MICRO BIOLOGY TODAY

QUARTERLY MAGAZINE OF THE SOCIETY FOR GENERAL MICROBIOLOGY 38:3 AUG 2011

MICRO-ECONOMICS

ECONOMICS OF BIODETERIORATION

WHERE THERE'S BUGS, THERE'S BRASS

KTPs — ENGAGING ACADEMICS IN BUSINESS

DIRTY MONEY

SPINNING-OUT

COVER IMAGE
iStockphoto / Thinkstock

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FEATURES

REGULARS

PLUS…

NEW MICROBIOLOGY CAREERS WEBSITE – www.sgm-microbiologycareers.org.uk

The SGM microbiology careers website (originally launched as 'bioscience@work' in 2002) has been reviewed and revamped. 'Microbiology Careers' was launched on 13 May under its new URL. The addition of new graphics and colour has given the site a fresh, contemporary feel, and the content has been updated and re-organized to ease navigation.

The site serves a broad target audience: from school children to early-career researchers. Pages aimed at the younger audience explain why microbes are important, where microbiologists work and the huge variety of jobs available. There is also information on microbiology courses and points to consider when applying to university. A selection of job profiles show the variety of careers in microbiology and illustrate that a degree in microbiology doesn't only lead to working in a lab (a common misconception).

For postgrad students and postdocs there is advice on career development and links to funding opportunities and training courses. Research is not for everyone and the 'Out of the Lab' section shows how a qualification in microbiology can be useful in a variety of careers such as science communication, policy, business and patent law.

Jane Westwell, Head of Meetings and Membership Services, said, '*The SGM careers website has long been a source of reliable information about careers in microbiology. We are delighted with the fresh new look and hope that researchers and students will continue to find it a useful resource.*'

Careers information sheets and an order form for SGM careers resources are also available, and an extensive list of useful websites can be found on the 'Links' page.

We would like to build up a collection of career profiles that can be used on a rotational basis. The profiles cover a range of career stages from undergraduate student through to established scientist and also encompass non-lab-based roles. If you would like to be profiled, please contact Stacey Munro (**s.munro@sgm.ac.uk**). Any ideas or suggestions for new content or information sheet topics would also be very welcome.

STACEY MUNRO, Membership Services and Grants

SGM journal websites get a radical facelift

On 7 June, the websites of the four SGM journals (www.sgmjournals.org) underwent a dramatic transformation as they were relaunched on the HighWire 2.0 platform. This was the culmination of a project that began over 3 years ago and has involved a number of staff at Marlborough House, as well as HighWire and external suppliers the Charlesworth Group and Inera, Inc.

The journal websites had remained more or less the same since they were launched back in 1999, and there was widespread agreement that an update was needed. HighWire have designed the new platform to be flexible and modular, allowing greater scope for innovation and interaction with Web 2.0 services and mobile browsing. It was also an opportunity to take advantage of the huge leaps forward that have taken place in browser technology over the last 10 years.

Readers should find the sites much simpler to navigate and easier on the eye. We are also planning new services to exploit the capabilities of the new platform.

Feedback is always welcome; click on the 'Feedback' link on the right of every page and let us know what you think of the new sites.

ROBIN DUNFORD, Journals Manager (email r.dunford@sgm.ac.uk)

NEW INITIATIVES

SGM has a long history of supporting microbiology in developing countries through the Watanabe Book Fund and the International Development Fund. We are delighted to announce two new initiatives that continue this tradition – but in a slightly different way.

HELPING WOMEN MICROBIOLOGISTS IN AFRICA

US$15,000 will be available each year for the next 2 years to enhance the professional experience of women microbiologists in Africa. The AWARD (African Women in Agricultural Research & Development) scheme is run by the CGIAR Gender & Diversity Programme and aimed at developing the careers of African women scientists. SGM will offer a travel grant scheme to AWARD fellows working in any field of microbiology who wish to present their research at an international conference. Grant recipients will also be offered free SGM membership for 1 year.

SUPPORTING REFUGEE MICROBIOLOGISTS

In response to a request from long-standing member Alan McCarthy, Council has decided to award £5,000 each year in 2011/12 to CARA (Council for Assisting Refugee Academics) to support microbiologists who have come to the UK as refugees escaping persecution. The grants will enable the recipients to brush up on skills or re-train in order to achieve employment in the UK. Grant recipients will also be offered free SGM membership for 1 year.

These initiatives are in addition to the existing schemes, details of which can be found on p. 144.

