) was on 7 November. A different YA (young adult) fiction angle will be played out during this year's Gothic Manchester Festival, where we will look at the epidemiology and pathogenesis of zombie-ism using *Zom B* by Darren Sham, *The Enemy* by Charlie Higson and *Dread Nation* by Justina Ireland, in combination with our SimZombie simulation and other games.

Orkney International Science Festival was more opportunistic in their use of a visiting scientist! The library at Kirkwall shortlisted 10 novels from the book club website, from which we selected 5: *Star of the Sea* by Joseph O'Connor, *World War Z* by Max Brooks, *The Island* by Victoria Hislop, *Oryx and Crake* by Margaret Attwood and *A Lovely Way to Burn* by Louise Welsh. Thus my session included discussion about the novels as well as an overview

of the bookclub. I donated some copies to the library so that multiple copies of each book were available. All of the audience had read at least one of the books, and several members were already in reading groups, so were interested in using some of the novels for future meetings. In addition, the festival asked if I would do a talk on yeast, as part of a tour of the famous Highland Park whisky distillery, and host a 'Menus made by microbes' event at the festival hub. The science focus of this festival seemed more flexible and open to innovative science events than the literature festival, who were perhaps less familiar with a visiting scientist! I wonder what will happen next year.



How welcome it was to see literature and science linked once more as they would have been until the 19th century separation

FURTHER READING

Verran J. *The use of a book club to enhance science literacy and understanding of infectious disease epidemiology*. In *Professional education with fiction media: imagination, engagement and empathy in learning*. Eds C Jarvis and P Gouthro. London: Palgrave Macmillan, 2019. pp. 129–157

Verran J, Aldana Reyes X. Emerging infectious literatures and the zombie condition. *Emerging Infectious Diseases* 2018; 24(9), 1774–1778

Verran J. *et al*. Refreshing the public appetite for 'good bacteria': menus made by microbes. *Journal of Biological Education* 2018; 53, 34–46. https://doi.org/10.1080/00219266.2017.1420678

Verran J. The Bad Bugs Book Club: science, literacy, and engagement. *Journal of Microbiology & Biology Education* 2013; 14(1): 110–112.

My interest in microbiology and fiction has really let me get involved in some fantastic events this year. For example, I was invited onto a panel at Bradford Literature Festival to discuss 'Inevitable Epidemics: Death in the Air' with author of *The Pandemic Century*, Mark Honigsbaum. I contributed my experiences about science and the arts in a discussion recorded at Cheltenham Science Festival and broadcast by BBC Radio Gloucester. Manchester International Festival and Contact Theatre hosted *Sanitising the working classes*, an immersive event commemorating the cholera epidemics and mass burials in Manchester in the nineteenth century: again I brought my unusual microbiology/literature perspective to a panel! SfAM also hosted a public event at the FEMS Congress in Glasgow, where a conversation with author Lesley Kelly revealed how knowledge of epidemiology and public health contributed to her *Health of Strangers* series of novels, in a session entitled *Influenza: in fact and in fiction*.

The final event for which SfAM funding was used focused on *The Killing Snows* by Charles Egan. The novel describes the potato blight disaster leading up to the Great Famine in Ireland, during which infectious diseases such as typhus, cholera and dysentery claimed more lives than starvation itself. The author travelled from County Mayo to the Irish World Heritage Centre in Manchester, and gave a talk about his research for the book, his family history and about how the famine has affected Ireland. More than 70 people attended the talk (which was preceded by a book club meeting), providing an appreciative audience who had not expected to hear quite as much about microbiology as they did!

The funding also contributed to a cake and room hire for a tenth anniversary birthday party to which all previous collaborators and book club members were invited.

We looked back on our previous meetings (overall, *Nemesis* was the favourite book in terms of literary excellence and scientific interest – a polio epidemic before knowledge of epidemiology, transmission and pathogenesis were known formed the underpinning element of the story), and forwards to the 'next 10 years!' We certainly are unlikely to run out of books. Personally, I have learnt such a lot: reading work from a range of authors has been fascinating and educational, and discussing the novels with non-scientists in an informal environment enables engagement on a level and different platform.

So, over the year, I have met several hundred (primarily) adults, using fiction as the focus for engagement with microbiology – and the 'normal' book club meetings have carried on as usual. The book club website received increasing numbers of hits (this will be monitored until the end of the year) and I am planning to develop a more interactive website at the end of 2019. I only hope the audiences have enjoyed finding out about microbiology and fiction as much as I have.

Thank you so much SfAM for supporting the book club at the beginning, at this important marker, at events during the 10 years – and hopefully in the future!

