microbiologist

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The magazine of the
Society for Applied Microbiology

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WHAT'S IN THE WATER?

Vibrio vulnificus **– the killer on the shores**

Marine bacteria: an overview for biotechnological applications

Infections in the Oval Office

VACCINES AND SYNTHETIC BIOLOGY

The vaccine development process is decades old. It involves developing a non-pathogenic variant of the virus, propagating that new variant in cultured cells and harvesting them to produce the vaccine. An emerging alternative promises to change that traditional cycle: synthetic biology.

This Society for Applied Microbiology meeting delivers lectures from some of the world's leading experts in both synthetic biology AND vaccines. Choose lectures on the topics that are applicable to your interests or sample ones from both. Either way – this meeting is not to be missed.

This year's Denver Russell Memorial Lecture will be given by **Philip Minor** (NIBSC):

Polio eradication – the endgame

Featured speakers include:

Simon Wain-Hobson
(Institut Pasteur)
Do the risks of synthetic biology outweigh the benefits?

Mary Ramsay
(Public Health England)
MenB vaccination in the UK

Louise Horsfall
(University of Edinburgh)
Metal decontamination and nanoparticle production using synthetic biology

Lance Turtle
(Institute of Infection and Global Health, University of Liverpool)
Zika virus infection and vaccines

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SW1Y 5AG

society for applied sfam microbiology

www.sfam.org.uk
sally@sfam.org.uk
+44 (0) 1933 382191

Paul Sainsbury reviews the content of this issue

microbiologist

What's in the water?

Questioning water quality became a pressing issue for me whilst on a three-day canoe and trek trip with a friend near Lake Huron in North America. With only one bottle of water between two, we armed ourselves with a couple of packets of an iodine-free, lightweight, compact water purification system.

Although my friend is an MD and I am a PhD chemist/basic microbiologist hybrid, I was still wary as to the effectiveness of the system and the taste of the end-product. Would I spend my entire Canadian holiday with giardiasis? I knew from my basic knowledge of disease-causing protozoa, bacteria and viruses that these organisms would not naturally occur in the outdoor water of a lake such as Huron; they would primarily be introduced from animal and human faeces (grim).

With that in mind, we drank some treated lake water and started to play a strange nerdy type of word association game… *Giardia*, *Cryptosporidium*, rotavirus, *Campylobacter jejuni*, *Entamoeba histolytica*, microsporidia, noroviruses, *hepatitis A*, *Shigella*, *E. coli* etc. etc., until, I (apparently) lost with my oh-so-clever *Cystoisospora belli* – as we were unlikely to encounter this in Lake Huron.

My strop lasted an hour.

I chose not to think about any more sources of malady found in American lakes, such as chemical pollutants or any (eeeek) parasitic trematodes that we may encounter. In fact, the water tasted fine after the purification treatment and I didn't get sick – so it appeared to do the intended job.

For this issue of *Microbiologist*, we look in more detail at some of the common and emerging waterborne pathogens found in lakes, oceans, rivers and within certain water distribution systems. We are also fortunate that Karina Salek, a researcher from Heriot-Watt University, has provided us with a gentle reminder that there are many multitudes of bacteria within the bodies of water on Earth that influence and enhance the planet's ability to sustain life. Some of these are being harnessed by microbiologists for their biotechnological applications.

The Journal Watch section gets an overhaul as we highlight special issues that we think you shouldn't miss and one of the most incredible science campaigners in the UK, Naomi Weir, gives us some details on her career path. Brendan Gilmore has a timely look at infections in the Oval Office and finally, for those with an interest in food safety, check out the SfAM Annual Applied Microbiology Conference 2017 on pages 42–43.

This question became a pressing issue for me whilst on a three-day canoe and trek trip

NEWS IN BRIEF

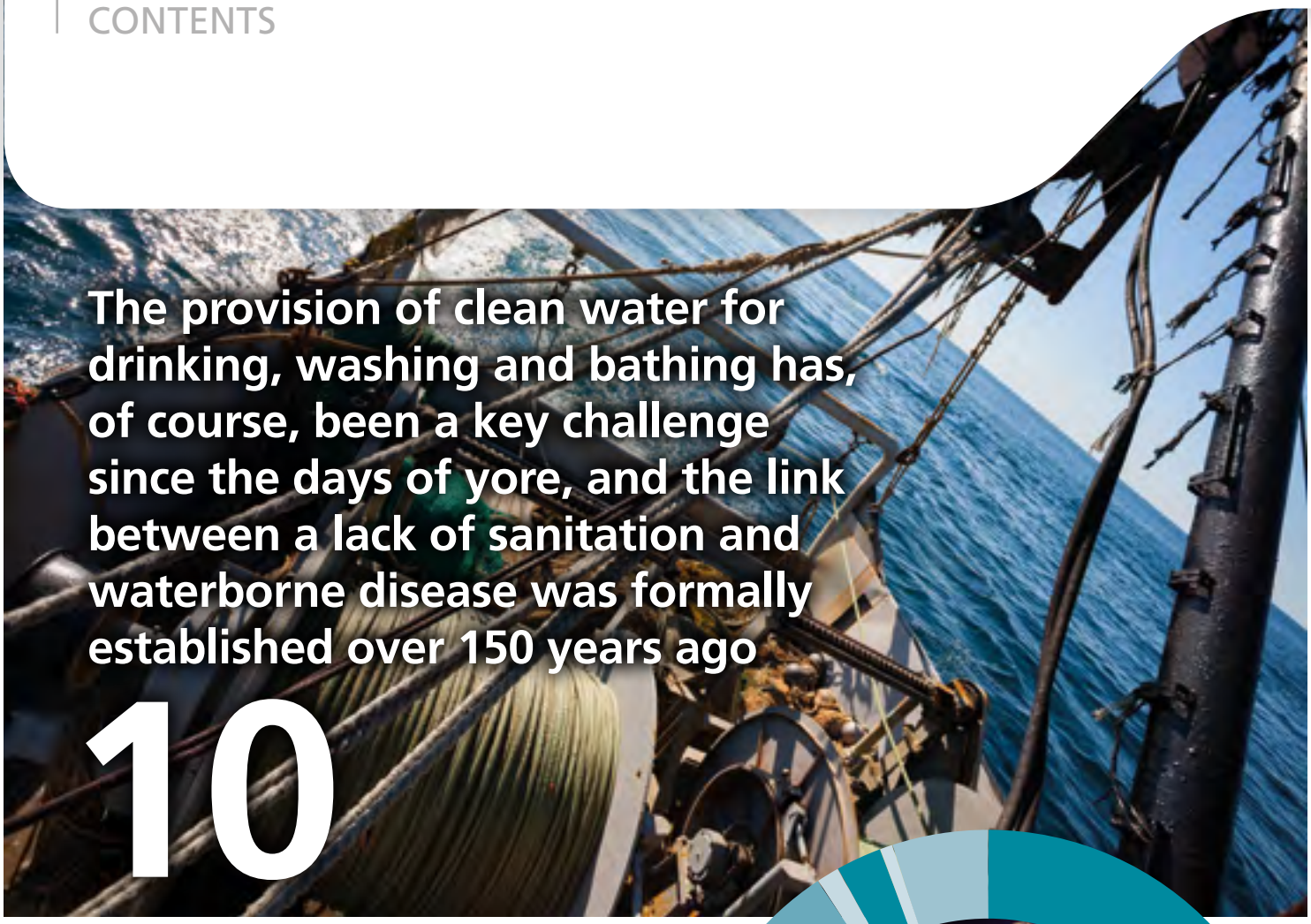
Antoni van Leeuwenhoek would have been 384 years old this year

Commonly considered the first microbiologist, Mr van Leeuwenhoek was the first scientist to observe and describe microorganisms.

Bacteria used in fight against Zika

Mosquitoes in two large areas of Brazil and Colombia are to be infected with bacteria that deprive them of the ability to transmit viruses, in an attempt to check the spread of Zika, which has been held responsible for brain damage in thousands of babies. **http://bit.ly/2eRrRzF**

Paul Sainsbury, *Editor*



The provision of clean water for drinking, washing and bathing has, of course, been a key challenge since the days of yore, and the link between a lack of sanitation and waterborne disease was formally established over 150 years ago

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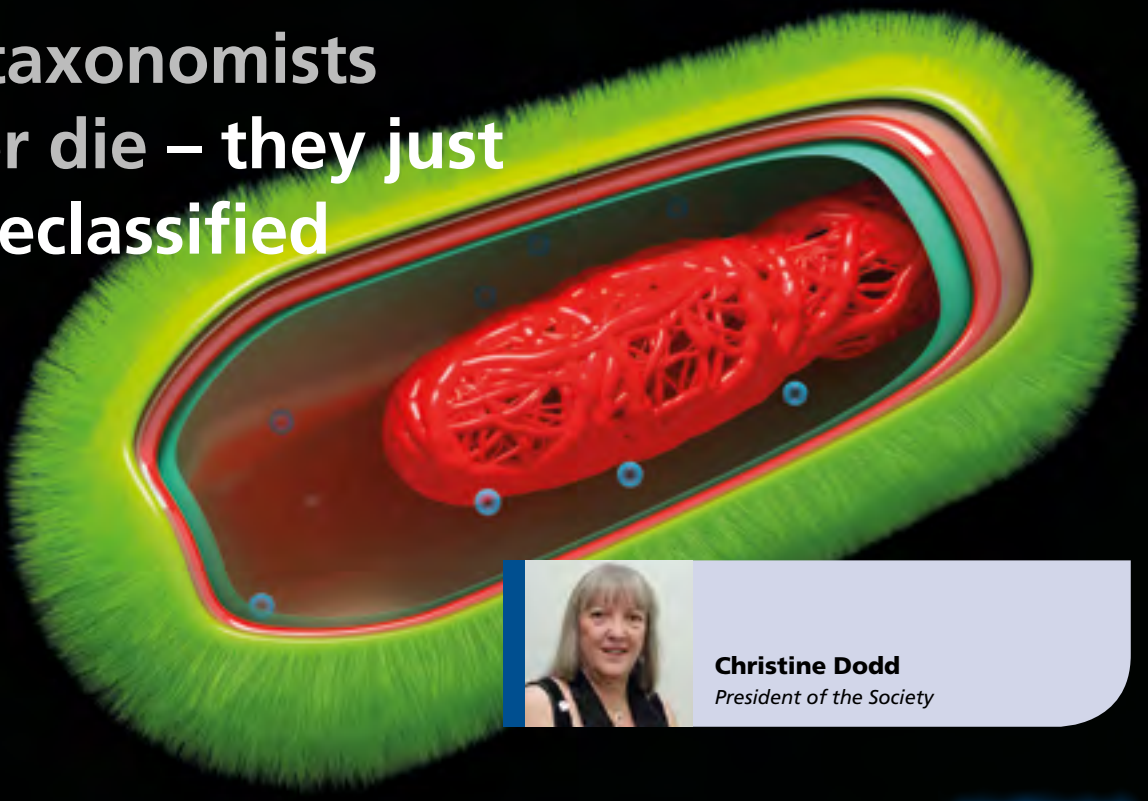
President's column

Another academic year has started with a new influx of students and a number of events combined to make me think about my time as a PhD student at Leicester. As I have said in this column before, I did not set out to be a microbiologist. My first degree was in biological sciences and the course units (module equivalents) I took were mainly in biochemistry and genetics. There was a microbiology option which I almost took, then changed my mind. So my microbiology knowledge as an undergraduate was based on *E. coli* and it was only when I started my PhD that I became exposed to a wider diversity of bacteria. As my PhD was on *Shigella* taxonomy, arguably I did not move far on the taxonomic tree, although I was working with examples of all the *Enterobacteriaceae* family and I did learn numerical taxonomy 'on the job'.

So how did I get a PhD with no formally taught microbiology background? My undergraduate research project was on plasmids and PhD was the effect of R (resistance) plasmids on *Shigella* taxonomy. My PhD supervisor was the late Dorothy Jones and I will be forever grateful that she took someone with a knowledge of plasmids for the project because '*we can teach you taxonomy*'. I broadened my microbiology experience through demonstrating on the microbiology module I hadn't taken (thanks Bill!) and I have continued to expand my knowledge of prokaryotes ever since. A new bacterial name has me searching on Google to be able to place it in my mind map of organisms. Scarily, as a food microbiologist over the last few years I have gone back to looking at antibiotic resistance plasmids, now in *E. coli*, which just demonstrates the adage *old taxonomists never die – they just get reclassified*.

There was not the same focus on conference attendance for PhD students as there now is and my first conference presentation was when I was a postdoc at Nottingham. In contrast my PhD students over the last few years have attended and presented at more conferences a year than I do. The benefits of this culture change was very evident when I attended our Early Career Scientists Conference recently and listened to an excellent set of presentations delivered by PhD students, some in the first year of their degree. Their knowledge and passion for their subject was very evident and I applaud the opportunities this conference and the offered paper sessions at our other conferences provide. So all of you do **please send in your abstracts for our conferences next year** and tick the oral presentation box! I'll look forward to hearing your contributions.

Old taxonomists never die – they just get reclassified



Christine Dodd
President of the Society

Hawaiian bobtail squid (Euprymna scolopes)

Harper's Postulates

Notes from the Chief Executive

McFall-Ngai's research has centred around the Hawaiian bobtail squid (*Euprymna scolopes*)

As I write this piece, it's the week of the 9th Environmental Microbiology lecture, which this year was beautifully presented by Professor Margaret McFall-Ngai. Her lecture elegantly described the persistent microbial colonization of animal epithelial surfaces using the model of squid–vibrio symbiosis. For those unable to attend, I'm sure you can imagine how visually interesting this was – and if you need evidence, you can watch it online. McFall-Ngai's research has centred around the Hawaiian bobtail squid (*Euprymna scolopes*) and its supremely colourful relationship with *Vibrio fischeri* for over 20 years, and listening to her talk with such passion about her work, you can see why. To quote Professor McFall-Ngai, "*Microbial diversity dominates life on Earth and symbioses are fundamental in ecosystems.*"

In the same way that humans and other animals rely on their symbionts in order to survive, membership organizations like S*f*AM would face an uncertain future without the significant contributions provided by their **Members**. Be it through direct involvement as a Trustee or Editor, or by enabling the Society's involvement in work which promotes, educates and informs diverse audiences of the importance of applied microbiology: without our Members, we would be unable to survive.

One particular group of **Members** who represent the future of applied microbiology are our Early Career Scientists Committee (ECS). On the same day as the EMI lecture, they held their 5th annual conference. I mentioned in a blog post how humbling these meetings are and this one was no exception. The quality of the science and the way it was presented was excellent and it was easy to forget that we were attending a meeting organized and run entirely by the ECS Committee – a group of scientists who are all taking their first steps into a scientific career. The panel discussion on bioethics was a lively one and involved an eminent panel, including Anne Glover DBE, Professor and Vice-Principal External Affairs & Dean for Europe, Aberdeen, Bobbie Farsides, Professor of Clinical and Biomedical Ethics and Law, Brighton, David Jones, Director of the Anscombe Bioethics Centre, Oxford, and John Bryant, Head of HEA Committee on Bioethics, Exeter. This was a typically excellent ECS conference which reinforced the importance of capturing the enthusiasm of this group of **Members** to ensure a bright future for applied microbiology.

Finally, as you will all know by now, 2016 has been a year of change for the Society, the most significant of which has been the move of the office from Bedford to London. This is already proving to benefit the Society operationally through strengthening internal and external connections and I'd like to thank all those **Members** and Trustees who have contributed to and supported the changes that have taken place this year. I'm certain 2017 will continue to see changes here at S*f*AM, but first it's time to rest and enjoy the festive break. I hope you all enjoy this holiday season and I look forward to seeing many of you in 2017.

Lucy Harper
S*f*AM *Chief Executive*

A changing of the guard

As frost hardens our gardens and we ponder the odds on a white Christmas, S*f*AM celebrates the recent success of our hugely enjoyable ECS Conference on Bioethics at the Royal Society of Medicine in October. The day featured inspirational talks from early career scientists and a panel session that inspired lively conversations on bioethics in microbiology.

After a busy year, the ECS Committee are now reflecting on our achievements and looking into a new year on the horizon. As the year draws to a close, and many people commit to healthy resolutions, we're also focusing on the future.

With a new season comes a new brand and to highlight this, we've decided to name our future conferences simply 'S*f*AM ECS Research Symposiums'. Our reason for updating the name of our event is simple – our conferences are really just about early career scientists presenting their work in microbiology with aspects of the conference focusing on applying the microbiology itself. It seemed appropriate to create a title that reflected the content structure through its name.

Since 2012, when we began holding a specialized conference for the early career Members of the Society, it's always been held in October. We've decided to change seasons and in the very near future, it will be moving to April. Despite the possible presence of daffodils in the ground, it won't be called a 'Spring Meeting'.

The next ECS Research Symposium will be held on the 19 of April 2017 in central London and will be teamed up with a workshop on bioinformatics. This conference will include enlightening talks presented by experts in the field of bioinformatics, followed by a hands-on bioinformatics workshop in the afternoon. In essence, it's a one-day conference where those in the early stages of their career can present any area of microbiology, enjoy a focused skills building session and network with peers. With our skills building session we hope to assist our Members in applying their talents to the many diverse areas of applied microbiology. Make sure you save the date, **19 of April 2017**, in your diary and we'll look forward to seeing you there.

The ECS Committee are also making a number of changes this year too. We'll be changing our current Chair and Secretary of the ECS Committee, Sabrina Roberts and Jana Shniete (neè Hiltner), as they step down from these roles. The ECS Committee would especially like to thank them both for their hard work and for leading the Committee with great direction. We're saying *bon voyage* to Agnieszka Piotrowska and Stewart Barker, both of whom stepped down from the Committee recently and we wish them all the best in their future endeavours.

Aside from the departures, we've also introduced new roles to the ECS Committee, welcomed new arrivals on to the Committee and seen existing Members move into new roles. Our new Committee structure will include a Content Manager, Marketing Officer, Finance Co-ordinator and Policy Officer.

With this in mind, we'd like to welcome Aled Roberts and Zara Gerrard who'll be moving into the roles of ECS Chair and Secretary, respectively. We are also excited to introduce and give a warm welcome to Alison Cartwright, Dianne Flynn, James Williamson, Jennie French, Tamsin Regdewell and Paulina Fernandez, who have all recently joined the ECS Committee.