Fred Griffith Review Lecture – Jeff Cole

Born in 'Bomb Alley' (Brentwood, Essex) in 1942, Jeff gained a scholarship from Plymouth College to St Peter's College, Oxford, in 1960, a first class degree in chemistry, and a DPhil in biochemistry supervised by David Hughes in the Krebs Laboratory in 1967. He was a Fulbright Scholar at UCLA before moving to a lectureship in Birmingham in 1969. He was SGM General Secretary from 1979 until 1984. In 1997, he formed the Microbial Physiology Section of the European Federation for Biotechnology. He is EFB Vice-President and Editor-in-Chief of *FEMS Microbiology Letters*, assisted by his wife, Sudesh.

Jeff's interest in microbial physiology focuses on how bacteria adapt from aerobic to anaerobic growth. Recognition that the *Escherichia coli* transcription factor FNR is a key player in regulating the use of alternative electron acceptors to oxygen led to intensive studies of the multiple pathways for nitrate and nitrite reduction, the ancillary genes required for enzyme assembly and post-translational modifications, and, more recently, protection mechanisms against reactive nitrogen species generated during anaerobic nitrate respiration. In collaboration with former SGM President Harry Smith, a host factor that protects gonococci from complement-mediated killing was shown to be the nucleotide CMP-NANA, the donor of sialic acid. This is a beautiful example of molecular mimicry: the ability of gonococci to sialylate lactoneotetraose on their surface lipo-oligosacharides makes them appear like other blood group factors such as transferrin, providing a passport to survival in the human body.

Jeff will deliver his lecture on Tuesday 6 September at the SGM Conference in York.

PETER WILDY PRIZE FOR MICROBIOLOGY EDUCATION – ANTHONY C. HILTON

Following a PhD in microbiology from the University of Birmingham, Anthony remained there as a lecturer in the Institute of Public & Environmental Health for 5 years before moving to Aston University in 2000. At Aston, he has continued to pursue his research interest in the molecular epidemiology of food-borne pathogens and other important clinical bacteria, including MRSA and *Clostridium difficile*. He was appointed as Senior Lecturer and Director of Biology/Biomedical Sciences in 2005, and promoted to Reader and Head of Biology in 2009. He has served as Honorary General Secretary of the Society for Applied Microbiology and has held several journal editorial positions. Through his work with the media, Anthony is a regular contributor to print and broadcast articles in the field of microbiology. He featured in an 8-part BBC3 series *Grime Scene Investigation*, taking a mobile laboratory to visit members of the public in their homes and revealing the microbial world living around them, and, more recently, he has appeared on BBC1's *The One Show*. He leads a 2-day microbiology roadshow taking practical microbiology into schools and is always keen to engage the public and young students in microbiology.

Anthony will deliver his lecture, entitled … *but is it as dirty as a toilet seat?* on Monday 5 September in York.

OUTREACH PRIZE SPONSORED BY Yakult – NICOLA STANLEY-WALL

Nicola is a lecturer at Dundee University. In 2005, she was awarded a BBSRC David Phillips Fellowship to establish her research programme in Dundee. Her research focuses on how the Gram-positive bacterium *Bacillus subtilis* forms biofilms. This is approached using a combination of classical genetic and biochemical techniques alongside advanced microscopy and mathematical modelling.

Her interest in outreach activities started shortly after her move to Dundee when she became a member of the Royal Society for Edinburgh *Talks for Schools Programme*. After providing several lectures for secondary school children, she decided that it would be exciting to develop a route to interact in a more 'hands-on' manner. She set her sights on developing an event that would involve the majority of the members of the Division of Molecular Microbiology in the College of Life Sciences. This plan morphed into *Magnificent Microbes* that was held at the Dundee Science Centre (formerly *Sensation*), an event that was funded in part by SGM. Following the success of this event, her outreach activities now include a partnership with Bell Baxter High School in Fife to establish a Microbiology Club and planning for *Magnificent Microbes 2*.

Nicola will give her talk on the afternoon of Tuesday 6 September, following the *Sir Howard Dalton Young Microbiologist of the Year* presentations in York.

Prize Lectures 2012

Nominations are now sought for the 2012 **Fleming Award**, **Marjory Stephenson Prize Lecture** and **Peter Wildy Prize for Microbiology Education**. The award panel will consider the submissions in the autumn and take their recommendations to November Council for approval. The outcome will be announced in the February 2012 issue of *Microbiology Today*. Prize lecture rules and a nomination form are available on the SGM website: **www.sgm.ac.uk/about/prize_lectures.cfm**

The closing date for all nominations for 2012 is **30 September 2011**.