Joanna Verran is Emeritus Professor of Microbiology at Manchester Metropolitan University. In 2019, she received the AAAS Mani L Bhaumik award for Public Engagement with Science for 'her commitment to devising and delivering innovative microbiology-focused public engagement with the same rigour as laboratory-based research, with attention to appropriate design, thorough evaluation and wide dissemination'.

British Science Festival 2019

Michael Pascoe
Cardiff University, Cardiff, UK

In mid-September, the British Science Association celebrated the 188th year of the British Science Festival. This year's festival was held in Coventry and hosted by the University of Warwick, which opened its campus doors wide for the public to explore some of the groundbreaking STEM research being conducted across the UK.

I was fortunate to attend the British Science Festival as the final element of my British Science Association Media Fellowship, which was sponsored by the Society for Applied Microbiology and facilitated by BBC Wales over the summer.

The festival featured a wide range of subjects, from 5G-enabled self-driving cars to the ethics of extraterrestrial communication and Brexit-beating beans. I was pleasantly surprised by the large representation of microbiologists at the festival who were offering a wide variety of talks and activities to the public.

My first taste of microbiology came with a session entitled 'Going Viral', which was hosted in a geodesic dome reminiscent of a viral capsid. Members of the public learned about the ubiquity of viruses on Earth and the many environmental niches they occupy. As well as the diseases they cause, the researchers explained their uses as

The 'Lab-Rover' visited four countries across Africa and brought cutting-edge technology to some of the most remote regions. © George Busby

biotechnological tools and how phages can be used to treat antibiotic-resistant infections. At the end of the session, attendees walked away with their own piece of viral-themed cyanotype art, which they made themselves by projecting images of viruses onto photoreactive paper.

A wide breadth of engaging talks were also on offer. George Busby of the University of Oxford discussed his recent journey across Africa using nanopore technology to sequence the genomes of *Plasmodium falciparum* and the *Anopheles* mosquito. By packing an entire genetics lab into the back of a modified Land Rover (humorously dubbed the 'Lab-Rover'), the mobile malaria mappers trained scientists across four countries in the techniques needed to improve our understanding of the world's biggest killer. In another talk, Siobhan Quenby described trailblazing research on using antibiotics to combat endometriosis and recurrent miscarriages. Quenby has recently been awarded £1.9 million by the National Institute for Health Research to support a trial involving 3,000 women across 10 hospital sites.

The evenings of the festival were also packed with events. On one night, a programme of late-night fitness

Main image: George Busby and colleagues training fellow scientists in the use of nanopore sequencing to research malaria. © George Busby

Above: Michael Pascoe and his dog

Right: Using sounds and touch to get to grips with the cosmos in Nicholas Bonne's Dark Tour of the Universe. © Michael Pascoe

Nestled in the centre of campus, the geodesic dome was home to Going Viral.

On one night, a programme of late-night fitness activities let the public get active whilst learning about the mysterious mating behaviours of sea slugs

activities let the public get active whilst learning about the mysterious mating behaviours of sea slugs, how dancing can beat stress and the ways in which orcas view the world under the sea. For those less inclined toward fitness, The Botanist hosted a night of drinks, music and hands-on activities. Festival-goers got to grips with biochemistry and got their hands messy using magnets and slime to find out how biofilms protect microbes in the lungs of people with cystic fibrosis. Hosting the events in a bar was a fantastic way to engage members of the public who do not come into contact with scientists in their daily lives.

Despite being the UK's oldest festival, the British Science Festival was an excellent showcase of diversity and the modern face of science. Women made up half of the exhibitors and several sessions highlighted the contributions made by women in STEM in shaping our modern world. In *A Dark Tour of the Universe*, Nicholas Bonne gave festival attendees a taste of what it's like to explore the universe through sound and touch. Whilst blindfolded, the visually impaired astrophysicist exposed us to the sounds of distant black holes and let us feel our way across the cosmos. In such a visually dominated field, explaining these concepts through alternative senses was an inspired way to engage audiences who are less able to participate in traditional STEM engagement.

Finally, the last evening played host to *Out Thinkers*, which was supported by the charity Pride in STEM. A trio of Warwick-based early career researchers used this session to discuss their research as well as their experiences of being LGBT scientists. Ares Osborn described their work on extrasolar planet formation whilst Ellis Monaghan and Scott Dwyer, both microbiologists, discussed their research on soil microbes and entomophagous fungi to improve agriculture. Whilst all three had positive experiences of being LGBT in STEM, Ares took the opportunity to highlight some of the injustices faced by trans scientists, who may change their name mid-career and subsequently face the choice of outing themselves or disowning past publications when applying for academic positions.

Bringing the festival proceedings to a close, incoming President of the British Science Association, Professor Alice Roberts, delivered an eye-opening keynote speech. She discussed the role of science in 21st century society and whether it's really up for tackling the problems we face in modern times. Climate change, antibiotic resistance and changing healthcare pressures are all key issues that need to be urgently addressed by scientists and policymakers. Professor Roberts called for researchers to take a leading role in working with the public to drive the changes we need to overcome these threats and make the world a better place for all.