Christiana Adesanwo
ECS Publications Officer

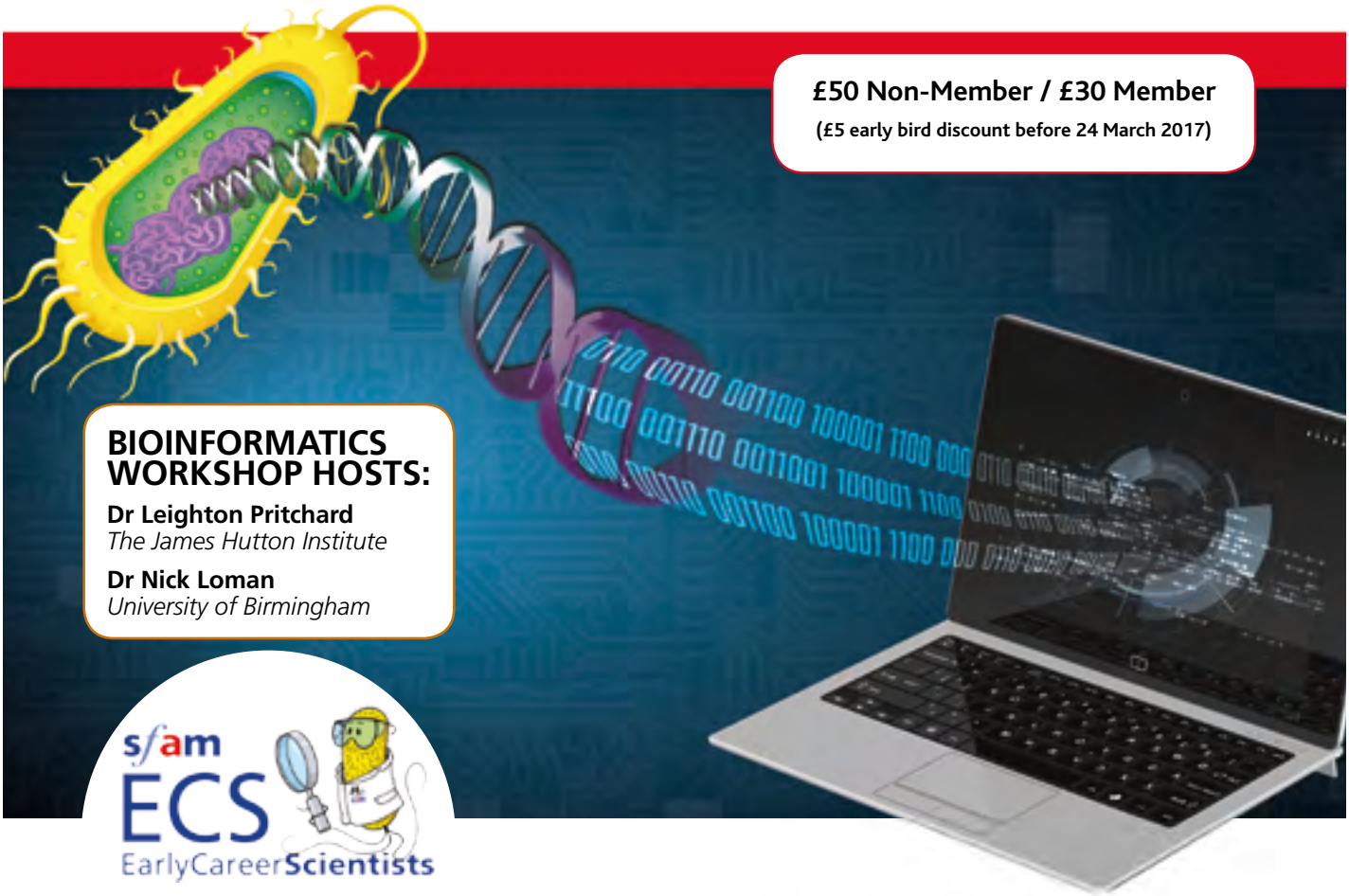
6th ANNUAL

ECS RESEARCH SYMPOSIUM

society for applied sfam microbiology

19 APRIL 2017 | 10:30 – 18:00

UNIVERSITY OF WESTMINSTER, LONDON



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BIOINFORMATICS WORKSHOP HOSTS:

Dr Leighton Pritchard
The James Hutton Institute

Dr Nick Loman
University of Birmingham

sfam ECS EarlyCareerScientists

The SfAM Early Career Scientists Committee is excited to announce our 6th Annual Research Symposium!

Join us at the University of Westminster on Thursday, 19 April 2017 as we showcase original research conducted by amazing early career scientists, with a skills building session in the afternoon. The ECS Research Symposium provides individuals with a forum to share developing ideas, theories and results across a broad range of microbiological topics.

This year we're excited to incorporate a bioinformatics workshop suitable for all levels of experience. Delegates are not required to bring their own data with them. The session will provide hands-on training focused on bioinformatics and computational biology. The workshop activities are specifically aimed at enabling life scientists to effectively handle and interpret biological data.

The symposium is also an opportunity for students to present their work to a friendly audience, so share with us the research that you are passionate about! There are no restrictions as to the field or topic of study and we are very open to, and highly encourage, creative submissions.

For those interested in presenting your work, then paper and poster submissions can be submitted online and should include a 300-word research abstract.

Travel expenses within the UK will be paid to oral and poster presenters (subject to prior approval).

Deadline for abstract submission is 10 March 2017!
Visit member.sfam.org.uk/SfAM/Events for further details.

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

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WHAT LURKS BENEATH

An overview of waterborne pathogens

The public health burden due to waterborne infectious disease is well known and often cited. Although by many measures the global situation is improving, the sheer scale of human suffering nevertheless justifies repeated emphasis. According to the WHO (World Health Organization), waterborne disease still accounts for around 3.4 million deaths globally. Approximately 1.8 million deaths result from diarrhoeal diseases, of which 1.5 million are attributable to unsafe water and 800,000 are children under five-years-old. Even in developed nations there is an acute problem; in the USA there are 12,000 deaths per year due to microbial waterborne disease. The provision of clean water for drinking, washing and bathing has, of course, been a key challenge since the days of yore, and the link between a lack of sanitation and waterborne disease was formally established over 150 years ago. John Snow's seminal study on a cholera outbreak in Victorian London provided the foundations not only for the germ theory of disease and the emergence of a new field of infectious disease, epidemiology, but also delivered some practical guidelines for waterborne disease prevention or mitigation. Chief among these: do not allow faecal contamination (human, but also animal) to enter the water supply, freshwaters or coastal seawaters. Even to this day, this basic rule requires continual reinforcement and vigilance. Over 600 people died from cholera in the outbreak, investigated by Snow in 1854, as a result of a discarded nappy cloth. Over 9,000 have died (so far) from a cholera outbreak in Haiti that began in 2010 as a result of UN peacekeepers allowing untreated waste to enter the waterways. Thus, whilst much of the basic microbiology and epidemiology underpinning waterborne disease management has been established for many years, resource provision and awareness remain key challenges.

Whilst recognizing the political and socio-economic barriers to addressing the needs of approximately 780 million people who simply do not have adequate access to safe water, there nonetheless remain many basic research challenges to understanding the ecology, pathogenicity, emergence and management of waterborne pathogens. Addressing these questions plays a critical role in developing novel disease management strategies, and are increasingly being posed within a broad 'one-health' context that considers both human, animal and whole ecosystem health. Whilst sanitation, diet and life expectancy has improved immeasurably since John Snow, on the flip side we are today faced with unprecedented pressures on global scales; not least the spread of antibiotic resistance, exponential population growth with the accompanying pressures on resources, and the increasingly undeniable and potentially dire prospect of climate change.

Effective management of infectious disease, waterborne or otherwise, begins with accurate and rapid detection, diagnosis and routine epidemiological surveillance, preferably on national or international scales. The detection of bacterial pathogens that cause outbreaks via the faecal contamination of water, such as *Vibrio cholerae* (cholera), *Salmonella enterica* (typhoid), *Shigella* spp. (bacilliary dysentery), is conventionally carried out indirectly by culture-dependent detection of

Hurricane Matthew was a very powerful, long-lived and deadly tropical cyclone which became the first Category 5 Atlantic hurricane since Hurricane Felix in 2007

faecal indicator bacteria (FIBs), typically coliforms such as *E. coli* or *Enterococci*. These FIBs can themselves also occasionally cause waterborne disease; *E. coli* O157:H7 is known to contaminate water via the faeces of wild animals or livestock, and *Campylobacter jejuni* can similarly be classed as both zoonotic and waterborne. Whilst the use of FIBs often provides early indication of faecal contamination, the method is slow, and the presence of these indicators typically does not correlate with the overall pathogen load. Not all waterborne pathogens enter the water via faeces, or only infect the gastrointestinal tract, and alternative molecular methods combined with quantitative microbial risk assessment (QMRA) are required for detecting the presence of bacterial pathogens from environmental sources.

Human pathogenic viruses, and in particular Norovirus and Enteroviruses such as polioviruses and coxsackieviruses, are common in tap water, river water and seawater and can cause a wide range of serious conditions, notably gastroenteritis, non-specific febrile illness and aseptic meningitis. Many viruses are notoriously resistant to water treatment and have been detected in drinking water that is free from coliforms, thus bespoke real-time PCR assays are most commonly

Waterborne disease still accounts for around 3.4 million deaths globally

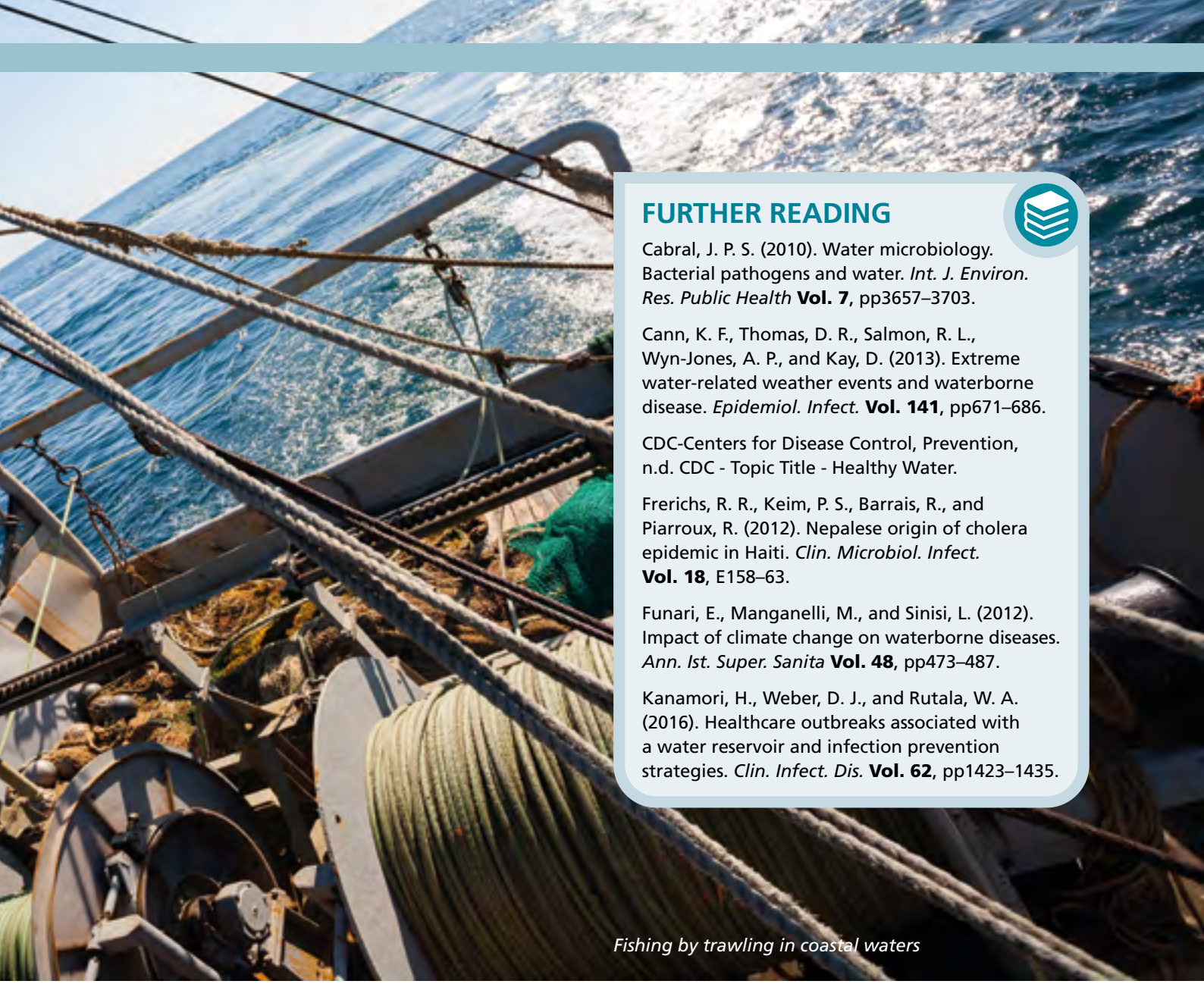
used for detection and monitoring. Recent advances in the use of next-generation sequencing and metagenomics, combined with size fractionation, provides a powerful approach for the characterization of whole bacterial, viral and eukaryotic communities. Rather than use multiple tests for each pathogen, this technology can in principle provide top-down data on microbial ecosystem perturbation due to polluting pathogens. While the cost of such next-generation sequences approaches is currently prohibitive in resource-poor settings, ongoing improvements in the technology and development of community-oriented bioinformatics tools will ultimately pave the way for their more widespread implementation.

Many opportunistic or emerging waterborne pathogens are able to tolerate a wide range of pH or temperature and are resistant to conventional water treatments such as disinfectants or chlorination. So-called opportunistic premise plumbing pathogens are characterized by high levels of persistence, often attributed to the ability to form, or exist within, biofilms, to enter semi-dormant states and to form close associations with amoebae or other eukaryotic hosts. In some cases, it is clear that the conditions within water distribution systems, or even water treatments, actively select for these pathogens. For example, *Legionella pneumophila* (page 28) has adapted to water systems that produce aerosols, such as air conditioning systems, cooling towers and spas, which provide the means of transmission to human lungs to cause legionnaire's disease, a severe form of pneumonia. *Legionella* represents an excellent example of a genus in which an understanding of basic ecology is critical to explaining its emergence as a serious human pathogen. These bacteria are intracellular parasites of protozoa (e.g., *Acantha* and *Naegleria*), which can help to explain both the persistence of this bacteria in the environment and in water distribution systems, as well as its ability to invade human macrophage. Species of the *Mycobacterium avium* complex (MAC; *Myco. avium* and *Myco. intracellulare*) represent another example of taxa that are ubiquitous in the aquatic environment and have adapted to infect the human respiratory or gastrointestinal tract via water. Immunocompromised individuals are particularly vulnerable to infection by these bacteria, which enter water distribution systems through leaks, form stable biofilms and can tolerate high temperatures.

Water provides a common and often undetected mode of transmission in the healthcare environment. In addition to *Legionella* and MAC, *Pseudomonas*, *Serratia*, *Klebsiella*, *Burkholderia*, *Acinetobacter* and many other pathogens, including viruses and fungi, are known to cause nosocomial infection via water. *M. chimaera* (page 18) is an example of an emerging nosocomial pathogen that causes serious infections following open heart surgery, and is specifically associated with contaminated water tanks in heater-cooler units used in theatres. Again, bespoke molecular approaches are required for the detection of such pathogens, and whole-genome sequencing is increasingly being used to understand genome dynamics, adaptation and transmission.

It is pertinent to also consider pathogens of finfish and shellfish and the threat they pose to global food security

Two distinct causal links can be identified between the incidence of waterborne disease and a changing climate. First, a key prediction of climate change science is an increase in extreme weather events including heavy raiAnfall, floods, droughts and hurricanes. Heavy rainfall increases run-off from fields and can overwhelm water treatment plants, resulting in greater pathogen load in the waterways. Droughts can similarly have a negative impact on water quality, as can heavy storms and hurricanes through infrastructure damage; hurricane 'Matthew' is likely to claim many lives in Haiti through a subsequent surge in cholera cases. The second link between climate change and waterborne disease lies in how changes in sea surface temperature and salinity impact on the ecology and abundance of aquatic pathogens. There is strong evidence that population abundance and outbreaks caused by pathogenic *Vibrio* species, in particular *V. cholerae* and



Fishing by trawling in coastal waters

FURTHER READING

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CDC-Centers for Disease Control, Prevention, n.d. CDC - Topic Title - Healthy Water.

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V. parahaemolyticus, are closely tied to sea surface temperature. The summer of 2014 even witnessed cases of *Vibrio* infection in sub-arctic regions due to an unprecedented heatwave across Northern Scandinavia.

Finally, the challenge of waterborne disease extends beyond protecting public health; it is pertinent to also consider pathogens of finfish and shellfish and the threat they pose to global food security. Aquaculture is the fastest growing food-producing sector, with finfish alone now providing 3.1 million people with at least 20% of their dietary animal protein. Since 2014, the majority of finfish consumed globally are farmed rather than caught. Moreover, aquaculture production is heavily skewed towards developing nations. Ninety-four per cent of the 18 million people employed in fish farming in 2014 were Asian, and of the top 10 aquaculture countries, in terms of production, only Norway is classified as high income. As the industry has rapidly intensified, so it has become more vulnerable to devastating outbreaks from bacterial, viral and eukaryotic pathogens. These include several *Vibrio* species, *Aeromonas salmonicida*, *Streptococci* and many different viruses, such as the Infectious Salmon Anaemia (ISA) virus outbreak that bankrupted the Chilean salmon industry in 2007, leaving debts of $1.8 billion.

Again, climate change is likely to play a key role; the emergence and spread of aquaculture pathogens, and the outcome of infection, is tightly linked to temperature as it impacts both on the replication rate of the pathogen and, being poikilothermic animals, on the immune response of the hosts. The development of sustainable aquaculture is thus dependent on developing effective disease management strategies; these include vaccination, farming practices that minimize stress and transmission opportunity, biosecurity and improved diagnostics and surveillance. As with human waterborne pathogens, new technologies such as the advent of next-generation sequencing, will play a central role in understanding, detecting and mitigating the spread of these disease agents.

Edward J Feil

The Milner Centre for Evolution
Department of Biology and Biochemistry
University of Bath

Vibrio vulnificus:

The Gram-negative bacterium *Vibrio vulnificus* is a naturally occurring and common inhabitant of estuarine and coastal environments. This bacterium is fascinating for a number of reasons – these include its striking pathogenicity, high case fatality rate, interesting and unusual epidemiology, cryptic virulence potential and the increasing incidence of disease. Globally, *V. vulnificus* is a significant foodborne pathogen capable of causing primary septicaemia, typically resulting in necrotizing skin lesions, and is the leading cause of seafood-related mortality. Most infections are linked to the consumption of raw or undercooked seafood such as oysters.