9th UK Meeting on the Biology and Pathology of Hepatitis C Virus

Eighty members of the UK hepatitis C virus research community gathered at Rydal Hall in the heart of the Lake District, on 13–15 May 2011, to share research findings pertaining to this important human pathogen. These meetings have now become an integral part of the calendar for the attendees and provide a friendly, supportive and collaborative environment for the presentation and discussion of new research data. The meeting covered a range of topics from pathogenesis and treatment to virus–host cell interactions and virus replication. Over the weekend, there were 29 short presentations, mainly by early-stage researchers. There was plenty of time for discussion and the frontiers of science were also enthusiastically pushed back into the early hours of the mornings, fuelled by the excellent local ales provided by the Badger Bar! Saturday afternoon was free to explore the surroundings of Rydal Hall; activities included fell running, crazy golf in Ambleside, watching the Cup Final and sleeping!

As in previous meetings, a guest speaker from outside the UK was invited, and we are grateful to the SGM for providing financial support through the Regional Meetings Scheme to allow us to host Professor Norbert Tautz from the University of Lübeck, Germany. Norbert gave us an excellent overview of the biology of the Pestiviruses, a family of viruses closely related to hepatitis C virus, outlining the lessons that can be learnt from comparative studies.

The meeting closed at Sunday lunchtime, giving time for delegates to wind their weary way back to their homes. Prizes (bottles of champagne!) were awarded to the best PhD student and postdoc talks; these went to Victoria Edwards from the University of Nottingham and Michelle Farquhar from the University of Birmingham, respectively. All attendees agreed that this was a very successful and enjoyable meeting, and everyone is looking forward to the next one – to be held on 13–15 April 2012.

The organizers: Alex Tarr, Nottingham / Mark Harris, Leeds / John McLauchlan, Glasgow

MARK HARRIS (email m.harris@leeds.ac.uk)

PEOPLE

STAFF

We are very pleased to announce that **DAVID EYRE**, who was appointed in 2010 as a Staff Editor at Marlborough House on a 12-month contract, has now been made a permanent member of the journal staff. David says, '*I am very happy about becoming a permanent member of one of the friendliest and most professional teams I've ever worked for. SGM does great work and I'm enjoying my time here.*'

We also welcome two new temporary members of staff to Marlborough House.


Sanketa Shetty

SHWETA SHETTY has just started a 3-month internship in *Food security and safety*. Shweta graduated with a BSc (Hons) in Parasitology from Glasgow and more recently completed an MSc in Molecular biology and pathology of viruses at Imperial College London. Shweta says, '*An academic background in infectious diseases and a strong interest in public policy means that the SGM is the perfect organization to work for to apply these skills and knowledge. As the SGM undertakes valuable outreach and educational work, produces highly regarded journals and publications as well as helping to shape key policies, it provides a perfect opportunity for a young scientist like myself to observe interactions with the science and policy communities. I am thrilled to be part of the SGM and very grateful to be doing this internship.*'

CLAIRE MACCLEAN started her 1-year contract as the Scientific Conferences and Events Manager at the beginning of June, covering **SUSAN LEONARD**'s maternity leave.

Claire has 10 years experience in events management, gained largely within the charity sector. She also has a Master's Degree in Teaching English as a Foreign Language and completed a BSc (Hons) in Psychology with the Open University last year. She is looking forward to meeting everyone at the SGM Autumn Conference in York.


Laura Udakis

News of Members

The Society offers its congratulations to: **PROFESSOR SIR JOHN ARBUTHNOTT**, former SGM President, on his election as the next President of the Royal Society of Edinburgh; **PROFESSOR JOHN K. FAZAKERLEY**, Group Leader and Professor of Virology at the Roslin Institute, who has taken up his post as Director of the Institute for Animal Health; **PROFESSOR R. JOHN PARKES**, Head of School and Distinguished Research Professor, School of Earth and Ocean Sciences, Cardiff University, on his election as a Fellow of the Royal Society; **PROFESSOR JOANNA VERRAN**, SGM Education and Public Affairs Officer on being voted *Communicator of the Year* by the Society for Applied Microbiology. The Society notes with regret that **PROFESSOR TONY ATKINSON** (member since 1971) has died after a short illness. Tony was widely regarded as one of the UK's leading industrial microbiologists and his work is highlighted in the article on p. 154.