The British Science Festival 2019 was an eye-opening experience that delivered cutting-edge science to the public in easy-to-understand terms. The inspiring methods used to communicate research was a particular highlight, which I'm keen to utilise in my own public engagement activities. In 2020, the British Science Festival will be hosted in Chelmsford by Anglia Ruskin University and I'm confident microbiologists will again take a leading role in inspiring the public with STEM.

I'd like to take the opportunity to express my gratitude to the Society for Applied Microbiology for affording me the opportunity to complete a British Science Association Media Fellowship this summer and thoroughly recommend other microbiologists apply for the scheme next year.

Marwa Hassan of the University of Warwick using magnets and slime to demonstrate how microbial biofilms protect themselves from antibiotics. © Michael Pascoe

An inspiring engagement:

Features Editor, Nick Jakubovics, chats to Charlotte May and Shaun Robertson

I recently saw Charlotte May give an inspiring overview of public engagement around the topics of microbiology and biofilms at the *Eurobiofilms* meeting in Glasgow, September 2019. Charlotte had been a Research Development Officer at the National Biofilms Innovation Centre (NBIC). She and her colleague from NBIC, Shaun Robertson, kindly agreed to share some of their experiences of public engagement and to explain how NBIC is involved in promoting science relating to microbial biofilms.

Can you tell us a bit about your background and how you came to get involved in public engagement? (this is one where we would like to hear from both of you!)

Charlotte: I have always seen undertaking public engagement as an intrinsic part of the identity of a researcher. My BA, MA and PhD in English Literature have all taken place at the University of Nottingham, and as soon as I joined the university in 2008 I became a member of local literary and history societies to get involved regionally with activities and meet people with similar interests. I am also an historical tour guide for the National Trust, so several times a month have an opportunity to share my expertise in literary history with the public. I find that this sharing of research contributes to my well-being. I have found the same with the outreach activities I have undertaken with the NBIC team. Curating key messages is essential for effective public engagement, so as a non-scientist, I realised that my knowledge of public engagement could provide a bridge between the research-intense focus of scientific researchers, and create events which would be of interest to the public in accessible ways.

Shaun: I agree with Charlotte and see communication of science to be a societal responsibility to break down barriers of understanding between scientists and members of the public. I have a BSc, MSc and PhD in various biological sciences and undertook a two-year postdoc in engineering/physics before joining the University of Nottingham in 2018. I'm now a Research Fellow with NBIC. I have always been a keen volunteer through the STEM ambassador scheme. I first volunteered for events in Aberdeen back in 2009 and continued to do so in Glasgow and now Nottingham, where I am part of the NBIC Outreach and Public Engagement Committee.

Which of your public engagement activities have been most successful?

Success can be difficult to determine with public engagement. In terms of numbers, we hosted a stand at an event close to the university, 'Science in the Park', run by the British Science Association. There were over 5,000 attendees within the day, so in terms of the numbers of individuals we could engage with, this was probably the most impactful due to footfall. However, the NBIC contributed to a stand at the Royal Society in 2019, focused on 'Superbiomaterials to fight Superbugs'. The prestige of the Royal Society combined with the resource of a large team from the EPSRC Programme Grant in Next Generation Biomaterials Discovery who led the event (Professor Morgan Alexander, Principle Investigator) enabled us to draw on expertise, funds and opportunities that we would not otherwise have had. Despite this, any public engagement event in which you have had the opportunity to engage with a member of the public, through shared conversation or explanations, can be thought of as successful. A useful resource for looking at success – or, more specifically, 'impact' – is through the UKRI's Pathways to Impact document, which is freely available online.

How do you recruit volunteers to help with public engagement?

Public engagement often relies on volunteerism. At a time when both academics and students are confronted with extensive workloads, it is important that public engagement does not over-commit individuals but instead works within schedules. Communication is key to volunteer

recruitment: administrative staff, academics and student communities can help to identify students who may be eligible or interested and make people aware of opportunities via email and social media. We run a shift system for events, and cascade this schedule to all volunteers to ensure volunteers are aware of their responsibilities, as well as when they can take a break.

What training do you give to your volunteers?

There is always at least a full briefing document sent to volunteers in advance of the event: times and locations of the stand, and a description of the activities with brief instructions. Previously, we have run in-person training sessions but due to timetables it is difficult to schedule an inclusive time and date. We also have standardised a set of frequently asked questions, so that volunteers know what the university guidelines are on, for example, the use of animals in research. One of the best ways of training is to see public engagement in action: we strongly encourage those who are interested to attend an event as a visitor, so that they can observe the different styles of public-engagement delivery people have.