Perhaps the most striking aspect associated with this bacterium is the extremely high case fatality rate. In individuals where *V. vulnificus* progresses to primary sepsis, the mortality rate is around 50%, placing these infections on a par with the most serious viral and bacterial human pathogens such as Ebola, Marburg and bubonic plague. Because of this virulence potential, immediate antibiotic therapy is required – and where infections have not been treated very rapidly, death is almost a certainty. *V. vulnificus* is a relatively rare cause of infection, but there have been a number of published studies that demonstrate an increase in disease in the USA and more recently in Europe. Indeed, this pathogen is particularly fascinating because most cases occur in males (~85%), and in patients with underlying conditions resulting in elevated serum iron levels, primarily hepatitis and alcohol-associated liver cirrhosis. Oestrogen appears to reduce the ability of this pathogen to elicit endotoxic shock in women, however, the molecular basis of this protective role remains

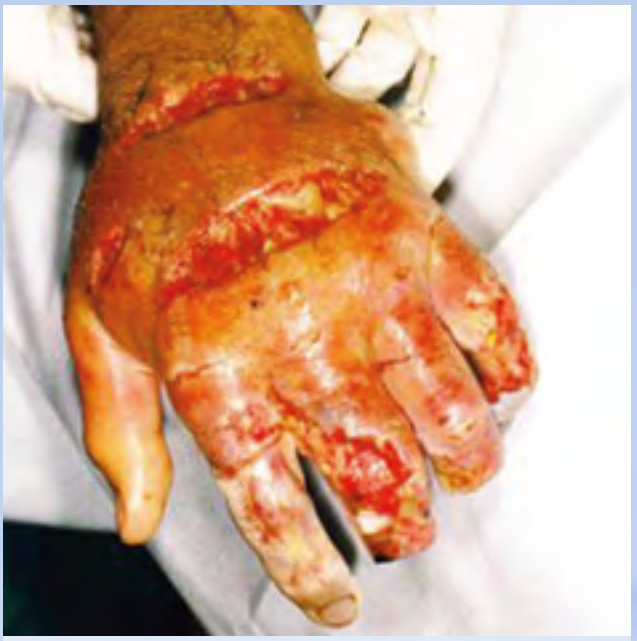

Figure 1: *Infection occurred in a 53-year-old male with no known predisposing factors who received a shrimp shell stick on his finger while fishing in a Louisiana marsh. Symptoms occurred within 12 hours and included swelling of his hand to double size. He reported 'unbearable' pain. He was given IV antibiotics at a hospital ER, but lost circulation in his arm and fingers, which developed necrosis. Despite hyperbaric chamber and continued antibiotic treatment, he underwent eight surgeries and above elbow amputation was being considered when his symptoms improved, and he was released after a month; it took six months for full hand recovery.*

Both food-associated and wound infections involve a short incubation period between exposure and the onset of symptoms, typically within 24 hours of exposure

unclear. These infections progress into visible lesions, typically on the extremities, and result in vesicles or fluid-filled bullae that become necrotic.

In addition to foodborne disease, *V. vulnificus* causes potentially fatal wound infections. Both food-associated and wound infections involve a short incubation period between exposure and the onset of symptoms, typically within 24 hours of exposure. Significantly, as with other vibrios, *V. vulnificus* requires only minute portals of entry to initiate wound infections, and often appear initially as an insect bite. Typically, *V. vulnificus* wound infections are characterized by swelling, erythema and intense pain (Figure 1).

This species is highly heterogeneous and is currently subdivided into three biotypes based on genetic, biochemical and serological features, as well as host range. Biotype 1 strains are human pathogens and are responsible for the vast majority of *V. vulnificus* infections reported worldwide. Biotype 2 contains strains which cause generally fatal infections in aquatic animals such as eels, with occasional human infections.

A further biotype (biotype 3) was discovered in 1996 after an outbreak of *V. vulnificus* infections in an Israeli fish market, and was later found to be a hybrid of biotypes 1 and 2. Complicating our understanding of the virulence process of *V. vulnificus* was the finding that biotype 1 strains are comprised of two distinct genotypes, termed 'C' (clinical) and 'E' (environmental). C-genotype strains are the form most often encountered in human septicaemias (90%), although comprising a much smaller proportion (c. 15%) of the *V. vulnificus* strains occurring in estuarine waters and shellfish. The opposite is the case for wound infections caused by this species, with nearly all isolates being of the E-genotype. Numerous individual genes have been suggested to be important in pathogenesis, including those involved in cytotoxicity, haemolysins, iron sequestration pathways, secretion systems and acid neutralization pathways. To date, and in spite of over a decade of efforts utilizing whole-genome sequencing, no single molecular target has been identified to distinguish pathogenic and non-pathogenic *V. vulnificus* strains, and is a key area of current work.

*the **killer** on the shores*

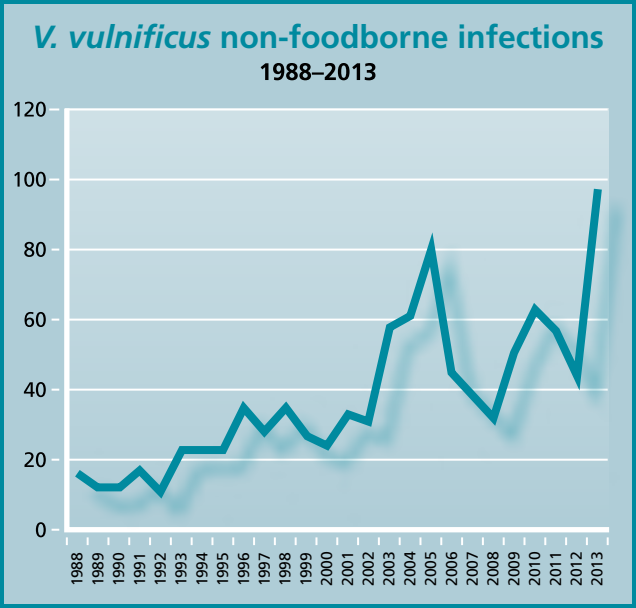

Figure 2: *V. vulnificus non-foodborne infections, 1988–2013. COVIS data regarding yearly totals of V. vulnificus non-foodborne cases reported in the USA (1988–2013) based on route of transmission (confirmed as well as suspected non-foodborne cases). Figure derived from COVIS adjusted datasets totalling 911 cases where classification of transmission routes have been ascertained. Where fatality data was known (noted in 831 cases) 151 fatalities were reported, with a case fatality of 18.1%. Largest yearly total was the last year in the COVIS dataset, 2013, with 97 reported confirmed or suspected non-foodborne V. vulnificus infections.*

Strikingly, the number of reported *V. vulnificus* infections (particularly wound associated) appears to be increasing in the USA (Figure 2). The factors underlying this increase in cases remain unclear, but changes in population density and demographics in coastal areas (and hence possible exposure), better systems of epidemiology and surveillance, and climate change are likely to be contributing to the numbers of infections seen. Certainly, warming of low salinity environments as a result of climate warming appears to be playing a significant role in driving disease emergence. For example, the advent of *V. vulnificus* infections in typically frigid marine waters, such as the Baltic Sea and North Sea during heatwave events serves to illustrate that climate change may be modulating the timing and geographical spread of these pathogens with huge ramifications for the identification, treatment and management of waterborne diseases.

No single molecular target has been identified to distinguish pathogenic and non-pathogenic *V. vulnificus* strains

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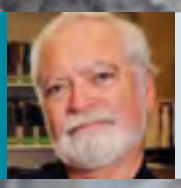
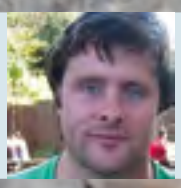
Globally, *V. vulnificus* is a significant foodborne pathogen capable of causing primary septicaemia, typically resulting in necrotizing skin lesions, and is the leading cause of seafood-related mortality. Most infections are linked to the consumption of raw or undercooked seafood such as oysters





James Oliver left
The University of North Carolina at Charlotte

Dr Craig Baker-Austin right
Centre for Environment, Fisheries and Aquaculture Science

Investigating the source of *Mycobacterium chimaera* aerosols associated with cardiac surgery

Non-tuberculous mycobacteria (NTM) are ubiquitous within the environment, particularly in natural and man-made water sources, and are recognized opportunistic pathogens most commonly causing pulmonary infections but also subcutaneous or soft tissue infections. In 2015, a hospital in Switzerland reported six cases of NTM invasive infection following cardiac surgery. The causative organism was identified as *Mycobacterium chimaera* (a recently identified NTM belonging to the *Mycobacterium avium* complex (MAC)) and the infections were attributed to the use of heater-cooler units (HCUs) associated with the cardiopulmonary bypass equipment.

HCUs circulate hot and cold water through lengths of plastic piping, which via heat transfer, enables fast and efficient heating and cooling of the patient's blood and cardioplegia solution during cardiopulmonary bypass. The water within an HCU can become heavily contaminated and whilst it should never come into direct contact with the patient's blood, it was hypothesized that its aerosolization from within the unit could facilitate the release of waterborne pathogens (including *M. chimaera*) and their transmission to the surgical site.

Following alerts from Switzerland and The Netherlands, the European Centre for Disease Prevention and Control (ECDC) issued a rapid risk assessment of invasive cardiovascular infection by *M. chimaera* potentially associated with HCUs used during cardiac surgery. In response, Public Health England (PHE) convened a multi-agency incident management team to assess whether patients in the UK are potentially at risk of *M. chimaera* from contaminated HCUs. As part of this investigation, the Biosafety, Air and Water Microbiology Group (PHE Porton) carried out a controlled laboratory-based study to determine if HCUs

Figure 1 (top) Heater-cooler unit
Figure 2 (bottom) Biofilm growth on the internal components of the heater-cooler

release a microbial aerosol and, if so, to identify potential areas of aerosol release.

The infections reported in Switzerland and The Netherlands were attributed to a specific make/model of HCU (3T HCU; Figure 1). PHE Porton received a 3T HCU that had been in hospital service since 2002 but had recently been decommissioned. Upon receipt, the HCU, which had been decontaminated and drained prior to shipping, was filled with sterile water. The HCU was placed in an environmental test chamber for investigation under controlled and reproducible conditions. Water samples were taken and a range of specialized aerobiological samplers, including a high volume all-glass cyclone sampler, were used to sample the aerosols generated by the HCU with and without water circulation. An aerodynamic particle sizer (APS) was used to identify areas of localized aerosol release. Movement and direction of air was visualized using smoke tracing.

The mean number of bacteria recovered from the water tanks of the HCU was 4.3 x 10^8 cfu/l and opportunistic waterborne pathogens including *Stenotrophomonas maltophilia*, *Sphingomonas paucimobilis* and *Legionella* spp. were identified. *M. chimaera* was also present. The survival and growth of microorganisms within the HCU was probably facilitated by the build-up of organic compounds, debris and a slimy green macro-biofilm that was present on surfaces within the water tanks (Figure 2).

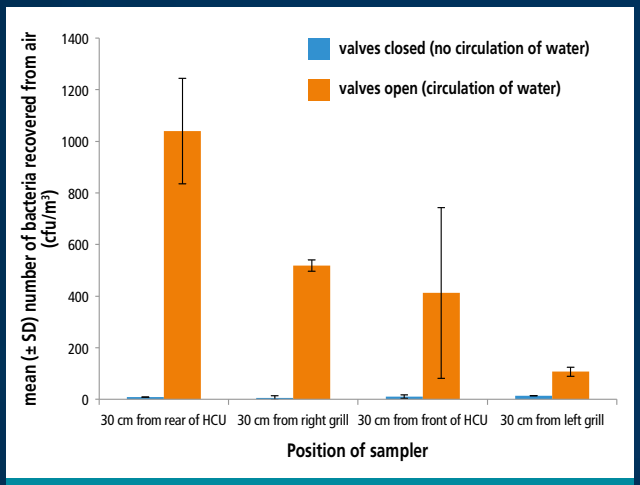
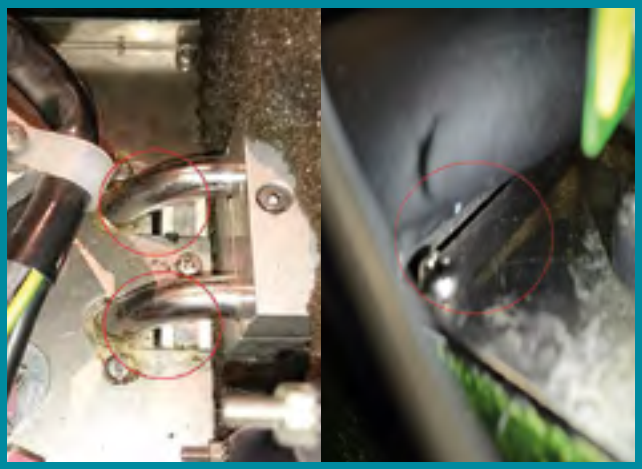


Figure 3 *Number of bacteria released from the heater-cooler unit with and without water circulation*

When the HCU was not circulating water, the mean number of bacteria recovered from the air was ~10 cfu/m³. With water circulating, significantly more bacteria including *M. chimaera*, were recovered (mean: 560 cfu/m³; $p < 0.05$), particularly at the rear of the HCU (Figure 3).

In 2015, a hospital in Switzerland reported six cases of NTM invasive infection following cardiac surgery



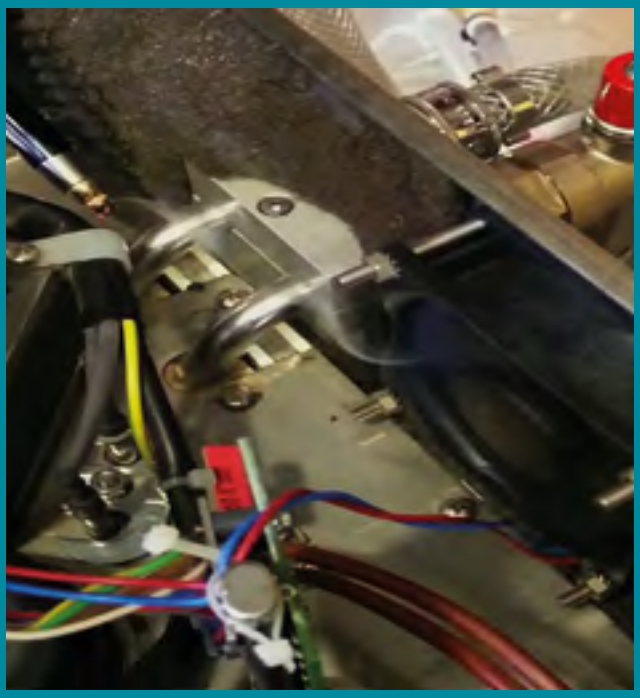


Figure 4 *(top) Gaps identified in the top of the heater-cooler water tanks*
Figure 5 *(right) Directional flow of air from the gaps in the top of the water tanks to the theatre environment via the fan located at the rear of the heater-cooler*

Studies with the APS identified a series of gaps close to the flow and return pipes of the patient and cardioplegia circuit water tanks as areas of aerosol release (Figure 4). Use of a smoke pen demonstrated the direction and flow of air from these gaps to the external environment via the cooling fan at the rear of the HCU (Figure 5). The majority of particles detected were < 2 µm in diameter. Once released into an operating theatre, aerosol particles of this size would remain suspended in air flows, facilitating their transmission to the surgical site.

The results of the aerobiological investigation confirmed that the 3T HCU can generate and release a bioaerosol and prompted the internal examination of a small number of HCUs in active service. However, whilst similar gaps/holes were observed in one HCU (manufactured in 2003), there were no visible breaches in the water tanks of newer machines. It is not known whether these holes can be inadvertently created by years of usage and/or are a result of a design fault that has been rectified in more recent units.

Strategies to control the airborne transmission of *M. chimaera* have been investigated. These include moving the HCU outside of the operating theatre or containing it in an anteroom or unit that prevents bioaerosol release. None of these solutions are logistically simple and they may interfere with the specialist dynamics of the theatre and the efficiency of the HCU.

In the case of the HCU investigated at PHE, a simple intervention, sealing the holes with adhesive putty, significantly reduced the number of particles detected ($p < 0.01$); in most cases to baseline levels (Figure 6).

The company that manufactures the 3T HCU has continued to provide support to NHS Trusts. A field safety notice was issued reinforcing the recommended decontamination protocol to be used by hospitals to alleviate the potential contamination of HCUs and growth of *M. chimaera*. This includes the use of filter sterilized water to fill the tanks, regular water changes and the chemical disinfection of the water and associated tubing. However, many users have struggled

Opportunistic waterborne pathogens including *Stenotrophomonas maltophilia*, *Sphingomonas paucimobilis* and *Legionella* spp. were identified

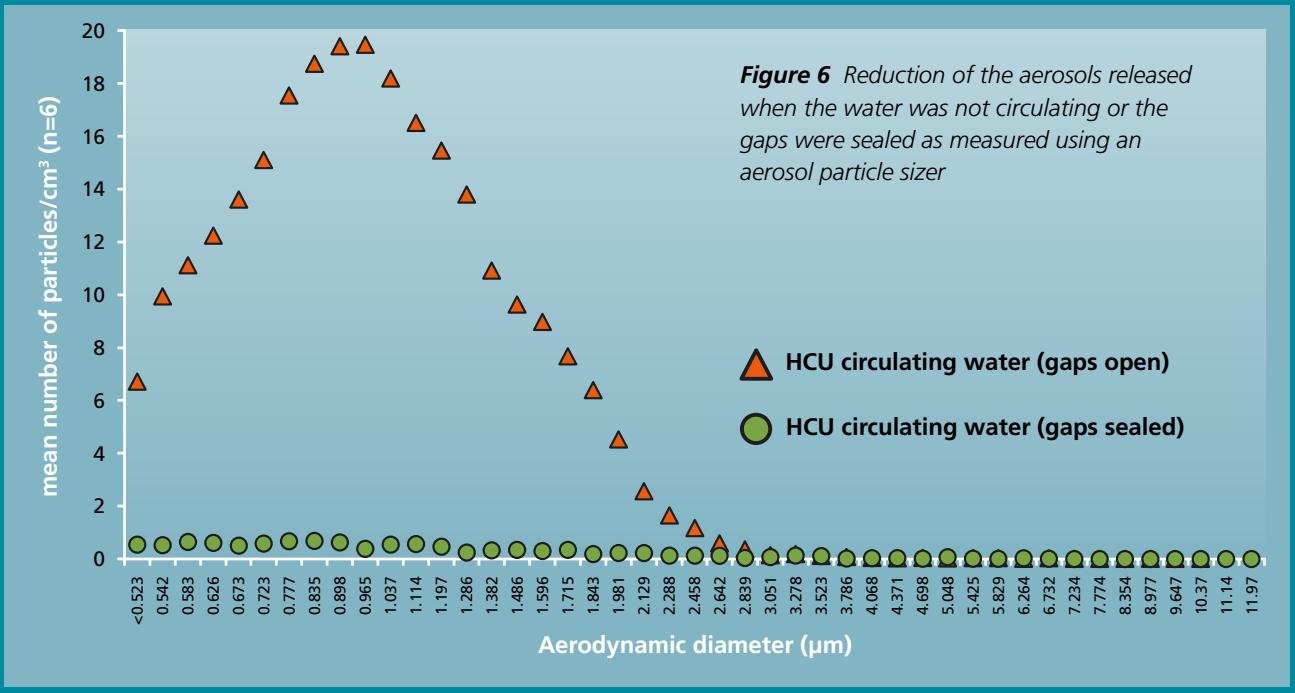


Figure 6 *Reduction of the aerosols released when the water was not circulating or the gaps were sealed as measured using an aerosol particle sizer*

to clear their HCUs of *M. chimaera*, which may reflect the extensive build-up of biofilm and the inability of the disinfectant to penetrate all areas of the HCU and associated tubing. The lipid-rich, hydrophobic cell wall of mycobacteria also contributes to disinfectant resistance. Where Trusts have been unable to clear the HCUs of *Mycobacteria*, the HCU manufacturer has offered to perform an enhanced decontamination involving dismantling and replacing many of the components in contact with the water. However, the issue of contamination was further complicated when Haller *et al*., (2016) published their results where water samples from the HCU's manufacturer were also positive for *M. chimaera*. Such data indicates a local, point source, contamination of units during manufacture, however, mycobacteria are natural contaminants of water so the significance of these findings are yet to be confirmed.