Wanted!
Good home for *SGM Symposium* volumes

Former SGM member Dave Hard is offering his collection of *Symposium* volumes to anyone who can give them a good home. The volumes in the collection are: 11, 23, 24, 25, 26, 27, 28, 30, 36 (both volumes), 37, 42 and 48. If you are interested, please contact Dave at **dnd@ntlworld.com**

MAY COUNCIL MEETING HIGHLIGHTS

NEW CHIEF EXECUTIVE

The President, **PROFESSOR HILARY LAPPIN-SCOTT**, welcomed the Chief Executive-elect, **DR SIMON FESTING**, to his first meeting of Council. Dr Festing would formally take up employment with SGM on 1 June, allowing a 5–6 week handover period before **DR RON FRASER** retired on 10 July. During that time, Dr Fraser would continue to run the company, while Dr Festing would familiarize himself with the staff, Council, procedures and current issues, before presenting his thoughts to Council in July. There would be a dinner for Council and invited guests on 7 July, to celebrate Dr Fraser's major contributions to SGM over more than 15 years.

COUNCIL MEMBERSHIP

DR PAUL HOSKISSON, due to retire as an elected member of Council in September 2011, was co-opted to serve for a further year, to cover the remainder of his term of office as Editor of *Microbiology Today*. Council approved the recommendation of Treasurer's Committee that **PROFESSOR CHARLES DORMAN** should be appointed as Treasurer, in succession to **PROFESSOR COLIN HARWOOD** when he came to the end of his term of office in September 2012. Professor Dorman would 'shadow' Professor Harwood for his last year of office. It was noted that there had been four nominations for the single vacancy for an elected member from September 2011, and that an election would be arranged.

PRESENTATION ON 'NEW MEDIA'

LAURA UDAKIS and **DARIEL BURDASS** from the Marlborough House staff entertained and informed Council with a lively presentation on SGM's use of 'New Media', which included videos, podcasts and the social networks *Facebook* and *Twitter*. These allowed SGM to add to and reinforce current and future written resources, highlight Society activities, reach new audiences and, importantly, gain feedback. The presentation generated a lively discussion.

SOCIETY OF BIOLOGY

PROFESSOR LAPPIN-SCOTT noted with pleasure that Council member **DR KIM HARDIE** had been elected to the Council of the Society of Biology by the college of individual members, and that former SGM Scientific Meetings Officer **DR PAT GOODWIN** had been re-elected by the college of member organizations.

FINANCIAL MATTERS

PROFESSOR COLIN HARWOOD presented the accounts for the financial year ending 31 December 2010, which were duly accepted by Council and signed. It had been a very successful year financially, and the Society's charitable objectives such as grant-giving, educational activities and conferences had been fully supported. Membership subscriptions and institutional journal prices for 2012 were agreed.

SGM CONFERENCES

The Scientific Meetings Officer, **PROFESSOR CHRIS HEWITT**, reported that a record of over 400 abstracts had been received for the spring conference at Harrogate, including 120 from non-members. This reflected the efforts of Marlborough House staff to publicize the conferences to a wider audience. Abstract submission was open for the autumn conference at the University of York. Future venues booked were the Convention Centre, Dublin (spring 2012), the Arts Centre at the University of Warwick (autumn 2012) and Manchester Centre (spring 2013).

SOCIETY BUSINESS

OUTREACH ACTIVITIES

Council noted that a discussion meeting on influenza organized at short notice by **DR FRASER**, with the support of **PROFESSOR WENDY BARCLAY**, for the Parliamentary and Scientific Committee at Westminster, had been a great success (see p. 184). There had been three excellent speakers and a robust question and answer session, which had continued over dinner in the House of Commons.

The Education and Public Affairs Officer, **PROFESSOR JOANNA VERRAN**, reminded Council that the Society was running three events and *Discover Zone* interactive activities at the Cheltenham Science Festival (see p. 186); Marlborough House staff were to be congratulated on the scale of these activities.

The next Council meeting will be held in July 2011.

RON FRASER, FORMER CHIEF EXECUTIVE OFFICER

GRANTS

SGM has a wide range of grant schemes to support microbiology. See www.sgm.ac.uk for details. Enquiries should be made to: **Grants Office, SGM, Marlborough House, Basingstoke Road, Spencers Wood, Reading RG7 1AG** (**tel.** 0118 988 1821; **fax** 0118 988 5656; **email** grants@sgm.ac.uk).