Have you ever encountered difficult questions or comments from members of the public and how do you deal with these?

The subject of antimicrobial resistance can present outreach providers with controversial questions. For example, visitors may share thoughts on vaccinations or ways they use antibiotics. Presenting yourself as a scientist on a public platform can inevitably draw people with these questions to you. However, this in itself is an opportunity. Ultimately, people often want to be listened to, and if they are reading particular non-scientific or inaccurate narratives, it is an opportunity to give them different resources to read and directions to pursue (for example, The Wellcome Trust webpages on AMR). It is not advisable to defensively argue against their ideas, but if we embolden the public to read more broadly on scientific issues and question the authenticity of what they hear through the media, then we are doing the very best we can. We'd love to change the world, but one public engagement event simply can't do this! So don't aim to change the world – just give people the information and confidence to see science as an accessible and dynamic field of study.

Can you tell us a little more about NBIC and how it is supporting public engagement and outreach around biofilm microbiology?

NBIC is the central hub where academia, industry, government and public policy come together to tackle the global challenges biofilms present, through a forward-thinking, collaborative and interdisciplinary approach. Funded by the Biotechnology and Biological Sciences Research Council (BBSRC), Innovate UK and Hartree Centre, our mission is to establish a network of research and innovation capacity in order to catalyse partnerships with industry in the study of biofilms to achieve breakthrough innovations and impact – from industry products and solutions to services and spinouts. The four core partners are the University of Southampton, the University of Edinburgh, the University of Liverpool and the University of Nottingham. They have now been joined by an additional 41 universities and over 150 industry partners in the aim to prevent, detect, manage and engineer solutions to biofilms.

NBIC helps support outreach through a number of avenues; we have an Outreach and Public Engagement Committee, where local and national events can be planned.
In addition, we have a small grant scheme that research institutes that are part of NBIC can access. We are also developing and collating resources from the UK biofilm community to provide a central point of information that can be accessed from our website (coming soon!) for the purpose of performing outreach activities.

The latest news, views and microbiological developments

APHA Scientific Biological Reagents – produced by experts for reliable laboratory testing

Animal and Plant Health Agency (APHA) specialise in diseases of livestock and plants, diagnosis of disease and surveillance of new and emerging disease. Our scientists have a unique breadth of veterinary and scientific expertise and a comprehensive knowledge of animal and zoonotic diseases.

APHA has achieved world reference laboratory (OIE) status for a number of animal diseases.

Over many years, we have developed specialist veterinary diagnostic reagents and test kits for effective, reliable laboratory testing. The reagents are manufactured in a dedicated Biological Reagent production unit certified to ISO 9001 quality standard and many of them are currently used by national and international reference laboratories.

With over 150 different reagents available for sale, and many more customised options, our wide range of products (antisera, antibodies and diagnostic kits) targets bacterial and viral pathogens found in common livestock.

- Avian Influenza
- Escherichia coli
- Infectious Bursal Disease
- Newcastle Disease
- Bovine Viral Diarrhoea
- Maedi-Visna
- Salmonella
- Brucella
- Infectious Bronchitis
- Mycoplasma

An extensive collection of cell lines, control sera and culture collection is also available.

As well as Biological Reagents, APHA Scientific also provides a range of services, including:

- Bacterial Identification and Characterisation
- Antimicrobial Testing
- Extensive Culture Collection

For more information, please see our website.

Order directly from APHA Scientific, or from our network of distributors available from our website.

Further information

Visit: **www.aphascientific.com**
Tel: **+44 (0)3000 600001**
Email: **salesdesk@apha.gov.uk**

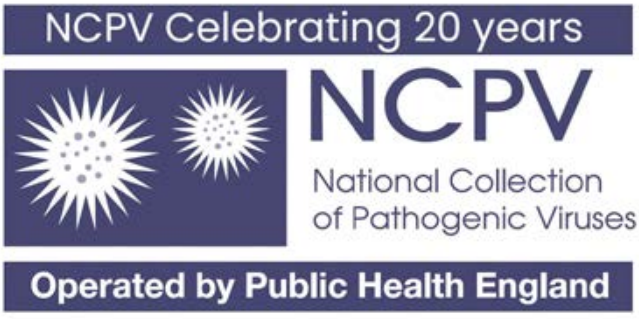
The National Collection of Pathogenic Viruses – 20 years serving the virology community

The National Collection of Pathogenic Viruses (NCPV) was established in 1999 and is now one of the four internationally renowned culture collections operated by Public Health England. The authenticity of research material is recognised as a hugely important issue and the remit for NCPV from the outset was to identify and preserve collections of relevant human pathogenic viruses that might otherwise be lost, as well as making relevant strains of viruses available to the research community. Today the collection contains a broad range of Hazard Group 2, 3 and 4 viruses, primarily human pathogenic viruses, from 21 families. The collection focuses on viruses of public health significance, surrogate viruses used for public health research, emerging diseases, currently circulating strains, vaccine strains and strains of historical interest.