Reports of *M. chimaera* infection associated with HCUs have emerged from other countries including the United States. Further reports of infection are possible in the coming months, however, the risk to patients undergoing heart surgery involving HCUs remains very low and appropriate infection control practices combined with correct disinfection and water testing should further limit future patient exposure.

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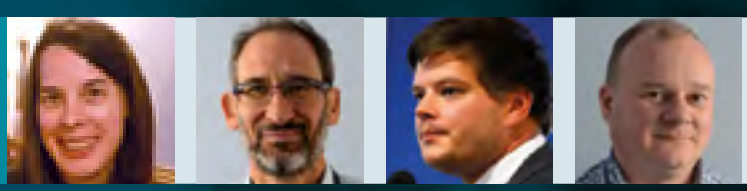

L to R: **Ginny Moore, Jimmy Walker Sam Collins and Simon Parks**
Biosafety, Air and Water Microbiology Group Public Health England

Marine bacteria: an overview for biotechnological applications

The oceans are abundant with microorganisms such as bacteria, viruses and protists, but very few are a potential threat to human health. In fact, many influence and enable the planet's ability to sustain life. These groups include those that degrade and use hydrocarbons as a food source and those that produce biologically important chemicals.

Welcome to the world of marine bacteria

The most rapid development in the commercial use of marine bacteria is reported in the pharmaceutical and medical sectors due to their ability to produce a wide range of bioactive compounds. Some are used in cancer treatment, as anti-inflammatory agents, antibiotics or as neuromodulating agents. Marine cyanobacteria, in particular, are considered to be the richest sources of bioactive agents in the development of anticancer drugs.

The discovery of streptomycin led to the isolation of many other antibiotics and medications from *Streptomyces* and proved an important step in expanding the search for other therapeutic molecules, including rare genera like *Amycolatopsis*, *Dactylosporangium*, *Micromonospora* and *Planomonospora*. The hunt for novel anticancer agents has provoked intense interest, resulting in their isolation from various marine cyanobacteria. The first of its kind, dolastatin 10, was isolated from the bacteria *Dolabella auricularia* from the Indian Ocean in the late 1980s and early 1990s. Since then, research to identify new types of anticancer agents has progressed and dolastatin 10 continues to be isolated from other species of cyanobacteria, in addition to completely new biomolecules of similar microtubule inhibiting properties.

Among many compounds isolated from cyanobacteria, a large group of drugs has been identified as anti-lung cancer agents. Extensive studies were devoted to Tiglicamide A from *Lyngbya confervoides*, which has been proven to be one of the most effective agents against lung cancer. Another cyanobacterial compound, Cryptophycin F, isolated from species of the genus *Nostoc*, was recently identified as a promising agent in the fight against breast cancer, which is the second most common type of cancer.

In addition to anticancer drugs, another important group of biomedical molecules that are produced by marine bacteria include the so-called anti-inflammatory agents. Recent reports have identified powerful anti-inflammatory agents produced by cyanobacteria, and they include molecules called Malyngamide 2 and Malyngamide F acetate. To date, more than 30 different malyngamide-type compounds have been reported with regards to their above-mentioned properties. Among those, some isolates were found to express high cytotoxic activities (e.g., Malyngamide C). Most commonly, malyngamide molecules are derived from marine cyanobacteria species, particularly of the genus *Lyngbya*.

As already mentioned, marine cyanobacteria have also been identified as sources of novel neuromodulating compounds. The focus on those was brought by the ability of some cyanobacteria to produce cytotoxic and hepatotoxic molecules, which are considered to be dangerous to public health, and wild and stock animals. The broad analyses of the compounds isolated from cyanobacteria has led to a novel approach of using selected molecules in the design and production of neuromodulating agents.

Another interesting feature of marine bacteria is their ability to produce an extensive variety of enzymes, which

catalyse a wide range of chemical and biochemical reactions. Although a vast majority of those enzymes can be derived from plants or animals, microorganisms offer a more attractive source of these enzymes to meet the demands of industry. Some of the most prominent enzymes are amylases (e.g., α-amylases used in food, paper and textile industries), cellulases (such as carboxymethylcellulases applied in ethanol production) and proteases (extensively used in pharmacy as digestive-aid remedies, in textile, food and detergent industries as well as in chemical technology).

Adaption of microorganisms to extreme environments requires enzymes that have evolved to function under certain extreme conditions where those organisms are found. Due to their varied habitat and some extreme conditions (hot or cold, increased salinity, acidity, etc.), several marine bacteria are recognized as sources of extremoenzymes. The most well-known example is DNA *Taq* polymerase isolated from *Thermus aquaticus* which has unquestionably been pivotal in molecular biology.

Some extremoenzymes are used in the textile and paper industries, where they're required to operate under high acid or alkaline conditions. Alkaline proteases, lipases, phosphatases and α-amylases have found various applications especially in detergent and paper industries.

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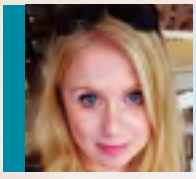
Last but not least, bio-surfactants produced by marine microorganisms have received intense interest for commercial applications. Bio-surfactants are produced by marine bacteria in the context of biodegradation of crude oil and petroleum hydrocarbons, which are characterized by high or absolute hydrophobicity and therefore very limited bioavailability to microorganisms. In order to access a carbon source like this, some bacterial strains are able to produce surface active biopolymers, which due to their amphiphilic structure, enhance the contact between a bacterial cell and a crude oil drop, and thus facilitate microbial degradation. A vast majority of marine bioemulsifiers are glycoproteins that lead to the formation of stable emulsions and foams, which makes them very interesting for the food and cosmetic industry. The best known bioemulsifier of marine origin, which is widely used in the food and cosmetic industry, is Emulsan isolated from *Acinetobacter venetianus* RAG-1.

Successful applications of marine bacterial products in food and cosmetic industries enhance the need to search for novel surface active biopolymers. In general, microbial surface active agents, SAs, are found to have a good environmental profile, which means they are characterized by lower toxicity and better bioavailability when compared with synthetic surfactants.

Last year an international consortium called MARISURF (www.marisurf.eu), led by Heriot-Watt University, was awarded a grant from the European Union framework programme for research and innovation Horizon 2020. The aim of this project is to apply an innovative approach to screening bacterial collections from various marine reservoirs for novel surface active biopolymers, which can be applied on an industrial scale by the cosmetic and food industry. Therefore, the industrial end-users are actively involved in the project in order to guide and provide specific characteristics, which are needed for implementing the surfactants to the industrial sector.

The marine environment contains a vast diversity of microorganisms, many of which offer the ability to produce biomolecules with a range of functionalities. Many have found applications in the medical, cosmetic and food industries, as well as in bioremediation. The natural origin of the compounds and possibility of their production under standard conditions (room temperature, atmospheric pressure, etc.) make them ideal as replacements for their chemically obtained counterparts.



Karina Salek
Institute of Mechanical, Process & Energy Engineering
Heriot-Watt University

The **microbiological risks** of dental unit waterlines

Figure 1 Dental units contain an intricate network of tubing and electrical wires

It is impossible to visit a UK hospital nowadays without being confronted by the evidence of infection control policies, from signs on doors and walls to the ubiquitous presence of hand sanitizer dispensers. Infection control also lies at the heart of dental practice management. Although the risks of cross-infection are generally much lower in a dental surgery than in a general hospital, there are some unique risks associated with dentistry. In particular, many dental procedures involve the generation of aerosols in the patient's mouth and it is critical that the water supply used is free from infectious agents or toxins.

Dental chair units, comprising the chair, light, waterlines, spittoon and handheld instruments, are regarded as medical devices under the EU Medical Devices Directive. As such, there is an onus on the dental practitioner to maintain the units and to minimize the risks of transmitting infections to patients or staff. Unfortunately, this is not always easy. Dental units typically contain several metres of narrow-bore tubes to supply water to cool and irrigate the turbine, handpieces, ultrasonic scalers and three-in-one air/water syringes as well as to provide water for patients to rinse their mouths (Figure 1). When not in use, water stagnates in these tubes providing an optimal environment for the formation of biofilms.

There are currently no European regulations concerning the microbiological quality of water released from dental units (DUWLs). However, the American Dental Association has issued guidance that levels of heterotrophic bacteria in water exiting DUWLs should be no higher than the maximum levels permitted in drinking water, currently ≤500 CFU/ml in the US. This is not always easy to achieve because biofilms inside the DUWLs provide a reservoir for the continual release of bacteria and fungi into the water column. Indeed, many independent studies have shown that the microbial load is higher in output water from DUWL waterlines than in the water entering the system. Most of these microorganisms are relatively harmless. For example, recent next-generation sequence analysis of microbes entering and exiting DUWLs found that proteobacteria constituted 60% of the total sequences detected and that the genera *Sphingomonas* and *Sphingobium* were particularly enriched in the output water (Figure 2). Even though these species are not pathogenic, they are Gram-negative bacteria and producers of endotoxins, which themselves may carry a risk of localized inflammation, fever or shock.

The major bacterial pathogens of concern for DUWL infections are *Legionella pneumophila* (Page 28), *Pseudomonas aeruginosa* and non-tuberculous mycobacteria. For a healthy adult, the risks of obtaining an infectious dose of any of these organisms from a DUWL is very low. Even so, it is important to be vigilant since infections can occur. In one well-documented case in 2012, an 82-year-old lady in Italy died from *Leg. pneumophila* infection that was traced back to her dental practice. It is very rare to find such a clear association. In this case, the dental practice was identified as the source of infection since the patient had not left her house in the 10 days prior to her admission to the intensive care unit. *Leg. pneumophila* was not detected in the water supply in her house, but was found in the DUWL at her dental practice. Furthermore, both the patient and the dental surgery were shown to have a rare sequence type of a virulent strain of *Leg. pneumophila*. It is likely that there are other cases of infection from DUWLs that are not traceable and therefore go unreported.

In 1987, two patients with solid tumours developed gingival abscesses following exposure to DUWL water containing *Ps. aeruginosa*. The dental unit turbine was shown to harbour the same pyocin-type *Ps. aeruginosa*

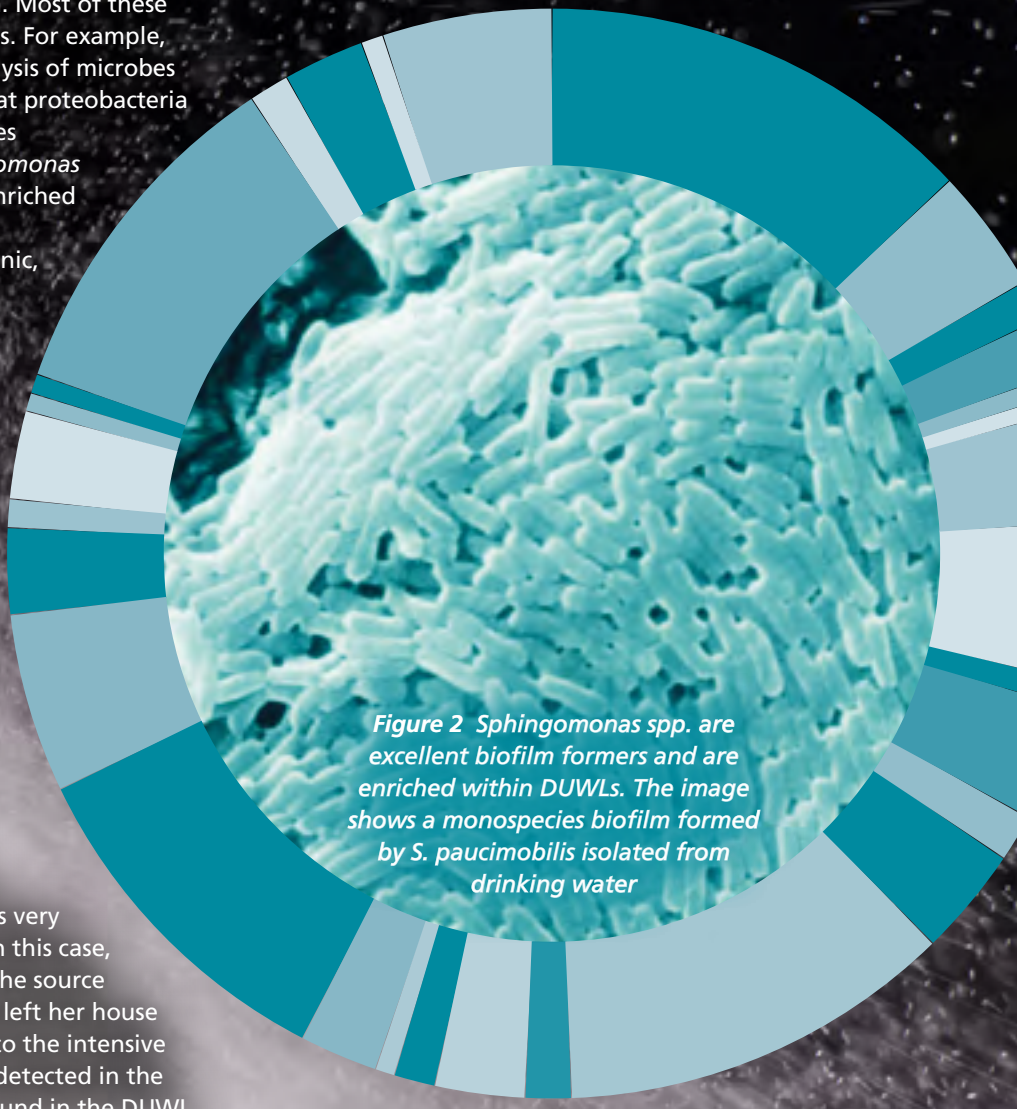


***Figure 2** Sphingomonas spp. are excellent biofilm formers and are enriched within DUWLs. The image shows a monospecies biofilm formed by S. paucimobilis isolated from drinking water*

It is critical that the water supply used is free from infectious agents or toxins

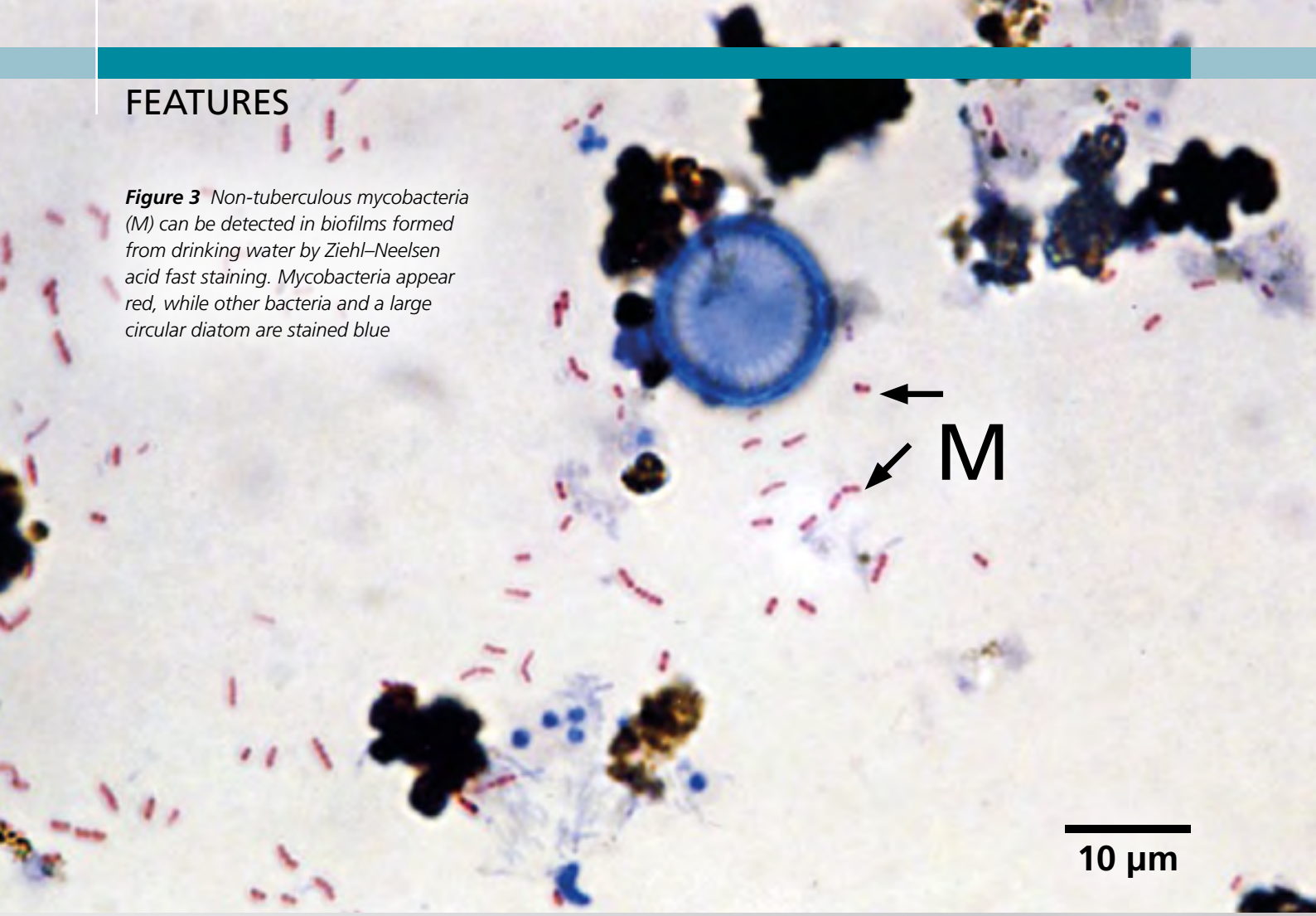


Figure 3 *Non-tuberculous mycobacteria (M) can be detected in biofilms formed from drinking water by Ziehl–Neelsen acid fast staining. Mycobacteria appear red, while other bacteria and a large circular diatom are stained blue*

as the strain that infected the patients. However, pyocin-typing is not terribly specific and it is possible that the infections originated elsewhere. *Ps. aeruginosa* is perhaps more of a concern for patients with cystic fibrosis since these patients are very susceptible to *Ps. aeruginosa* colonization of the lungs. A Danish study looking at the transmission of *Ps. aeruginosa* to cystic fibrosis patients following dental surgery found relatively low acquisition rates after dental procedures that were not significantly different from the background rate. Nevertheless, patients with cystic fibrosis that undergo frequent dental visits may be at elevated risk of acquiring new *Ps. aeruginosa* infections.