SGM CONFERENCE GRANTS

We offer several grant schemes to support attendance at our conferences. Closing dates: Autumn Conference (York) – **2 September 2011** Irish Division (ITT Dublin) – **26 August 2011**

POSTGRADUATE STUDENT CONFERENCE GRANTS

All PG Student Associate Members resident and registered for a PhD in an EU country are eligible to apply for a grant to support their attendance at one SGM conference each year. Grants contribute towards travel, registration and accommodation expenses. The student need not be presenting their research so it is an ideal introduction to scientific meetings at little or no cost to themselves or their supervisor's budget.

TECHNICIAN CONFERENCE GRANTS

All Associate Members who are technicians are eligible to apply for a grant to support their attendance at one SGM meeting each year. Applicants need not be presenting work at the meeting. Some microbiology technicians who are not members of SGM may also apply for a grant to attend a Society Meeting.

UNDERGRADUATE STUDENT CONFERENCE GRANTS

UG student members who have results to present from either their final year or vacation project can apply for funding to attend one SGM conference a year. The grant contributes towards travel and accommodation costs (registration is free) and applicants must have had their abstract accepted for presentation. Students need not be the first author but should be present at the poster session to talk about their work.

RETIRED MEMBER GRANTS

Cover accommodation and Society Dinner at one SGM conference a year.

MEDICAL MICROBIOLOGY SUPPORT GRANTS

ELECTIVE GRANTS

Funding for medical/dental/veterinary students to work on microbiological projects in their elective periods.

TRAINEE SUPPORT GRANTS

Funding for SGM members carrying out small lab-based microbiology projects during either foundation or specialty postgraduate medical training. Up to £3,000 is available towards the consumables costs of a project.

Closing date for both grants: **23 September 2011**.

TRAVEL GRANTS

PRESIDENT'S FUND FOR RESEARCH VISITS

Up to £3,000 is available to support early-career microbiologists who are planning a short research visit to another laboratory (minimum visit 4 weeks, maximum 3 months). Closing date: **23 September 2011**.

SCIENTIFIC MEETINGS TRAVEL GRANTS

Support for early-career microbiologists wishing to present work at a scientific meeting in the UK or overseas. Graduate research assistants and lecturers (within 3 years of first appointment in both cases) in UK and Ireland, postdoc researchers (within 3 years of first appointment) and PG students in the EU are eligible to apply. Retrospective applications are not considered.

SGM REGIONAL MEETING GRANTS

Contribution of up to £2,000 towards the costs of running a regional or special topic microbiology meeting.

EDUCATION & DEVELOPMENT

NATIONAL

EDUCATION DEVELOPMENT FUND

Small grants to members for developments likely to lead to an improvement in the teaching of any aspect of microbiology relevant to secondary or tertiary education in the UK. Up to £1,000 is also available to support public engagement activities.

GRADSCHOOL GRANTS

PG student members who are not eligible for a free place on a Vitae (www.vitae.ac.uk) personal development course (National GRADSchool) may now apply for a grant from SGM to cover full course fees. Retrospective applications are not considered.

SEMINAR SPEAKERS FUND

Small grants to cover the travel and other expenses of up to two speakers on microbiological topics in annual departmental seminar programmes.

STUDENT SOCIETY SPONSORED LECTURES

These cover the travel and other expenses of up to two speakers on microbiological topics per society each year at student society meetings.

INTERNATIONAL

INTERNATIONAL DEVELOPMENT FUND

The Fund exists to provide training courses, publications and other help to microbiologists in developing countries. Closing date: **23 September 2011**.

THE WATANABE BOOK FUND

Members who are permanently resident in a developing country may apply for funding to acquire microbiology books for their libraries. These annual awards are available as a result of a generous donation from Professor T. Watanabe of Japan. Closing date: **23 September 2011**.

GRANTS FOR TEACHING FELLOWS

In response to a growing need among our members who are in teaching-focused roles, we are pleased to announce a slight amendment to the Scientific Meetings Travel Grants. The eligibility for this grant is now extended to those members who are within the first 3 years of a Teaching Fellowship and will fund applicants who wish to present work in the field of microbiology education research.