NCPV aims to work closely with the scientific community and is constantly appealing to researchers and clinicians for novel, outbreak and recently circulating strains. If you work with a virus that you think may be of interest to the scientific community, please contact us: culturecollections.marketing@phe.gov.uk. To keep up to date with NCPV news sign up for our newsletter and follow us on Twitter @NCPV.

Further information

Visit: **www.phe-culturecollections.org.uk/collections/ncpv.aspx**
Tel: **+44 (0)1980 612512**
Email: **culturecollections@phe.gov.uk**



Chill Out with a Whitley Workstation

Some organisms require lower temperatures in order to thrive so special workstation conditions are needed to maintain lower temperatures or even extract heat generated by equipment used inside a chamber.

Don Whitley Scientific has three 'chilling' solutions:

Reducing the heat

The **Heat Removal System** is an option for the 135 and 155 Workstations. It is specified when equipment needs to be operated inside the chamber and where the equipment generates heat that would cause the workstation temperature to rise beyond the desired set point. This compact, unobtrusive system maintains temperatures inside the workstation of between 20°C and 35°C.

Chilling experiments

The **Refrigeration System** achieves much cooler temperatures – less than 10°C. This unit is specified when lower temperatures are needed for experiments such as those with psychrophiles.

The 85 solution

The **Whitley Refrigeration Unit** can be added as an option on A85 (anaerobic) and M85 (microaerobic) Workstations. The operating temperature of the workstation can be reduced to a minimum of 8°C, maintaining the necessary environment to store samples prior to incubation or grow organisms that thrive in lower temperatures.

All three chiller units can be turned off when not required so the maximum temperature of 45°C can still be achieved. DWS chillers provide a very flexible solution.

Further information

Visit: **www.dwscientific.com**
Tel: **+44 (0)1274 595728**
Email: **sales@dwscientific.co.uk**

GPS™, part of an H2020 project for the diagnosis of tuberculosis: ARREST-TB

The Spanish company **Genetic Analysis Strategies SL**, the owner of the **GPS™** brand dedicated to developing genetic diagnostics methods, participates in an H2020 European project called **ARREST-TB** (*Accurate, Rapid, Robust and Economic diagnoStic Technologies for tuberculosis*). The project brings together a consortium of academics from the University of Edinburgh, Heriot Watt University (Edinburgh) and the University of Padua, together with the SME companies **GPS™**, DestiNA Genómica and Optoi (Italy), in collaboration with the Central Institute of Tuberculosis Research (Moscow, Russia), the National Institute for Tuberculosis Research (Chennai, India) and ShanMukha Innovations Pvt. Ltd. The new technologies, based on molecular probes and optical devices for the detection of *Mycobacterium tuberculosis* and its resistance to antibiotics, will be evaluated in countries with a high TB prevalence.

Tuberculosis is costing 1.3 million human lives annually (2016 WHO report), is the ninth leading cause of mortality in the world and participates in the global growth of resistance to multiple antibiotics that has been detected in many other pathogens. According to **Dr Antonio Martínez-Murcia**, Professor at the Miguel Hernández University (Alicante) and director of **GPS™**, 'as a result, drug resistance is considered to be the most acute and imminent threat to the population'.

Further information

Visit: **www.geneticpcr.com**
Tel: **+44 (0)965 429 901**
Email: **info@geneticpcr.com**

New additions to the National Collection of Industrial Food and Marine Bacteria (NCIMB)

The School of Natural and Environmental Sciences at Newcastle University have added 15 new strains from interesting and extreme environments to the NCIMB open collection. Microbes that thrive in extreme environments can be a source of industrially useful enzymes. An example of this is *Thermus aquaticus*, a microbe isolated from a hot spring in Yellowstone National Park, which is the source of the heat-resistant enzyme Taq DNA polymerase. As this is used in the polymerase chain reaction (PCR) DNA amplification technique, it has become one of the most important enzymes in molecular biology. These new strains are therefore an exciting addition to the collection.

The new accessions, which were all isolated in Indonesia, include:

- Three *Streptomyces* species (NCIMB 15210; NCIMB 15211; NCIMB 15212); and one *Arthrobacter* sp. (NCIMB 15209) isolated from the Parangkusumo sand dunes;
- Five species isolated from hot spring sediment (*Micrococcus* sp. NCIMB 15213; *Rhodococcus* sp. NCIMB 15214; *Micromonospora* sp. NCIMB 15215; *Pseudonocardia* sp. NCIMB 15216; *Actinospica* sp. NCIMB 15218);
- Two *Dermacoccus* sp. (NCIMB 15219; NCIMB 15220), and *Verrucosispora* sp. NCIMB 15223, isolated from arid sand dunes;
- *Kytococcus* sp. NCIMB 15217 and *Amycolatopsis* sp. NCIMB 15222 isolated from a saline mud volcano;
- *Amycolatopsis* sp. NCIMB 15221 isolated from volcanic sand dunes.