Non-tuberculous mycobacteria are also only a minor concern for immunocompetent individuals. However, patients with reduced immune function, such as those with AIDS, are at greater increased risk of infection. Mycobacteria are enriched in biofilms in water systems (Figure 3) and are transmitted via aerosols. There have been a very small number of case reports of immunocompromised patients becoming infected with non-tuberculous mycobacteria following dental extractions but the overall risk of infections from these organisms in dental practices is probably very low.

Eukaryotic microorganisms may also play a role in DUWL biofilms. Amoebae are a concern as they can act as hosts for *Legionella* spp., protecting the bacteria from disinfectants. Amoebae have been detected in DUWL output water. Next-generation sequence analysis also found that *Candida albicans* was elevated in DUWL output water. *C. albicans* is a common colonizer of the oral cavity and is an opportunistic pathogen. It is possible that *C. albicans* may have been inoculated into the DUWL after treatment of a patient, although it was also detected in the inflowing water. Oral streptococci have also been identified in DUWL biofilms, indicating that patients are a potential source of contamination for DUWL biofilms. Anti-retraction valves on dental handpieces can help to prevent backflow of water from the patient but it is important that these are well-maintained as failures of the valves have been documented.

There is increasing concern that viruses may be a source of infection in drinking water throughout the world. Many different viruses can be found in water supplies including adenovirus, hepatitis A and E viruses, and norovirus. Chlorine is effective at inactivating most of these viruses. However, concerns over toxic disinfection by-products from chlorine are leading some water distributors to move towards alternative disinfection approaches such as monochloramine or ultraviolet light. Unfortunately, these are not active against all viruses leaving potential risks of infection. The role of viruses in DUWLs has received almost no attention to date so it is completely unclear whether waterborne viruses pose a serious risk of infection in dental practices.

DUWL biofilms pose a relatively low infection risk to healthy individuals

To combat the risks of infection, regular treatment of DUWLs with disinfectants is essential. This can be done either continually or periodically. There is some evidence that a high dose treatment before a period of water stagnation, for example, over the weekend, helps to reduce the bacterial load in the system. However, disinfection has its own limitations. Disinfectants can accumulate in DUWL biofilms leading to the slow release of toxic by-products. There is evidence that some disinfectants interfere with dental adhesives. Chlorine-based disinfectants may leach mercury from dental amalgam leading to the accumulation of mercury in the waste water. In addition, an inappropriate choice of disinfectant can lead to degradation of materials in the DUWL necessitating costly replacement.

Overall, DUWL biofilms pose a relatively low infection risk to healthy individuals. Nevertheless, it is extremely important to control biofilm growth to protect the health of patients and staff. Manufacturers of dental units have a responsibility to test different disinfection approaches so that they can endorse appropriate products that are compatible with their units. At the same time, further research is needed on the long-term impact of different disinfection approaches on biofilm growth in DUWLs. Clear guidance from dental governing bodies will be important for helping dentists to maintain DUWLs in their practices and to monitor them effectively to ensure that they remain safe for all patients, including those with reduced immune function.

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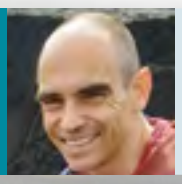

Nick Jakubovics
Newcastle University

Legionella

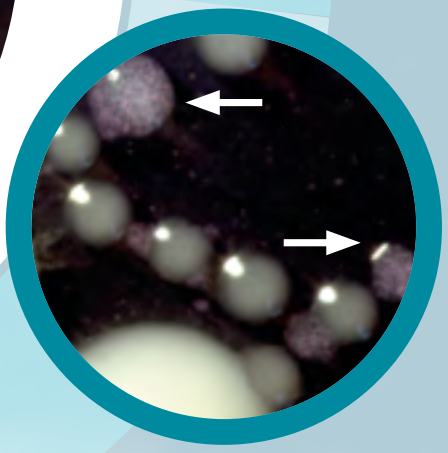

Figure 1: *Legionella pneumophila sg-1 colonies (arrows) on BMPA agar*

Do we always look in the correct place?

Legionellae are ubiquitous environmental organisms, which can cause legionnaires' disease (LD), a potentially fatal pneumonia or Pontiac fever, a milder self-limiting illness. There are more than 60 species of *Legionella* but *Legionella pneumophila*, and in particular *Leg. pneumophila* serogroup 1 (Figure 1), account for the majority of global disease. The incidence of LD is increasing with the highest number of cases ever reported in Europe in 2014 (Figure 2). LD is a notifiable disease in the UK and other countries, meaning it must be reported to the national surveillance scheme of that country. Depending on the circumstances of each case, an investigation may be initiated to determine and ultimately control the source of infection. There is epidemiological evidence that unambiguously links LD to the inhalation of aerosols from contaminated water including cooling towers, spa pools, and hot and cold water systems. Whilst cooling towers are well-documented causes of large community outbreaks, the majority of LD cases are sporadic and a source is rarely found. This may suggest that there are hidden reservoirs of *Legionellae* that are not frequently considered during investigations.

In 2010, a Health Protection Agency (now Public Health England) case-controlled study suggested that approximately 20% of sporadic LD cases could be attributed to exposure to car windscreen wiper fluid without added screenwash, which would otherwise have controlled the presence of *Legionellae*. This hypothesis was supported by a study in 2012 demonstrating the detection of *Leg. pneumophila* in windscreen wiper fluid without screenwash. Similar studies have also been conducted in the United States. Whilst this potential exposure route is interesting, no LD cases have been definitively linked to windscreen wiper fluid. This area warrants further investigation, as a simple public health intervention, namely adding screenwash, may significantly reduce LD incidence.

In 2009, an investigation in Spain highlighted a device not previously linked to LD. Eleven cases were traced to a milling machine used in street repaving. The water tanks of the machine had been filled with natural spring water. Aerosols were created during the milling process and those nearby were exposed. As these milling machines are mobile and move frequently it is surprising that they were identified as a source at all. A more recent report of LD in The Netherlands implicated a particular piece of medical equipment. Continuous positive airway pressure, or CPAP, is used as a treatment for sleep apnoea. Dutch investigators linked a case of LD

to contamination of a CPAP machine in the home of the patient. The machine had been poorly maintained and had been topped up with non-sterile domestic tap water. These case studies demonstrate that *Legionellae* are not confined to systems typically associated with LD and that more unusual sources may be important reservoirs and vectors for transmission.

There is another species of *Legionella* which made the UK headlines in 2014 after causing a number of cases of LD in Scotland. *Legionella longbeachae* is responsible for approximately 50% of LD cases in Australasia but is rarely encountered in Europe or North America. Unlike traditional waterborne *Legionella* it is typically found in potting compost. Picard-Masson *et al*. recently reported two interesting cases of *Leg. longbeachae* infection not related to compost exposure. Both cases worked at a metal recycling plant. Several potential exposures to soil were noted and *Leg. longbeachae*, which was indistinguishable from the patient isolates, was cultured from soil samples. This investigation highlights the need to consider occupational exposure as well as traditional potting compost exposure for *Leg. longbeachae* infections. However, *Leg. longbeachae* is not the only *Legionella* found in soil. Multiple clinically relevant

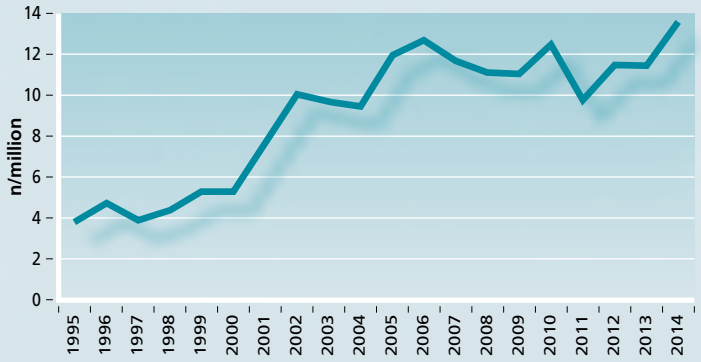

Figure 2: *Number of cases of legionnaires' disease in Europe by year. Courtesy of the European Centre for Disease Prevention and Control (ECDC)*

Leg. pneumophila sequence types (STs) have been found in garden soil in The Netherlands. *Legionella pneumophila* is also present in commercial potting compost. This raises an important question. Could garden soil and/or compost be an important source of *Leg. pneumophila* infections? Could they account for some of the cases for which a source is never found?

In 2014, a large community outbreak of LD occurred in Portugal. One of the first cases of disease occurred in a man, who, after being exposed to *Legionella* from the implicated cooling tower travelled 300 km to his home which he shared with his mother. She cared for him during the early stages of his illness and was subsequently diagnosed with LD. She was infected with the same type of *Legionella* as her son. Investigators proposed probable human-to-human transmission. Although an isolated report, this is a very interesting finding that could have important consequences for future investigations of LD. Finally, an intriguing report published in September 2016 by David *et al*. also gives the *Legionella* field pause for thought. In Northern Europe, approximately 50% of all sporadic cases of LD are caused by a discreet number of specific *Leg. pneumophila* sequence types (1, 23, 37, 47 and 62). With the exception of ST1, these STs are rarely isolated from environmental sources. Using whole-genome sequencing, the authors were able to show that these STs have emerged recently, independent of each other and that they have spread globally in a short period of time. The mechanism for this spread remains unknown. It seems plausible that water systems that travel the world, e.g., ships and planes, may be partly responsible for this spread. However, the authors propose an additional hypothesis, suggesting that infected humans may be contributing to the spread of strains by linking man-made water systems through human transmission. This is an intriguing thought that certainly warrants further research as it could be that some *Legionella* are not strictly accidental opportunistic pathogens after all.

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Dr Samuel Collins
Biosafety, Air and Water Microbiology Group
National Infection Service,
Public Health England

BIOFOCUS

The life sciences sector in the UK is a success story worth celebrating

In October we celebrated the fifth annual Biology Week with life science celebrations happening all over the UK, including many microbiology events and activities.

The Learned Society Partnership on Antimicrobial Resistance (LeSPAR) and the European Federation of Biotechnology (EFB), of which the RSB and S*f*AM are members, jointly held a very popular Policy Lates event on antimicrobial resistance (AMR). S*f*AM's Vice President Mark Fielder was part of the expert panel which examined the roles of innovation and regulation in tackling the AMR crisis from different perspectives, including veterinary research, biotechnology and public health.

Professor Fielder spoke about the need to take a 'one health view' – think of the human, the environment and the animal – instead of thinking of them separately. Audience questions covered a range of topics, including the rising availability of antibiotics for purchase online and their regulation, and the lack of rapid diagnostics leading to pressure on GPs to prescribe antibiotics without an accurate diagnosis. There was also a

discussion about the lack of new antibiotics on the market and the lack of incentives for pharmaceutical companies. At the end of the event it was also noted that there are still more people dying from lack of access to antibiotics rather than from resistance, which can make international collaborations challenging. You can read about the Longitude Prize for AMR research on our blog.

We were very pleased to welcome both the President and Chief Executive of S*f*AM to the Biology Week Parliamentary Reception in the House of Commons, held in partnership with BBSRC. The Churchill Room was packed with more than 120 invited guests, including Rt Hon Jo Johnson MP, Minister of State for Universities, Science, Research and Innovation. The audience heard from Stephen Metcalfe MP, of the Science and Technology Committee, who stated that science was a unique policy area that cuts across all major parties and all of society. Chi Onwurah MP, Shadow Minister for Industrial Strategy, outlined the importance of conducting 'science for science's sake', but also emphasized the important contribution that biology makes to society as a whole.

We also welcomed S*f*AM's Chief Executive to our annual awards ceremony which celebrated the best in biology books, photography and science communication. S*f*AM contributed to our Biology Week Quiz – which was widely used in schools during the week. As part of the 13–15 quiz we asked S*f*AM's question: 'Which of the following cannot be seen under a light microscope – virus, bacterium or cell?' The quiz, along with many other educational resources created and shared in celebration of Biology Week, will be available on our website throughout the year.

Many of our other Membership Organizations got involved in Biology Week events and activities. The RSB, Biochemical Society and Cancer Research UK organized a debate around the question: *Can we predict people's chance of getting cancer? Should we?* Hundreds gathered in the Royal Institution's famous Faraday Theatre to discuss the latest screening and genome sequencing techniques, along with the ethical and societal impact of 'The DNA Revolution'. A report and audio recording of the event are available on our website now.

Earlier this year we ran several public engagement activities for a general audience, in partnership with S*f*AM and our other Membership Organizations, for example, in June the 'Biology Big Top' went to Cheltenham Science Festival. We'll soon be planning our public engagement activities for 2017 and hope to collaborate on some cross-over activities.

Soon in the new year we hope to start working with S*f*AM and our other MOs on the annual Voice of the Future event. At Voice of the Future, young scientists and engineers quiz key political figures in the Houses of Parliament about the science policy issues that matter to them. It is a unique event – in no other part of Parliament is the normal select committee format completely reversed so that MPs have to answer questions rather than ask them. The event aims to highlight the importance of policymakers using reliable evidence and being held to account on their decisions and today's young scientists will be vital for this in the future.

Finally, we would like to welcome the S*f*AM team to Charles Darwin House in London, where the RSB is also based.

There was also a discussion about the lack of new antibiotics on the market and the lack of incentives for pharmaceutical companies

Dr Mark Downs CBiol FRSB
Chief Executive of the Royal Society of Biology

In the midst of perhaps the most toxic and ill-tempered US election campaigns in modern history, US presidential candidate Hillary Clinton became ill during a 9/11 commemoration ceremony at Ground Zero, NY. In the stifling heat, she was filmed stumbling and being helped to her car by a member of her security entourage. Appearing a few hours later, claiming she was 'feeling great' it later emerged that she was in fact suffering from pneumonia. In an election campaign where her opponent, US Republican president-elect Donald Trump repeatedly questioned whether Mrs Clinton had the 'mental and physical stamina' to be president, both were at pains to demonstrate vitality and vigour. Health had, in Trump's words, become 'an issue'. But what's new? From the first infection-stricken war-hero presidents to the modern era, presidents and presidential candidates alike have sought to hide their ailing health. The health of those that would be president has always been a political issue. Infectious diseases in particular have, from the foundation of that august office, dictated the length, timbre or trajectory of the terms of many past Presidents of the United States of America; perhaps more so than any scandal, war or assassin's bullet. Deadly, embarrassing (George Bush Snr famously vomited on the Japanese Prime Minister at a formal dinner), devastating and tragic; here are a few of the most notable examples:

George Washington

1789 – 1797

The first US President, George Washington might well be remembered as the president who had everything, quite literally. Washington was witness to (and survived) more epidemics than any other president and led a life plagued by deadly infections. As a youth of 15, Washington contracted diphtheria, and by 17, malaria. Taking to voyage with his tuberculosis-stricken half-brother to Barbados in 1751, the 19-year-old Washington not only contracted TB himself, but also smallpox, and made a full recovery (his half-brother died the next year). He would later accuse the British, in 1776, of deliberately infecting Bostonians with the disease in an act of bioterrorism and advocated variolation to promote immunity for his soldiers and the general population during the Revolutionary War. He endured recurrent bouts of dysentery, tonsillitis (quinsy), epiglottitis (*Haemophilus influenzae* infection) and pneumonia. By the time he was inaugurated president, he had lost

all but one of his teeth to infection and decay. He was one of 20,000 who fled the 1793 Philadelphia yellow fever epidemic, managing to dodge the most severe epidemic in American history, which claimed the lives of at least 5,000 Philadelphians. In 1799, two years after leaving office, having refused a third term to enjoy his retirement, Washington died aged 67 of upper airway obstruction due to acute laryngitis or acute bacterial epiglottitis, most likely a streptococcal infection. Although his junior physician suggested a tracheotomy, which would most probably have saved him, his older physician considered the procedure, still in its infancy, too risky to perform on a man of such stature.

Thomas Jefferson

1801 – 1809

Founding father, principal author of the 1776 Declaration of Independence and 3rd President of the US had, by the time he took office, endured a litany of diseases and injuries which made him certain, in 1797, that death was near. Despite this, during his terms of office he suffered only one bout of dysentery (1802) and a severe jaw infection (1806). Unfortunately, things got a little worse towards the end of his life when in 1818 he contracted a severe infection (boils) on his buttocks, which possibly led to septicaemia. He was plagued by urinary retention due to prostatic hypertrophy, which was relieved by the use of 'bougies', early urinary catheters which, being unsterile introduced bacteria into the bladder and led to urinary tract infections and pyelitis. Following bouts of recurrent diarrhoea, Jefferson died on 4 July 1826, just a few hours before John Adams.

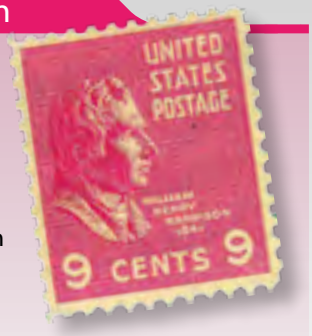
However, Jefferson is notable for being the first president to champion Edward Jenner's approach of using cowpox inoculation to prevent smallpox (John Adams had been approached in 1800 but did not respond, perhaps put off by his own experiences of variolation which was, by all accounts, horrendous). In a letter to Jenner in 1806, Jefferson wrote "*having been among the early converts, in this part of the globe, to its efficiency, I took an early part in recommending it to my countrymen*", Jefferson had himself and his family inoculated against smallpox.

From the first infection-stricken war-hero presidents to the modern era, presidents and presidential candidates alike have sought to hide their ailing health

Infections in the Oval Office: A bug's eye view of the American Presidents

William Henry Harrison

1841 – 1841



The first US President to die in office, Harrison didn't get to stride the corridors of power for long. He gave his two hour inauguration speech on a wet, freezing and windy morning on the 4 March. He caught a cold and had, by 27 March, developed right lower lobe pneumonia. He died one month to the day of his inauguration, on 4 April. Pneumonia would also claim the life of his grandson, President Benjamin Harrison (1889–1893) in 1901.

Zachary Taylor

1849 – 1850

Infection was once again destined to claim the life of a serving president. Taylor had endured three bouts of malaria before becoming president and while on a presidential tour in 1849 fell ill with a suspected case of cholera, leaving his health in a precarious state. On 4 July 1850, Taylor attended a number of Independence Day celebrations in Washington DC, including the dedication of the Washington Monument, became overheated and later developed abdominal cramps. Initially blamed on his consumption of iced milk and cherries. His conditioned worsened; diarrhoea, fever, vomiting and bloody motions led to a diagnosis of 'cholera morbus' (an antiquated term for gastroenteritis), which eventually led to his death on 9 July. The exact cause of death is unclear, but cholera or typhoid fever (*Salmonella typhi*) contracted from the cherries consumed on 4 July been proposed.

Abraham Lincoln

1861 – 1865

Honest Abe, the most famous and beloved of US Presidents, contracted malaria on at least two occasions and is suspected to have caught scarlet fever in 1860 from his son, Willie (who died in 1862 from typhoid fever). Lincoln travelled with his personal valet, William H. Johnson, to the dedication of the Soldiers' National Cemetery,

Gettysberg, Pennsylvania where he delivered the now infamous Gettysberg Address on the 19 November 1863. On the return journey to Washington DC, Lincoln developed a severe headache, weakness and fever, eventually diagnosed as smallpox. By December, Lincoln had recovered, however, William H. Johnson who had also contracted the disease at the same time, died on 28 January. Abraham Lincoln was assassinated by John Wilkes Booth on 15 April 1865.

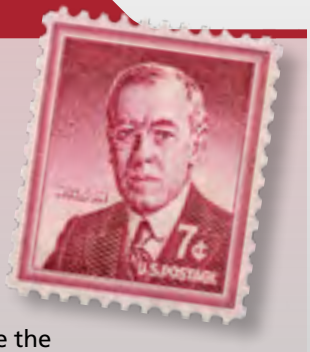
James A. Garfield

1881 – 1881

President James Garfield, the 20th US Commander-in-Chief, en route to his first presidential family vacation (his wife Lucretia was convalescing after contracting malaria) was shot, by assassin Charlie Guiteau, at a railway depot in Washington DC on 2 July 1881. Two bullets hit Garfield, the first grazing his shoulder, the second entering via the right posterior thorax, lodged beneath the pancreas. The physicians attending Garfield were unable to locate the second bullet, and the wound was probed regularly by multiple physicians. In response to the shooting, Alexander Graham Bell invented the 'induction balance' (an early metal detector) to help locate the bullet, but to no avail – the president's bedsprings interfered with the signal to such an extent that the detector (which would have worked otherwise) was useless. Although Lister's theories of antiseptic surgery, published in 1867, would have been well known at the time of Garfield's shooting, his physicians in probing for the bullet with unsanitized hands and instruments undoubtedly led to the president's death 80 days later on 19 September 1881. Garfield's original wound was 3.5 inches in length, by the time of death it was over 20 inches in length and copiously purulent. One of his physicians, Dr D. W. Bliss, later died of septicaemia contracted when he cut himself dressing the president's wound.

Woodrow Wilson

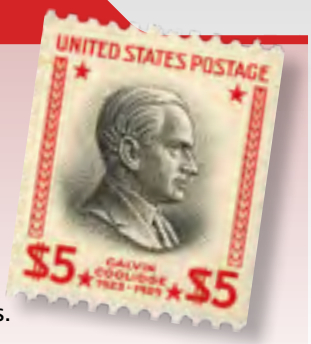
1913 – 1921



Wilson's presidency coincided with the First World War and the 'Great Pandemic' (Spanish influenza), which resulted in the deaths of tens of thousands of US soldiers. While attending the Paris Peace Conference to negotiate the Treaty of Versailles in January 1919, Wilson developed severe coughing spasms, diarrhoea and fever, later diagnosed as Spanish influenza. Although he recovered, he was unable to participate in some of the key negotiations, the outcomes of the peace conference were therefore significantly different to those Wilson envisaged.

Calvin Coolidge

1923 – 1929



The presidency of Calvin Coolidge gives us a stark and tragic reminder of the horrors of the pre-antibioitc era. In 1924, his 16-year-old son, Calvin, developed a blister on his foot after a game of tennis. The abrasion became infected and Calvin Jr died a few days later from septicaemia. Many agree that the tone of his presidency changed entirely after the death of his son. The remainder of Coolidge's time in office was marked by severe episodes of depression. Once described as the 'Great Refrainer' Coolidge's *laissez-faire* attitude led many to blame him for the Wall Street Crash of 1929. Fleming's discovery of penicillin in 1928 was the dawn of the antibiotic era.

Franklin Delano Roosevelt

1933 – 1945

Four-term President Franklin D. Roosevelt contracted Polio, aged 39, during a family visit to Canada in 1921. As a result, Roosevelt was paralysed in both legs and had to use a wheelchair for the remainder of his life. Famous for extensively funding polio research, and founder of the 'March of Dimes' a grass-roots initiative whereby people, including millions of children, across the US sent dimes to the president to fund research into a vaccine, led to Jonas Salk's polio vaccine in 1954 and Sabin's oral vaccine in 1962.

Professor Brendan Gilmore
School of Pharmacy
Queen's University Belfast

CAREERS

Naomi Weir. Shaping organizational priorities: Giving evidence

Not too many years ago I was a biology student and wasn't sure what I wanted to do next. In fact, I didn't really know what the options were and I certainly hadn't heard of science policy. During my penultimate summer as a student I interned with the company that sponsored my university sports team – which happened to be a bank. When they subsequently offered me a place on their graduate scheme I didn't have any other alternatives so accepted. I was earning money, the hours weren't terrible, and the team I worked with were lovely. I persisted for a couple of years, but after an initial period of getting to understand the role and taking some financial exams, every day more or less looked the same. I couldn't imagine staying in that kind of role long term so began investigating the alternatives.

I asked everyone I knew what they did for work. Now often you know what friends or family do for work – in the sense that you might know their job title and the company they work for. But if someone said they're an environmental consultant or a civil servant, an account manager or a business analyst for instance – what did they actually do?

Then I spoke to a friend from church who worked in policy. Her job seemed to involve coming up with better ways of doing things, basing ideas on research – be that number crunching, literature reviews or talking to people – and then trying to get these ideas to happen by interacting with the individuals and organizations with the power to do something about it. It sounded appealing.

My tendency is to be quite risk averse and to do the sensible thing, but I realized that staying put would have been more of a risk than trying something new and it not working out. And so after applying directly for a range of entry level roles in science policy without success I took the decision to leave my well-paid, but uninspiring, permanent job for a three-month temporary administration job in a policy organization to get some experience. Wonderfully, the move paid off and I soon began my first role as a policy officer working on higher education policy.

A few years later an opportunity cropped up to venture back into science working at the Campaign for Science and Engineering (CaSE). CaSE is a small team of five people and I lead our policy work with the overarching aim of seeking to ensure the UK has the funding, policies and skills to help science and engineering thrive.

Over the year I challenged myself to saying yes to things that slightly scared me

I particularly enjoy the diversity of my role. Working at the intersection between politics and science involves interacting with a wide range of people, including academics, industry representatives and colleagues working in policy as well as parliamentarians and civil servants. A typical day could include anything from detailed analysis of research and development spending, meeting with MPs in Parliament to discuss a piece of legislation, or writing a quick-response comment piece on a Government announcement, to planning a policy workshop on priorities for the sector in the Brexit negotiations, working on a substantial evidence-based report on immigration policy, or meeting with a CaSE member to understand their policy priorities.

I also enjoy the constant opportunities to take on new challenges. After being at CaSE for a year or so I had a bit of a career fast-forward when my boss went on maternity leave and handed me the reins for 2015 – an important General Election and Spending Review year. It was a wonderful opportunity for me but also quite a responsibility. Thinking back on the year, feeling constantly out of my depth did train me to say 'yes'. Not to every task, or event, or invitation – that would just leave me busy and ineffective. In fact, I still need to get better at saying 'no' to some of those. But over the year I challenged myself to saying yes to things that slightly scared me. And there were plenty. Introducing myself to that person at an event. Asking a question at a large conference. Commenting in the press. Meeting with a minister. Shaping organizational priorities. Giving evidence to a Select Committee. Chairing a conference.

Of course, you can come unstuck. For instance I've been asked a number of times to speak at events on issues that I genuinely know very little about. Saying 'no' to those was probably wise. But even in one short year, what once was a daunting prospect became just part of my job and a new set of opportunities and challenges always seems to crop up.

I couldn't have anticipated the meandering route my career has taken to date. And I hope that the learning curve continues and that I'll look back in another 10 years and again be surprised at where I've ended up.

Naomi Weir
Deputy Director
Campaign for Science and Engineering

Membership CHANGES

We would like to warmly **welcome** the following new Members to the Society.

AUSTRALIA
B. Elgamoudi

CANADA
E. Hartnett

CROATIA
O. Sandi

FRANCE
C. Bedu-Ferrari
C. Moran

INDIA
S. Das

KENYA
S. Okoth

MALAYSIA
N. Abudllah Sani
B. Talip

NIGERIA
I. Adesiyan
O. Areh
O. Bolarinwa
T. Ekundayo
A. Ogunyemi
O. Okozide
O. T. Oyedemi

REPUBLIC OF IRELAND
J. Connolly
A. Patange

SINGAPORE
L. Ji

SOUTH AFRICA
R. Owusu-Darko

SWEDEN
E. Smeds
U. Windahl

UNITED KINGDOM
B. S. Abdullahi
K. Acharya
R. Alsharedeh
C. Baines
K. Baker
A. Bashir
S. Bell
C. Beynon
R. Bhangal
J. Blaxland
O. Bramhall
J. Brett
C. Bruschi
P. Burns
E. Carter
R. Corrigan
K. Costello
A. Cottell
S. Dolan
J. Doyle
E. Elcocks
N. Fernandes
K. Frain
S. Ghul Mohammad
E. Goldstein
A. Green
R. Gulati
A. Hameed
Z. Hashim
J. Hayes
E. Henly
C-Y. Hsu
N. Irwin
P. P. Jason
K. John-Hall
A. Jonah
D. Kanisova
A. Kubala
G. Kyazze
J. Latimer
R. Loughlin
S. MacIntyre
H. Morgan
D. Morse
D. Pearce
N. Pond
B. Salamaga
K. Salek
L. Sims
D. Smith
H. Southam
O. Spiller
J. Twigg
E. Wareing
N. Williams
K. Winterburn
G. Yashkov
J. Yasmin

UNITED STATES
H. Crawford
C. Genigeorgis
J. Gilbert
A. Mustapha
K. Nealson
M. Richardson
M. Styke
A. Vasan
I. Walls
W. Xu
K. Yasuyoshi

DEATHS
We were saddened to learn of the death of the following Member of the Society:

Dorothy Jones

Membership OPTIONS

Full Ordinary gives access to our many grants and awards, online access to the *Journal of Applied Microbiology*, *Letters in Applied Microbiology*, *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*, copies of *Microbiologist*, preferential registration rates at Society meetings, and access to the Members-only area of the website.

Full Student confers the same benefits as Full Membership at a specially reduced rate for full-time students not in receipt of a taxable salary.

Associate is only open to those with an interest in applied microbiology without it being a prime aspect of their job. For example, school teachers and those taking a career break, on maternity leave, or working temporarily in other areas. It does not provide access to any journals or Society grants and awards.

Honorary membership of the Society is by election only and this honour is conferred on persons of distinction in the field of applied microbiology. Honorary Members have access to our online journals.

Retired is available to Full Members once they have retired from their employment. Retired Members are entitled to all the benefits of Full Membership except grants and access to the Society's journals.

eAffiliate: this category of membership is open to microbiologists residing in Band I developing countries and is free of charge. It is an online only membership and provides access to the eAffiliate bursary only.

eStudent: this category of membership is open to undergraduate students only. It is an online only membership and is free of charge. This category of membership does not provide access to the Society's grants or journals.

Corporate is open to all companies with an interest in microbiology. Corporate Members benefits include:

- Quarter page advertisement in each issue of *Microbiologist* (which can be upgraded to a larger size at discounted rates).
- The opportunity to publish press releases, company news, etc., in each issue of *Microbiologist*.
- FREE banner advert on the Society website with a direct link to your company site.
- Up to three Members of company staff attending Society meetings at Members' rate (this means a 50% discount on non-Member registration rate).

Join us!

You can apply for membership online (**www.sfam.org.uk/join**) or offline. To apply offline, please contact the Membership Officer, Julie Buchanan on **+44 (0)207 685 2596**, or email **julieb@sfam.org.uk**.

London's MICROBIOTA

A series on applied microbiology themes in the capital

If you find yourself fortunate enough to visit SfAM's new offices in Charles Darwin House, then a short walk will lead you to a site of significance to our knowledge of mycotoxins. In nearby Gray's Inn Road, opposite Gray's Inn itself, stands a recently refurbished building that once housed the laboratories of the Tropical Products Institute (TPI).

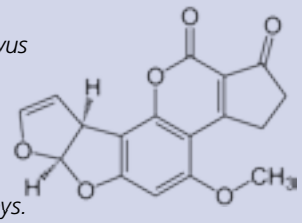
TPI originated as the Scientific and Technical Department (later the Colonial Products Laboratory) of the Imperial Institute, a celebration of Empire opened in Kensington by Queen Victoria in 1893. The magnificent buildings of the Imperial Institute were demolished in the 1950s to make room for the expansion of Imperial College, although an original tower, known as the Queen's Tower, still survives. With the end of Empire and changing attitudes towards international development, TPI was established in Gray's Inn Road in 1957 with the brief to conduct research, development and advisory work to help developing countries derive greater benefit, post-harvest, from their renewable resources.

Over the years TPI worked in areas as diverse as fish processing, essential oil production, paper making, copra processing, and insect pheromones and conducted market surveys, field studies and pilot trials around the globe. The importance of microorganisms in post-harvest agriculture for both good and ill quickly led to microbiological questions becoming an important aspect of TPI's work.

In the spring of 1960, a mysterious new disease was identified on English poultry farms, affecting young turkeys in particular. Described as turkey 'X' disease, more than 500 outbreaks were reported between May and August. These centred mainly on farms in the southeast of England and caused the death of 100,000 turkeys, with heaviest losses among those around one month old. Teams from a number of agencies including TPI failed to identify any known bacterial or viral pathogen and attention eventually turned to peanut meal which had been used as a protein source in a pelleted feed used on affected farms. This had been imported from Brazil where conditions of storage had allowed the mould *Aspergillus flavus* to grow on the peanuts, producing the potent toxic and carcinogenic secondary metabolites now known as aflatoxins. It was at TPI that the responsible *Aspergillus flavus* was first identified and that methods of aflatoxin analysis were developed, based on their separation by thin layer chromatography and detection by the intense fluorescence they produce under short wave UV light. Dr Philip Spensley, who later became a Director of TPI, apparently coined the name 'aflatoxin'.

Turkey 'X' disease subsided rapidly with the end of the turkey hatching season in the late summer but a major new hazard to both animal and human health had been discovered, and international concern about mycotoxins in food and feed burgeoned. To this day they remain a major challenge wherever safe storage of dried commodities can be a problem. In the years that followed, important work on mycotoxins continued at TPI with, for example, the first structure determination of rubratoxin (by a noted S*f*AM Member, Maurice Moss and colleagues) and numerous projects with very practical concerns such as safe crop storage, sampling plans, detection and detoxification.

***Aflatoxin B*$_1$** *is an aflatoxin produced by Aspergillus flavus and A. parasiticus. It is arguably the most potent carcinogen known, and is up to twice as carcinogenic as an equitoxic dose of X-rays.*



With Government economic cutbacks from around 1980, TPI went through a long period of retrenchment, contracting and amalgamating with other Government-run scientific units working in related fields such as the Centre for Overseas Pest Research. It finally left Gray's Inn Road in 1988 and today its successor, the Natural Resources Institute (NRI), is based in Chatham as part of the University of Greenwich. No longer a Government unit, its activities are funded by a range of national and multinational agencies and it retains an active interest in food microbiology, contributing two speakers to the 2015 S*f*AM Summer Conference programme on fermented foods.

It might also be worth a passing mention that TPI was the home (at different times) of two future Presidents of S*f*AM – Professor Basil Jarvis and myself. During his time at TPI, Basil Jarvis worked on mycotoxins other than aflatoxin such as rubratoxin. Regrettably I can make no claim to having made any seminal contributions to our knowledge of mycotoxins. Some might say my most noteworthy achievement was running the TPI's 5-a-side football team which for several years graced the Finsbury Leisure Centre lunchtime league. It is perhaps misleading to suggest that the team was an asset to the league, noted as we were compensating for a distinct lack of skill with a dour negativity, which one season saw us earn points from 11 goalless draws out of 20 matches – we lost the others. In the laboratory, my time was spent largely on fermentation projects such as vinegar production from materials such as export reject bananas, cashew apples, pineapple juice and cocoa sweatings, and the preservation of fish by lactic acid fermentation. A distinct problem with the latter work was that, ever a martyr to scientific rigour, I felt compelled to include untreated controls in all experiments. In time, these would become such noisome examples of piscine putrefaction they were capable of disabling passengers on the upper deck of passing buses. I'm sure this will resonate with my former colleagues at TPI for whom the memory doubtless lingers on, rather like the smell.

Martin Adams
SfAM President 2011–2014

ANNUAL APPLIED MICROBIOLOGY 2017 CONFERENCE

New insights into Food Safety

BALTIC Centre for Contemporary Art in Gateshead | 3–6 July 2017

*Sf*AM would like to invite all scientists with an interest in food microbiology to attend and participate in the Annual Applied Microbiology Conference 2017

Fees before 2 June (includes accommodation):

Full Member	**£250**
Student Member	**£200**
Student Non Member	**£400**
Non-Member	**£600**

INDIVIDUAL DAY RATES WITHOUT ACCOMMODATION ARE AVAILABLE

Deadline for abstract submissions and Studentship Grant applications: **10 March 2017**

Foodborne diseases are a chief concern of many microbiologists as they not only affect people's health and well-being, but also have major impacts for countries' economies too.

While there have been some successes in the reduction of foodborne disease caused by particular pathogens, the level of foodborne disease caused by microbial agents remains unacceptably high, and is a major cost and burden to society.

This conference will look at our current understanding of the key pathogens that are causing the greatest risk to our health and our economy. There'll be a focus on new insights into these individual agents that aid our understanding of the problems they cause.

New issues such as the transmission of antibiotic resistance through the food chain will also be presented, as will new techniques for reducing levels of disease through approaches to control and food safety education.