If you would like to find out more about these strains contact enquiries@ncimb.com or visit our website www.ncimb.com.

Further information

Visit: **www.ncimb.com**
Tel: **+44 (0)1224 711 100**
Email: **enquiries@ncimb.com**

A decade of delivering a unified voice

The Society of Biology, now the Royal Society of Biology, was founded October 2009. Formed from the merging of the Institute of Biology and the Biosciences Federation, the Society of Biology was originally created to bring together the diverse communities of biologists and biosciences organisations and ensure our voice was present, loud and clear, for policymakers and politicians.

Since then, the society's repertoire has greatly expanded; we support biosciences education, through our accreditation programme, education policy work and school competitions; we work to highlight the importance of biosciences through our outreach and engagement work; we provide career support for biologists of all ages and across all disciplines through our training programmes; and we provide membership services to smaller bioscience societies to help nurture their communities, just to name a few of the areas we now oversee.

In 10 years, our network has expanded from 11,000 to 18,000 members and to 100 membership organisations, including the formation of new branches, special interest groups and working groups, and essential partnerships that will continue to support the biosciences for the next decade and beyond.

A lot has happened since the society's formation, and it is timely to take a moment, reflect, review and celebrate as part of our Anniversary Year celebrations. Upcoming events and activities in our Anniversary Year calendar include a new blue plaque scheme to commemorate UK bioscience pioneers, a new grant to support 10 Big Biology Days worldwide, social media campaigns and specially commissioned content, and our Anniversary Gala dinner, for members and membership organisations to join us in celebration of this milestone.

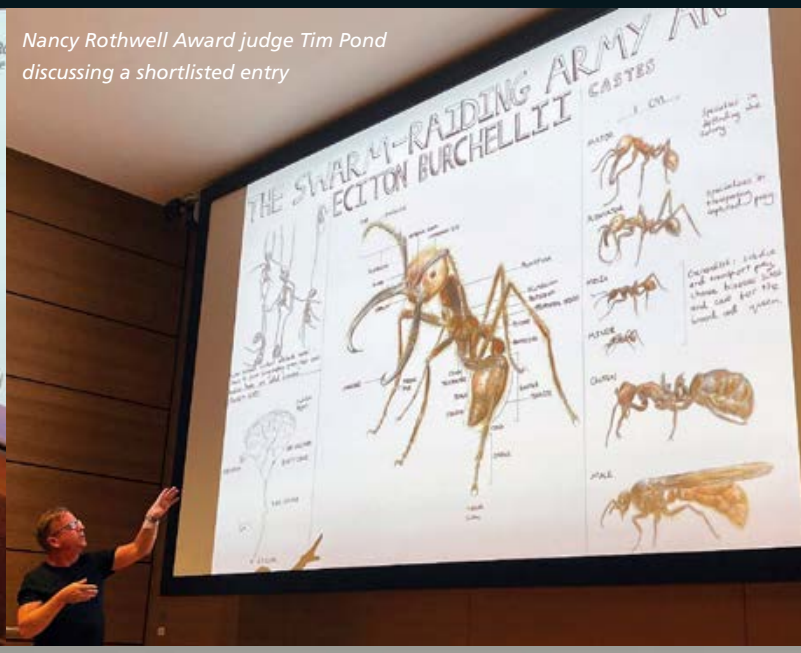
Our new 10 years anniversary logo

The society was launched by Sir David Attenborough Hon FRSB and Sir Paul Nurse Hon FRSB at Fishmonger's Hall, London Bridge, so it is fitting that they will be joining us at the dinner, taking place in March. Tickets are available for individuals and we are delighted that SfAM will be a sponsoring partner with a table dedicated to applied microbiology.

From one biology celebration to another – this year's Biology Week, our annual celebration of the biosciences, was as large and as exciting as ever, with more than 110

Mark Downs CSci FRSB
Chief Executive of the Royal Society of Biology

Debate at the Royal Institution



Nancy Rothwell Award judge Tim Pond discussing a shortlisted entry

events taking place worldwide, including festivals, fairs, debates and more.

For our annual poll we chose 10 iconic freshwater species, all protected by the Wildlife and Countryside Act or considered threatened by the ICUN Red List, and ran an online ballot for people to vote for their favourites. We also published free resources and fact files for schools, parents and guardians, to help younger children learn more about these essential ecosystems.