Speakers include:

Sarah J. O'Brien University of Liverpool, UK
Foodborne disease - the current UK situation

Sandra Hoffmann USDA, USA
The cost of foodborne disease

Paul Cook Food Standards Agency, UK
Antimicrobial resistance risks in the food chain

Ellen Evans Cardiff Metropolitan University, UK
Tailoring food safety education

Mike Peck Institute of Food Research, UK
Clostridium botulinum, Clostridium perfringens and Clostridium difficile

Suresh D. Pillai National Center for Electron Beam Research, USA
Photons to electrons: the rapidly evolving food irradiation technologies and consumer perceptions

Paula Bourke Dublin Institute of Technology, School of Food Science and Environmental Health
Cold plasma technology

Rob Kingsley Institute of Food Research, UK
Salmonella

To book and for further details:
www.member.sfam.org.uk
or **contact sally@sfam.org.uk**

ECS Science Communications Workshop

David Gregory-Kumar BBC correspondent and presenter

sfam ECS EarlyCareerScientists

*Sf*AM **Summer Conference 2016**

The 2016 S*f*AM Summer Conference was held on the 4–7 July in Edinburgh, Scotland, at the Assembly Rooms. The conference promoted the latest scientific research on the role of microorganisms in soil and plant ecosystems. Over 150 delegates attended the event, which gave scientists of all levels the opportunity to network with peers from across the globe and discuss the latest in applied, experimental and theoretical environmental microbiology.

Delegates were also treated to some great award lectures at the event including the New Lecturer Research Grant, presented to Dr Tony Gutierrez (Heriot-Watt University, Edinburgh, Scotland). Tony previously outlined the amazing research he has been doing on the microbial degradation of oil hydrocarbons in the June 2016 issue of *Microbiologist*. The following pages give us further insight into the research of three other S*f*AM award recipients.

JAM Lecture 2016

The Journal of Applied Microbiology (JAM) publishes high-quality research and review papers on novel aspects of applied microbiology, including environmental, food, agricultural, medical, pharmaceutical, veterinary, soil, systematics, water and biodeterioration. In celebration of its success, eminent speakers are invited to present the annual *Journal of Applied Microbiology* lecture at the S*f*AM Annual Conference.

In 2016, the JAM lecture, *The Diffusible Signal Factor (DSF) family of bacterial cell–cell signals*, was delivered in The Assembly Rooms, Edinburgh, by Max Dow of University College Cork, Ireland. Max gave an overview of recent advances in understanding of DSF signalling and then described approaches for the control of bacterial virulence through its modulation.

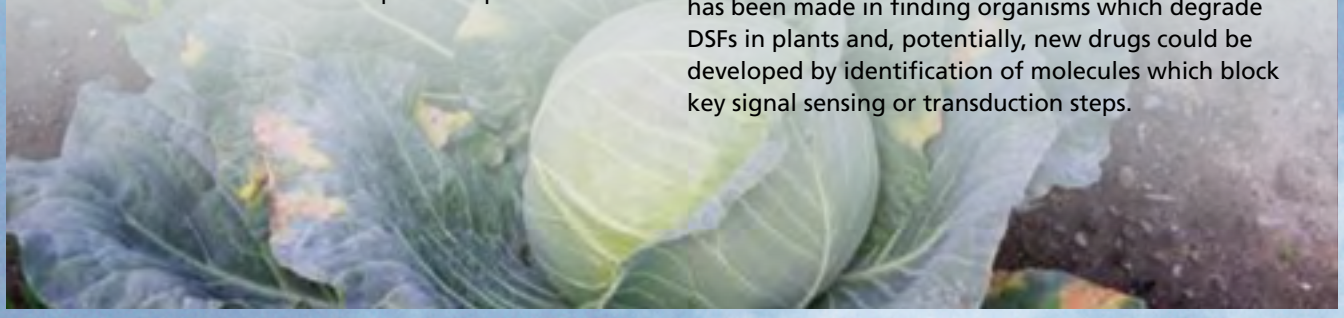
Molecules of the DSF family are *cis*-2-unsaturated fatty acids, the paradigm of which is *cis*-11-methyl-2-dodecenoic acid, produced by the black rot bacterium *Xanthomonas campestris* pv *campestris*. Virulence of this organism is regulated by the *rpf* (regulation of pathogenicity factors) gene cluster and signal perception and transduction requires the RpfC/RpfG two-component system. Mutants of the HD-GYP domain regulator RpfG have been shown to exhibit attenuated virulence associated with increased aggregation and biofilm formation and reduced protease production.

This DSF system has been found to be conserved in other plant-pathogenic xanthomonads including *Xanthomonas oryzae* pv *oryzae*, *Xanthomonas oryzae* pv *oryzicola* and *Xylella fastidiosa*. Likewise, DSF signalling influences the virulence of the opportunistic human pathogen *Stenotrophomonas maltophilia*.

Similar molecules have been discovered in unrelated bacteria such as *Burkholderia cenocepacia*, *Pseudomonas aeruginosa* and *Streptococcus mutans*. The involvement of the former two in the pathology of cystic fibrosis (CF) raises interesting questions about inter-species signalling. Flow cell work in Copenhagen has shown manifestations of altered biofilm architecture as a consequence of signal perception when *Strep. maltophilia* and *Ps. aeruginosa* are co-cultured.

Interestingly, sputum samples from CF patients in Cork have been found to contain detectable levels of DSF molecules. It may be that DSF-mediated inter-species signalling has a role in such polymicrobial infections. Furthermore, intra-kingdom signalling has been demonstrated by *Burkholderia* DSF (BDSF) signalling influencing the yeast-hyphal transition of *Candida albicans*.

Applications of this work are currently focused on translating our knowledge of DSF signalling into disease control measures in plants and animals. Some progress has been made in finding organisms which degrade DSFs in plants and, potentially, new drugs could be developed by identification of molecules which block key signal sensing or transduction steps.



W H Pierce Prize Lecture

The S*f*AM W H Pierce Memorial Prize for 2016 was given to Professor Jack Gilbert, Director of the Microbiome Center in the USA, who (despite jet lag) gave an energetic 'whistle-stop tour' of projects that have employed molecular methods to test fundamental hypotheses about microbial ecosystems. He started by explaining that mode of delivery at birth influences what type of 'starter cultures' colonize babies and thus the subsequent microbiota that develops. This has a life-long influence on health. For example, the human microbiota may be one factor that helps determine whether people with an inherited susceptibility will develop Alzheimer's disease. Another example given was how products of microbial metabolism in the gut can affect the behaviour and phenotype of fruit flies, even influencing their attractiveness to others.

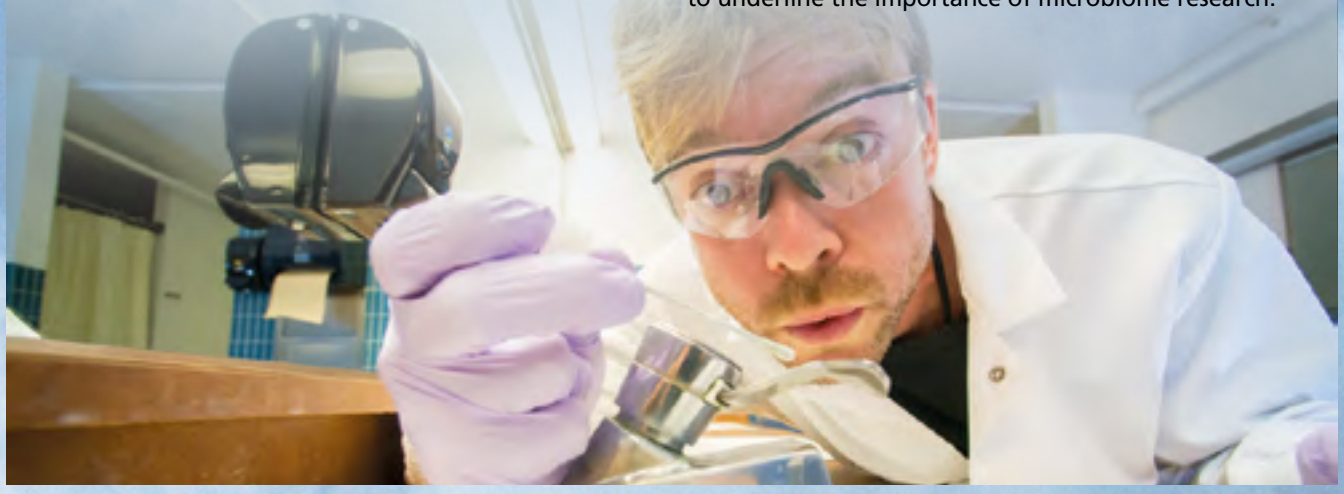
Many factors can disrupt the human microbiota making it less supportive of health. In particular, antibiotics cause gut dysbiosis, which can lead to diarrhoea and more serious disease but faecal microbiota transplantation studies have shown dramatic and positive effects for treating antibiotic-induced *Clostridium difficil*e infection. To further illustrate the importance of the early colonization process, Professor Gilbert described the effect of different lifestyles of two farming communities in the USA. The Amish people have family-run farms and their children, who are exposed to the animals from an early age, have low incidence of asthma. In contrast, the genetically related Hutterite community run industrial farms where children are not allowed and, as a consequence, have high levels of asthma and allergies.

The importance of the gut–brain axis, another key area of microbiome research, was illustrated by experiments that subjected rats to stress. Germ-free rodents do not display the anxiety shown by their colonized counterparts because of the gut bacteria, which can produce neurotransmitters such as γ-amino butyric acid and serotonin. Another area of research discussed by Professor Gilbert was the effect of the gut microbiota on obesity and obesity-related disease.

Modern lifestyles have also meant that people spend much more time indoors, so microbiologists are now working with architects to improve microbial exposure in buildings, particularly for neonates. 'Microbe highways' can now be tracked in buildings to show the movement of people. A new branch of science, microbial forensics, started almost accidentally from a US project where students were challenged to break into their professors' houses. Surface swabs enabled the team to identify who were the 'culprits' in each house, based on detecting the microbial signature they had left behind.

Another of the many posts held by Jack Gilbert is Professor of Surgery at the University of Chicago, and he described some of the research that led to this appointment. The construction of a new hospital in Chicago allowed his group to swab surfaces of the building as it became operational and populated by staff and patients. After opening, its surfaces rapidly became colonized by human microbes. The work also led to the realization that bacteria causing post-operative infections were not contaminants from staff or other patients; the source was the infected patients themselves. It appears that the stress of surgery and hospitalization makes their bacteria more virulent. The increased exposure to oxygen and antibiotics during surgery, leads to a depletion of available phosphates for the gut bacteria, which causes them to form a biofilm at the operation site. To prevent this, non-absorbent prebiotics bound to polyethylene glycol are being developed that can be delivered orally to surgical patients.

Even to those familiar with the field, the breadth of research covered in this talk was amazing, only serving to underline the importance of microbiome research.



*Sf*AM PhD Studentship Lecture

In 2013, S*f*AM introduced a new grant to recognize the challenges faced by those seeking funding for PhD studies. The Society invited potential supervisors at recognized universities or research institutes to apply for a PhD studentship grant. The first PhD studentship grant was awarded to Dennis Linton of The University of Manchester to support the studies of Danielle Weaver into *Glycoprotein N-linked glycans as targets for antibody-based detection of Campylobacters*. Danielle presented her results at the S*f*AM 2016 Summer Conference.

Campylobacter species are the most frequently isolated agents of gastrointestinal infection in humans and associated with potential neurological complications. Since most infections are transmitted by the consumption of contaminated retail chicken, intervention strategies to prevent the colonization of poultry are urgently required. Key to this is the application of rapid on-farm detection tools, which do not as yet exist. Animal infections are also common and represent a significant economic burden and would similarly benefit from rapid on-farm detection tests.

The aims of Danielle's project were to develop and characterize antisera which can be used to develop robust detection and identification tests for *Campylobacter* species. N-linked glycans are attractive targets for such tests. Five distinct N-linked glycan structures have been identified in *Campylobacter* species. The majority of species which are pathogenic to humans have Type 1 N-linked glycans (*Camp. jejuni, Camp. coli, Camp. Helveticus* and *Camp. upsaliensis*) whilst *Camp. lari* has Type 2 and the species associated with sheep/cattle disease (*Camp. fetus*) has Type 3.

Camp. jejuni N-linked glycan-specific polyclonal antiserum (CjNgp) was produced by injecting rabbits with *E. coli* carrying a plasmid into which the *Camp. jejuni* pgl (protein glycosylation) locus had been transferred. The antiserum has been found to be highly reactive against reference strains of *Camp. jejuni* and strains isolated from chicken meat over a two-year period. Some reactivity has been observed against *Camp. lari* but not against *Camp. fetus.* The next steps for this part of the project are to develop a procedure for large-scale purification of the antiserum and use it as the basis for a latex agglutination test.

Work to similarly produce antiserum specific for *Camp. fetus* N-linked glycan (CfNgp) has been more challenging due to the lack of an *E. coli*-based N-linked glycosylation system. To overcome this obstacle a hybrid set of genes was created to synthesize Cf glycan based on Cj pgl genes. By individually adding predicted transferase genes from Cf onto a truncated Cj glycan base the full Cf glycan structure could be engineered in *E. coli*. This CfNgp antiserum has been found to be reactive with *Camp. fetus*-linked glycoproteins and is currently being characterized further by mass spectrometry.

The microbiome and human health

Since we discovered microbes cause infectious diseases, we've largely focused on keeping them under control. As we come to better understand these organisms, there's growing evidence that an imbalance in those microbes can affect our well-being and may contribute to a range of chronic conditions.

This Society for Applied Microbiology meeting brings together experts in the field to explore how the underlying human microbial composition and function directly affects human health and the role it plays in immunological, metabolic and neurological diseases.

This conference will look at the microbiome from a number of angles and we're excited to welcome a broad and highly regarded roster of speakers

12 April 2017
10:00 – 17:00

The Bloomsbury Hotel, London, UK

Plenary Lecture
High-throughput genome sequencing to investigate microbial communities
Anne Neville
Wellcome Trust Sanger Institute, UK

The regulation of host defences by the commensal microbiota
Thomas Clarke, Imperial College London, UK

The gut virome and phage ecogenomics
Lesley Ogilvie, University of Brighton, UK

Probiotics and suppression of gut infections
Simon Cutting, Royal Holloway University of London, UK

Vaginal microbiota
Janneke Van De Wijgert, University of Liverpool, UK

Interactions between *Neisseria* commensals in the nasopharynx
Rob Read, University of Southampton, UK

Whats bugging you? Microbiome as a key regulator of brain and behaviour
John Cryan, University of Cork, Ireland

Closing date for registration 29 March 2017

Fees before 15 March £100 Non-Member |£50 Full Member| £30 Full Student, Honorary, Associate or Retired Member

Deadline for abstract submissions 17 February 2017

Decisions regarding abstract submissions will be communicated by 3 March 2017

For further information please contact sally@sfam.org.uk

society for applied sfam microbiology

www.sfam.org.uk
sally@sfam.org.uk
+44 (0) 1933 382191

microbial biotechnology 2020

Open Access

Despite predictions of failure, and objections that there were already more than enough scientific journals, it was officially decided to launch the open access journal *Microbial Biotechnology* during the recession of 2008, which was hitting the publishing world particularly badly.

However, Juan Luis Ramos, Marty Rosenberg, Ken Timmis, Willem de Vos, Willy Verstraete and their friends, saw the desperate need for a high-profile journal of excellence in the field and pressed ahead regardless. Today *Microbial Biotechnology*, with its new Editor additions, Siegfried Vlaeminck and Auxi Prieto, is the leader in an exceptionally dynamic and exciting sector of the biomedical sciences that is unique in the breadth and diversity of products and services it provides and to which it contributes.

These include topics such as disease prevention and therapy; diagnostics; agriculture and horticulture; food provision and nutrition; production of energy, chemicals and materials; water and waste treatment; recycling, acquisition of and adding value to natural resources; environmental monitoring; forensics; sustainable practices, etc. The list goes on.

The development of rapid and affordable genomics technologies has been accompanied by that of bioinformatic tools, systems and synthetic biology approaches, single-cell techniques, and high-resolution analytical and imaging instruments. These have all provided new impulses to the field and opened new avenues of application, including microbiome engineering, bioenergy and bioelectric applications, the use of microbial toxins for therapy and cosmetic applications, etc., are game changers.

All these applications promise to revolutionize our lives in a similar manner to the development of computers, the Internet and smart phones.

The extent of present and future enrichment of human endeavour, prosperity and well-being to be brought about by microbial biotechnology, as well as its contribution to solutions to fundamental problems we and planet Earth are facing – the Grand Challenges – is only now beginning to be appreciated.

Microbial protein: future sustainable food supply route with low environmental footprint

Silvio Matassa, Nico Boon, Ilje Pikaar and Willy Verstraete

P 568–575

Monitoring and managing microbes in aquaculture – Towards a sustainable industry

Mikkel Bentzon-Tilia, Eva C. Sonnenschein and Lone Gram

P 576–584

Biofuels 2020: Biorefineries based on lignocellulosic materials

Miguel Valdivia, Jose Luis Galan, Joaquina Laffarga and Juan-Luis Ramos

P 585–594

Electromicrobiology: realities, grand challenges, goals and predictions

Kenneth H. Nealson and Annette R. Rowe

P 595–600

A roadmap for biocatalysis – functional and spatial orchestration of enzyme cascades

Claudia Schmidt-Dannert and Fernando Lopez-Gallego

P 601–609

Microbial Biotechnology – 2020

With this is mind, an opportune moment arose to strategically analyse the immediate future of the field of microbial biotechnology and the Editors and Friends of *Microbial Biotechnology* invited luminaries in the field to define where, in the context of these 'Grand Challenges', we aspire to be in 2020, to articulate which obstacles lie in the way, and to suggest how these may be circumvented: in other words – to propose a roadmap for dealing with the obstacles and arriving at the goals set for 2020.

These pieces make up the Special Issue entitled *Microbial Biotechnology – 2020*. This outstanding issue is available to all and makes interesting immediate reading for researchers in the field and will serve as a useful guide over the next few years. With over 20 contributions from more than 40 esteemed scientists this special issue is by far the most heavily downloaded edition of the journal since its conception. Certainly not to be missed and you are urged to visit the journal yourself to see just how incredible *Microbial Biotechnology – 2020* is and why all the Editors and contributors are rightly proud.

Prospects of microbial cell factories developed through systems metabolic engineering

Martin Gustavsson and Sang Yup Lee

P 610–617

Bioremediation at a global scale: from the test tube to planet Earth

Víctor de Lorenzo, Philippe Marlière and Ricard Solé

P 618–625

Microbial Biotechnology 2020; microbiology of fossil fuel resources

Ian M. Head and Neil D. Gray

P 626–634

Plant–microbe partnerships in 2020

Birgit Mitter, Nikolaus Pfaffenbichler and Angela Sessitsch

P 635–640

Moving towards adaptive management of cyanotoxin-impaired water bodies

Hans W. Paerl, Timothy G. Otten and Alan R. Joyner

P 641–651

A few questions

Ken Timmis aspiring husband and father, and Editor of EMI, EMIR and MBT talks to *Microbiologist* about the MBT special issue.

Q: What inspired you to look towards the year 2020?

A: It is my personal view that the field of biotechnology, and especially microbial biotechnology, will deliver many novel products and processes that will contribute substantively to the solution of important Grand Challenges faced by society today. It seemed to me that creating this type of special issue could be useful to provide a more concrete view of the near future and provide the field with a vision of where we might aspire to be in 2020 and concrete roadmaps to get there.

Q: Is it possible to contemplate the possible evolution of microbial biotechnology even further into the future – perhaps a few decades from now?

A: Well: the field, and interdependent disciplines and technologies with which biotechnology is intimately networked, are so dynamic and creative that it's difficult to imagine where we will be going 10 years from now. Undoubtedly personalized medicine will be booming and expanding in all sorts of directions, driven in part by large-scale human genome sequencing, miniaturization and the development of smart exploratory-diagnostic-therapeutic devices. Microbiome research will be mainstream and all sorts of creative microbiome engineering applications will be leading in currently unimaginable directions. Bioenergy research is also likely to be at the forefront and evolving in a currently unpredictable direction.

Q: This issue is largely positive in its outlook for 2020, are there any issues within microbial biotechnology that concern you?

A: No. I'm unreservedly optimistic about the future of microbial applications!

Q: With over 20 contributions from more than 40 scientists, this issue has covered a broad range of topics – is there an area you would have explored given more time?

A: Yes, there are other topics that merit inclusion, such as biomining, and bioprospecting microbial diversity for all kinds of new applications, and it's clear that the diversity of microbiome applications will explode over the next years.

Q: What do you see as the greatest bioethical question in the foreseeable future?

A: One is the issue of ownership and access to medical data in general, and patient genome sequence, microbiome and clinical data. Genetic manipulation of the germline is obviously another, though not yet a microbiology issue. However, in the long term it might become one. Then there are the big issues of sustainability and protection of the health of the planet for future generations, in which microbial biotechnology has a role to play, e.g., in global warming and greenhouse gas emissions, groundwater pollution and bioremediation, deforestation and desertification, mining and the mobilization of heavy metals into the biosphere, etc., etc.

Q: Where do you see *Microbial Biotechnology* being in 2020?

A: Well: I think it is now perceived by many as a beacon for the most exciting advances in applied microbiology, so I expect this to have become the general perception in 2020. IF-wise, we want to be snapping at the heels of Nature Biotechnology!

JournalWATCH

Highlights from the *Sf*AM journals

Environmental Microbiology

www.env-micro.com

Special Issue on Human Microbiome in Health and Disease

Highlight
The emerging view of *Firmicutes* as key fibre degraders in the human gut (pages 2081–2083) David Berry.

Targeting the gut to protect the bladder: Oral Phage therapy approaches against urinary *Escherichia coli* infections? (pages 2084–2088) Harald Brüssow.

http://onlinelibrary.wiley.com/doi/10.1111/emi.2016.18.issue-7/issuetoc

Environmental Microbiology Reports

www.env-micro.com

Special Issue on Marine Microbial Ecology

Highlight
A role for fungi as parasites in the black box of marine trophic interactions (pages 429–430) Thomas A. Richards and Aurélie Chambouvet.

http://onlinelibrary.wiley.com/doi/10.1111/emi4.2016.8.issue-4/issuetoc

Journal of Applied Microbiology

www.journalappliedmicro.com

Online Lecture: The DSF family of bacterial cell–cell signal molecules by Dr Max Dow

https://www.youtube.com/watch?v=Qiq2zDOsXWk or search for '***JAM* lecture**' on the *Sf*AM website

Letters in Applied Microbiology

www.lettersappliedmicro.com

Editor's Choice Article: Evaluation of the ability of *Acinetobacter baumannii* to form biofilms on six different biomedical relevant surfaces

Highlight
In the hospital environment, *Acinetobacter baumannii* is one of the most persistent and difficult to control opportunistic pathogens. The persistence of *A. baumannii* is due, in part, to its ability to colonize surfaces and form biofilms. This study demonstrates that *A. baumannii* can form biofilms on a variety of different surfaces and develops substantial biofilms on polycarbonate – a thermoplastic material that is often used in the construction of medical devices. The findings highlight the need to further study the *in vitro* compatibility of medical materials that could be colonized by *A. baumannii* and allow it to persist in hospital settings.

http://onlinelibrary.wiley.com/doi/10.1111/lam.12627/full

Microbial Biotechnology

www.microbialbiotech.com

Thematic Issue on Lactic Acid Bacteria

Highlight
A timely reminder of technical limitations (page 435) James I. Prosser.

http://onlinelibrary.wiley.com/doi/10.1111/mbt2.2016.9.issue-4/issuetoc

Melissa McCulloch
Wiley-Blackwell

Corporate NEWS

The latest news, view and microbiological developments from our Corporate Members

Vaccine Development Service

APHA Scientific offers a comprehensive, high quality vaccine development service to help you with your vaccine development programme ranging from producing initial research data, identification of vaccine candidates to batch testing on the finished products.

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- Detection of extraneous agents in seed lots
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- Testing for attenuation
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New from BioConnections – Micronaut AST system

Now available in the UK through BioConnections, the Merlin Diagnostics Micronaut AST system allows for the susceptibility testing of bacteria and yeasts using the reference laboratory microdilution method.

The Micronaut AST system can either be run manually, semi-automated or fully-automated which includes plate inoculation and following incubation automatic reading and reporting of sensitivity results.

Benefits of the Micronaut AST system include:

- Detection and confirmation of multi-resistant organisms including MRSA, ESBL, Carbapenemases, VRE, MDR or MRGN
- Plate layouts based on MIC or breakpoint testing
- Specific plates for special demands such as cystic fibrosis
- Customised AST panels freely configured to your own layout
- Wide range of anti-fungals and veterinary antibiotics
- Visual or photometric reading

To find out more about these new products and how they can help in your laboratory testing please visit the BioConnections website, alternatively contact us by email or by telephone.

Further Information

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For over 40 years, Cherwell Laboratories has produced pre-prepared microbiological media for customers under the Redipor® brand name. Customers range from multi-national pharmaceutical manufacturers to small laboratories with their own individual requirements. The head office and manufacturing facility in Bicester, Oxfordshire can produce up to 7,000 plates per batch and as few as 20 depending on the order size.

Offering an extensive selection of both industry standard products and those with a unique formulation or presentation, the Redipor® range provides a flexible solution for environmental monitoring, sterility testing of products, operator validation and process validation. The range includes petri dishes (55mm, 90mm and 140mm) and contact plates, plus bottled media, broth bags and ampoules. An extensive range of irradiated media is also available, with all products subjected to a full array of QC tests, including comprehensive growth tests.

For more information about Cherwell's Redipor® range of media, SAS air sampler product range and cleanroom decontamination solutions from Mar Cor Purification which includes the Minncare®Dry Fog 2 system visit Cherwell's website at www.cherwell-labs.co.uk.

Further Information

Visit: www.cherwell-labs.co.uk
Tel: +44 (0)1869 355 500
Email: sales@cherwell-labs.co.uk

NCTC 3000 – bacterial genome sequencing project

NCTC 3000 is an exciting, large scale whole genome sequencing project undertaken in collaboration by Culture Collections (part of Public Health England), the Wellcome Trust Sanger Institute (WTSI) and Pacific Biosciences. The project aims to sequence the genomes of bacteria which are of global public health importance from the National Collection of Type Cultures (NCTC).

When completed, 3000 high quality reference genomes will be available to the scientific community as both assembled and annotated sequences. In total 1901 DNA extractions have been successfully performed and sent WTSI for sequencing including 523 Type strains. The strains come from 613 species and represent 66 different bacterial families. So far 1600 bacterial strains have been successfully sequenced. The next stage of the project is the inclusion of a selection of Hazard Group 3 strains.

The data is currently available through individual collection entries on the Culture Collections website. A new online recourse is also being designed to share the data which will have integrated web links to strain-specific information held on external websites (eg journal papers in PubMed).

It is hoped that the data will be used to improve public health research in order to advance clinical diagnostics by combining reference genomes with historical and biological information.

Further Information

Visit: www.phe-culturecollections.org.uk
Tel: +44 (0)1980 612512
Email: culturecollections@phe.gov.uk
Twitter: @NCTC_3000

Improved Maintenance of Anaerobic Conditions

The Catalyst Monitoring System is an efficient and effective way of alerting users to both the condition of the catalyst and the anaerobic atmosphere in a Whitley Workstation.

If you need to keep strict anaerobic conditions or want to know the best time to change the catalyst, you can now get your workstation to automatically test your catalyst/atmosphere on a daily basis - reducing the need for control plates.

A factory-fitted option for Whitley Anaerobic Workstations, the Catalyst Monitoring System is set to conduct the test overnight. When you arrive at the lab in the morning, a pop-up box on the touchscreen informs you of the status of the catalyst. 'Green' means all is fine and there is plenty of life left in the catalyst; 'amber' means the catalyst performance is reduced; and 'red' means that the catalyst should be changed to maintain good anaerobic conditions.

The test confirms that the catalyst is working and that hydrogen is present in the atmosphere, both of which are essential for the maintenance of strict anaerobic conditions.

This option can also be used in conjunction with the Whitley Anaerobic Conditions Monitor, which provides continuous monitoring of the level of oxygen present in your workstation.

Further Information

Visit: www.dwscientific.co.uk
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Sigma-Virocult® Still Leader of the Pack for Virology Specimens

It is almost 40 years since Virocult® was launched as the first commercially available viral transport system. Developed to maintain viruses in a viable condition for detection with cell culture, those same qualities ensure that in the molecular era the integrity of nucleic acid is assured for accurate identifications. Now as Sigma-Virocult® with a screw-top vial of Virocult® liquid medium and with a variety of swab devices, for respiratory, STD, and skin specimens, it can be used with confidence on any of the newer diagnostic platforms, including multiplex systems. It has also been successfully used in tackling recent emerging diseases such as avian flu, swine flu, Ebola, SARS and MersCoV.

References

Porterfield, J.N., & R.D. Hume, 1979, Evaluation of Virocult® Collection and Transport Device, ASM General Meeting, Los Angeles, US

K. Khan, M. Stone, H. Jones, 2015, Evaluation of the Virocult® viral transport swab for the detection of Herpes Simplex Virus using the BD Max™and Smartcycler®, 9th European Meeting for Molecular Diagnostics, Noordwijk, Netherlands.

Further Information

Visit: www.mwe.co.uk
Tel: +44 (0)1225 810361
Email: sales@mwe.co.uk

NCIMB hosts European Culture Collections' Organisation meeting

NCIMB was delighted to welcome members of the European Culture Collections' Organisation (ECCO) to Aberdeen for their 35th annual meeting. The event, which took place from 2 – 4 November, brought microbiologists, molecular biologists and biochemists together to learn about and discuss important and innovative developments in the microbiology sector.

ECCO was established in 1981 with the aim of promoting collaboration and exchange of ideas and information about all aspects of culture collection activity. The organisation comprises 61 biological resource centres (BRCs) from 22 European countries, which together represent a vital research resource for research and industry.

By conserving genetic resources and biodiversity, BRCs provide essential underpinning activity for the development of a sustainable, international, scientific infrastructure and are an indispensable element in the development of a knowledge-based bio-economy. The opportunity that ECCO creates for information sharing and collaboration amongst culture collections plays an important role in ensuring that collections are not only serving the rapidly developing requirements of the industry today, but that their genetic resources are preserved for generations of scientists to come.

Topics for discussion at this year's event included current practices associated with microbial resource centres, how microorganisms can be utilised and how modern technologies can be used to determine the full potential of the microorganisms stored.

For more information contact Dr Samantha Law
s.law@ncimb.com

Further Information

Visit: www.ncimb.com
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ChromaZona – for fast and accurate diagnosis

Synbiosis has recently launched ChromaZona – an IVD certified instrument for automated antibiotic susceptibility testing and microbial ID, designed for speeding up testing in the clinical laboratory. Working to EUCAST and CLSI guidelines, the system's sensitive CCD camera, unique three channel lighting and powerful Chromogenic ID software, microbial species on chromogenic plates can be identified in seconds. Then by accurately analysing zones around antibiotic discs and MIC strips using ChromaZona's eAST software, appropriate antibiotics to treat the infection can be determined.

ChromaZona can be easily connected to a LIMS system or, if preferred, reports can be generated and stored in Excel, eliminating data transfer errors as well as providing the user with fully traceable information and reports. The stored results can be analysed at any time and used to identify and monitor incidence of bacterial resistance, helping to improve infection control.

It is suitable for use in a CFR Part 11 environment.

Microbiologists wanting to find out more about this revolutionary product can click the link:
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Further Information

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Email: sales@synbiosis.com

CONTACTPOINT

Society Office Staff

CHIEF EXECUTIVE:
Dr Lucy Harper
email: lucy@sfam.org.uk
tel: +44 (0)207 685 2591

HEAD OF MARKETING, MEMBERSHIP AND COMMUNICATIONS:
Dr Paul Sainsbury
email: paul@sfam.org.uk
tel: +44 (0)207 685 2594

FINANCE AND GRANTS CO-ORDINATOR:
Tina Sellwood
email: tina@sfam.org.uk
tel: +44 (0)207 685 2593

MEMBERSHIP OFFICER:
Julie Buchanan
email: julieb@sfam.org.uk
tel: +44 (0)207 685 2596

EVENTS MANAGER:
Sally Hawkes
email: sally@sfam.org.uk
tel: +44 (0)1933 382191

PRESS & MEDIA OFFICER:
Stewart Cumiskey
email: stewart@sfam.org.uk
tel: +44 (0)207 685 2595

POLICY OFFICER:
Dr Christopher Brown
email: christopher@sfam.org.uk
tel: +44 (0)207 685 2408

COMMUNICATIONS SPECIALIST:
Nancy Mendoza
email: nancy@sfam.org.uk
tel: +44 (0)7920 264596

Society for Applied Microbiology
Charles Darwin House
12 Roger Street, WC1N 2JU,
United Kingdom
tel: +44 (0)207 685 2596
fax: +44 (0)207 685 2598
email: communications@sfam.org.uk
web: www.sfam.org.uk

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ORDINARY COMMITTEE MEMBERS UNTIL JULY 2017

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email: tim.aldsworth@coventry.ac.uk

Dr Linda Thomas, Yakult UK Ltd, Anteros, Odyssey Business Park, West End Road, South Ruislip, Middlesex, HA4 6QQ
email: LThomas@yakult.co.uk

ORDINARY COMMITTEE MEMBERS UNTIL JULY 2018

Dr Mike Dempsey, School of Science & The Environment, Manchester Metropolitan University, Lower Ormond Street, Manchester, M15 6HB
email: m.dempsey@mmu.ac.uk

Ms Charlotte Duncan, Pro-Lab Diagnostics, 3 Bassendale Road, Bromborough, Wirral, Merseyside, CH62 3QL
email: cduncan@pro-lab.com

Mrs Claire Hill, Medical Wire & Equipment Co Ltd, Unit 29, Leafield Industrial Estate, Corsham, Wiltshire, SN13 9RT
email: chill@mwe.co.uk

ORDINARY COMMITTEE MEMBERS UNTIL JULY 2019

Professor Valerie Edwards-Jones, School of Healthcare Science, Manchester Metropolitan University, John Dalton Building, Chester Street, Manchester, M1 5GD
email: v.e.jones@mmu.ac.uk

Dr Brian Jones, Pharmacy and Biomolecular Sciences, University of Brighton, Moulsecoomb, Brighton, BN2 4GJ
email: B.V.Jones@brighton.ac.uk

Dr Simon Gould, School of Life Science, Faculty of Science, Engineering & Computing, Kingston University, Penrhyn Road, Kingston upon Thames, KT1 2EE
email: s.gould@kingston.ac.uk

Professor Stephen Forsythe, School of Science and Technology, Nottingham Trent University, Clifton Lane, Nottingham, NG11 8NS
email: stephen.forsythe@ntu.ac.uk

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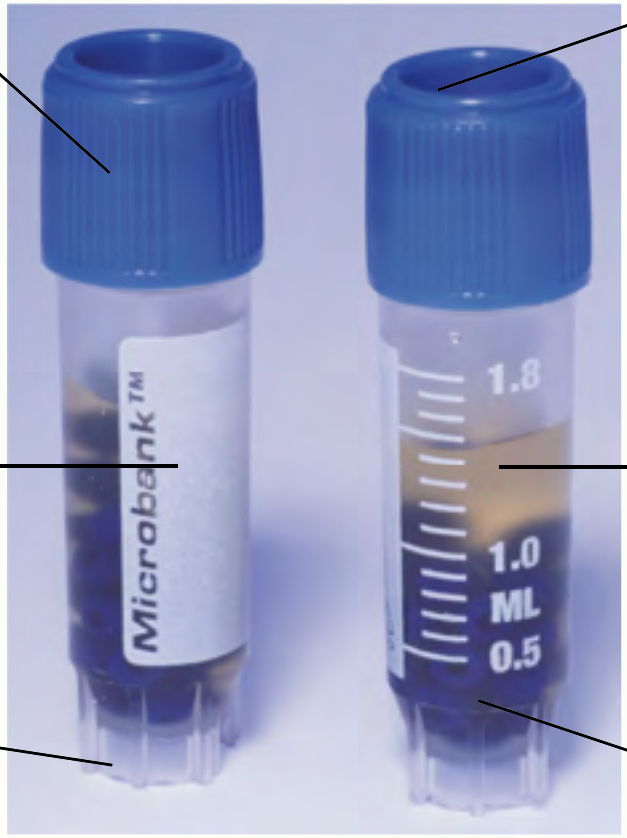

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Pro-Lab Diagnostics U.K.
3 Bassendale Road
Bromborough, Wirral, Merseyside
CH62 3QL
United Kingdom
Tel: 0151 353 1613
Fax: 0151 353 1614
E-mail: uksupport@pro-lab.com

Pro-Lab Diagnostics Canada
20 Mural Street, Unit #4
Richmond Hill, ON L4B 1K3
Canada
Toll Free: 1-800-268-2341
Tel: (905) 731-0300
Fax: (905) 731-0206
E-mail: support@pro-lab.com

Pro-Lab Diagnostics U.S.A.
21 Cypress Blvd., Suite 1070
Round Rock, TX, 78665-1034
U.S.A.
Toll Free: 1-800-522-7740
Tel: (512) 832-9145
Fax: 1-800-332-0450
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