Marine health was the theme of our annual Biology Week debate at the Royal Institution, in partnership with the Biochemical Society. A panel of experts came together to discuss the impact of marine plastics on the ocean, and a lively and informative debate followed.

As part of our Biology Week Policy Lates series, we also brought together a panel of experts to discuss insect declines – a topic that is as concerning as it is complex. We're already planning next year's Biology Week events, including a partnership with SfAM for our 2020 Policy Lates event, so watch this space!

During Biology Week we launched our Technician Action Plan; as a member body of the Science Council, we support their Technician Commitment, and have proposed our own action plan to support technicians and technical staff.

We have also had approval from the Science Council to pilot a process for sublicensing professional registration awards such as RSciTech and RSci. Sublicensing will allow RSB member organisations' own members to access professional registration awards via the RSB system, to help support professional development. Once complete we hope that SfAM will be keen to consider this opportunity.

Finally, our future relationship with the EU remains critical to science. We will therefore continue to work closely with our membership and partners to ensure the biosciences voice remains part of the wider conversation. This is as important now as it was back in October 2009. And, with the pace of change in biology, perhaps even more so.

For our annual poll we chose 10 iconic freshwater species, all protected by the Wildlife and Countryside Act

Farewell Dr Brown

After 3 years at SfAM, our Policy and Public Affairs Manager Chris Brown is leaving to embark on a new chapter in parliament. We wish Chris the best of luck in his new position as Policy Specialist for the House of Commons Science and Technology Committee.

Food policy launch at FEMS

Chris was instrumental to the Society's food safety campaign and has worked closely with the Food Standards Agency. The first two reports of the campaign focused on *Food safety after Brexit* and *Food safety and food manufacturing and processing*. The food safety campaign was soft launched at FEMS 2019, co-hosted by SfAM and attended by Jacqui McElhiney, Head of Food Protection Science and Surveillance at Food Standards Scotland. The policy team is currently in the process of preparing the third report of the campaign on primary food production and microbiological food safety. If you would like to get involved with the food safety campaign, contact the SfAM policy team (policy@sfam.org.uk).

Chris introducing the Food safety and food manufacturing and processing report at FEMS 2019 alongside Lucy Harper and Christine Dodd.

FEMS Community Corner conversations

FEMS 2019 welcomed the Community Corner, a living room of the congress to promote a different approach to networking. From specialist groups on emerging topics in microbiology to advocacy groups promoting public policy.

Diversity in STEM

Clare Taylor, SfAM's General Secretary hosted community conversations highlighting the importance of embracing diversity to build inclusive communities. The conversations covered topics such as the challenges that prohibit the microbiology community from becoming diverse and the challenges faced by specific groups within the community. The diversity in STEM community corner conversations included: women in STEM, LGBT+ in STEM and STEM in Africa.

Lucky Cullen
SfAM Policy Officer

In conversation with the 'LGBT+ in STEM' panellists

'LGBT+ in STEM' Community Corner panel from left to right: Lucky Cullen, James Williamson, Dukas Jurenas and Clare Taylor (Chair).

About the panellists

James Williamson

James is a postdoctoral researcher at the University of Warwick. His research focuses on engineering environmental bacteria for the utilisation of waste plant material, with an aim to produce high-value products. James is also the secretary of the SfAM ECS committee.

Lucky Cullen

Lucky has recently completed her PhD at Kingston University London. Her research focused on characterising the emergence of antimicrobial resistance in Escherichia coli through mutation mapping of the resistome. Lucky is also lead policy and diversity and inclusion officer of the SfAM ECS committee.

Dukas Jurenas

Dukas is a postdoctoral researcher at the Institut de Microbiologie de la Méditerranée. His research is mostly focused on bacterial toxins from toxin–antitoxin systems and type VI secretion systems. Dukas is also a member of the Belgian and Lithuanian Societies for Microbiology.

Q1 How did you feel being asked to sit on the panel of the 'LGBT+ in STEM' Community Corner discussion?

James: I was definitely apprehensive about being asked to sit on the panel for this discussion; the thought of standing up in front of a whole conference and saying 'Hi, here's this aspect of my personality, please don't judge me too harshly' was daunting for several reasons. Firstly, I've only been 'out' to my family very recently, and at that time there were still family members who didn't know.

Secondly, I often feel like a fraud when talking about LGBTQ+ issues, mainly because I've had very few negative experiences. It's almost as if I haven't suffered enough to be an advocate, which is clearly ridiculous.

Lucky: It was a complete honour to be asked to participate in the LGBT+ panel discussion. Clare has always been somebody I have looked up to and admired within the Society, and she was fundamental to me being so open about my sexuality when joining SfAM in 2013. However, during the days leading up to the panel discussion I became increasingly nervous, as it dawned on me that I was outing myself at FEMS, the largest gathering of microbiologists in Europe.

Dukas: I contacted Clare and proposed myself as a participant, so in a sense it was my choice to show up on the panel. I wasn't entirely aware of the format, but I assumed it would be public. I found that the atmosphere was well created, open and cosy enough for anyone interested to pass by, but not standing out too much.

Q2 What did you hope to achieve from participating in the discussion?

James: My main objective from the event was to not make a fool of myself and try and not feel like a fraud. I knew that the experiences I had to share could be a lot less extreme than of other people on the panel, but I hope that my slightly less serious stories helped to highlight how ridiculous some of the situations we find ourselves in are, and how if we were not LGBTQ+ they wouldn't even be considered worthy of retelling.

Lucky: Going into the panel discussion I was really unsure about what I wanted to achieve. A part of me was of the opinion that we shouldn't even be having an 'LGBT+ in STEM' discussion, as I want to be judged solely for my scientific capabilities (my sexuality is completely irrelevant). Yet, I have been in a position both personally and professionally where I have hidden my sexuality, and it is truly exhausting. Therefore, I felt if sharing my experiences and raising the visibility of 'LGBT+ in STEM' at FEMS could help individuals in similar circumstances, I would do it all again in a heartbeat.

Q3 How did you feel the session was received by the audience at FEMS?

James: Most of all I got over a fear of being put centre-stage and talking about a personal and sometimes polarising subject. I also now feel less of a fraud than when I was asked to be on the panel. Finally, afterwards I was able to meet some lovely people, and got to discuss their adventures as an LGBTQ+ person in microbiology.

Lucky: I was honestly shocked at the number of people who turned up to the Community Corner for the 'LGBT+ in STEM' discussion. The audience was not only engaged during the discussion, but they were extremely understanding of the anxiety of the panel and the courage it had taken to sit on stages and speak out about such personal experiences. It was also extremely encouraging to hear some stories from the audience, and it provided a real sense of community spirit.

Dukas: I felt that the session was received with great interest and comprehension. The crowd was responsive, and some people came by after the session to share their story or express their sympathy.

Q4 What did you take away from this experience?

James: Honestly, it was all such a blur. However, following the panel I had some great conversations with people, and it seemed to go down well. If nothing else, it was a great way to bring this portion of the microbiology community together so we could meet each other. The issue of visibility was raised during the panel. Should we all raise our hands and say, 'Here we are'? Probably not (for a long list of reasons), but there's certainly something to be said for subtle ways of making ourselves known to each other.

Lucky: I found the session very rewarding and I was very happy to play my part in such an engaging discussion. Following the panel, it was also very humbling to see the responses on social media. I think this experience has given me the confidence to be an LGBT+ ambassador in whatever role I embark on following the completion of my PhD.

Dukas: I took away an overall good feeling and realised the importance of speaking out. I rarely do; however, I feel that in the professional community it can make a difference. Taking into account that not all people dared to speak up, and preferred to talk personally, I feel that LGBT+ is still sort of a stigma – probably due to real phobias but also due to our internalised phobias. I felt that speaking up, openly and honestly, despite the presence of my colleagues in the crowd that didn't know about my identity, had an overall very positive return for myself and for others.

New ECS Officer positions

The Society is committed to ensuring equal opportunities and proactively promoting a culture of equality, diversity and inclusion. In continuing with this commitment, the ECS committee has appointed two new officer positions.

Welfare Officer

Nasmille Larke-Mejía

Nasmille is a postdoctoral researcher and faculty staff representative at the Earlham Institute in Norwich. In her new role Nasmille will focus on the growing theme of welfare throughout academic and industrial science and actively promote positive mental health, work–life balance and self-care amongst the Society's ECS members.

Diversity and Inclusion Officer

Lucky Cullen

Lucky has recently completed her PhD at Kingston University and has joined the SfAM team as a science policy intern. Lucky has been an active member of the ECS committee for the last 2 years where she is now lead policy officer. In her new role, Lucky will work with the committee to ensure that diversity and inclusion is an integral part of all SfAM events and activities.

Marine microbiology campaign

SfAM produced a short briefing in 2018 on the *Marine microbiome*, following a response to the House of Commons Environmental Audit Committee inquiry into *Sustainable seas*. Ahead of the *UN Decade of Ocean Science*, the SfAM policy subcommittee is organising a marine microbiology roundtable workshop in early 2020. If you are interested in getting involved in the marine microbiology campaign, contact the SfAM policy team (policy@sfam.org.uk).

Further information

If you are interested in learning more about the Society's policy work and want to get involved, get in contact with the SfAM policy team.

policy@sfam.org.uk

Society for Applied Microbiology
LABS, 90 High Holborn, London WC1V 6LJ, UK

+44 (0)20 3880 2881
communications@sfam.org.uk

www.sfam.org.uk