Musical microbes

Wind instruments with wooden reeds, such as clarinets and saxophones, are a haven for microbes, according to a recent study. The researchers from Tufts University School of Medicine have urged proper cleaning of musical instruments – particularly if they are shared between individuals. The group collected samples from 20 clarinets, flutes and saxophones and found viable bacteria as well as fungi on all instruments. They used a pump and an aerosol generator to apply *Escherichia coli*, *Staphylococcus* and attenuated *Mycobacterium tuberculosis* to clarinets. They showed that *E. coli* and *Staphylococcus* sp. survived for up to 2 days on reeds, while *Mycobacterium* persisted for 13 days after application. In simulated play experiments, the tested bacteria could survive up to 5 days. To minimize the transfer and growth of microbes on instruments, the researchers have suggested alcohol wipes, soap and water or a commercial disinfectant as efficient methods of cleaning.

Int J Env Health Res
doi:10.1080/09603123.2010.550033

Clarinet mouthpiece. *Comstock / Thinkstock*

Conventional air filter. *iStockphoto / Thinkstock*

Bacterial biofilters

Pesticides that accumulate in the environment could be removed from the air by biofilters containing genetically modified bacteria. Scientists in China have shown that a biofilter based on *Escherichia coli* BL21 is able to extract the toxic pesticides parathion and methylparathion from the air. Average removal efficiencies were 95.2% for parathion and 98.6% for methylparathion. The authors believe that optimization of the system may allow closer to 100% removal. Organophosphorus compounds, such as parathion and methylparathion, are potent insecticides but may pose a health risk to humans if they accumulate in the environment. The researchers said that the *E. coli* BL21 biofilter was more effective than conventional biofilters, particularly in the initial stages of filtering. The breakdown products of the pesticides are degraded by other naturally occurring microbes present in the biofilter.

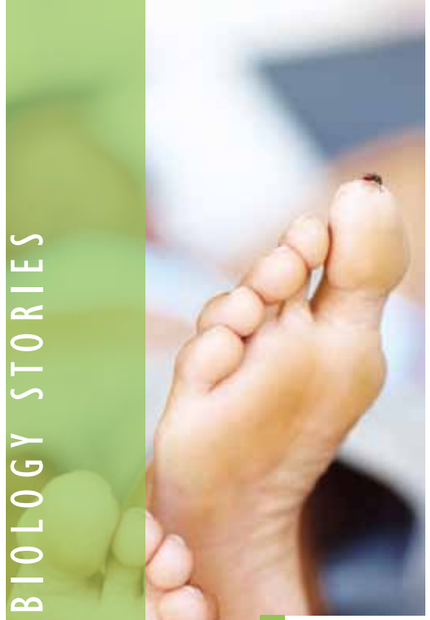
Int J Env Pollut doi:10.1504/IJEP.2011.039080

Smelly feet attract malaria mosquitoes

Foot odours are used by female mosquitoes to guide them to their preferred biting place – the feet. Researchers in the entomology group at Wageningen University have now revealed a mechanism to explain the phenomenon. The group previously showed that bacteria living on the human foot produce at least 10 bacterial foot odours which, when combined, were attractive to malaria mosquitoes. Female *Anopheles gambiae* mosquitoes, which carry malaria, use exhaled carbon dioxide to sense humans. At close range, microbial foot odours block the response to CO_2 and divert the mosquito towards the feet. The researchers have now shown that 9 out of 10 of these odours are detected by the three olfactory receptors on the mouthparts of the mosquito. Five of these odours inhibit the CO_2 response. The researchers believe that these inhibitory odours cause the switch from the long distance CO_2 signal, redirecting the mosquito to the feet. They suggest that by inhibiting the CO_2 signal it might be possible to lure malaria mosquitoes towards odour traps that contain other attractive human odours.

www.wageningenuniversity.nl/UK/newsagenda/news/Malaria_mosquitoes_accurately_find_their_way_to_smelly_feet.htm

LAURA UDAKIS HIGHLIGHTS SOME RECENT MICROBIOLOGY STORIES



iStockphoto / Hemera / Thinkstock

Neutrophil engulfing a *Candida* cell. *SPL*

How immune cells pick their fungal targets

A mechanism has been discovered to explain how immune cells can identify when invading fungi pose an infectious threat. A receptor called Dectin-1 found on the surface of white blood cells only recognizes fungi that come into direct contact with it. The immune cells are then activated to destroy the invader. This mechanism means that the immune system does not waste precious energy mounting an attack on debris that is sloughed from invading fungi and doesn't pose an immediate threat. The researchers from the Cedars-Sinai Medical Center in Los Angeles showed that when Dectin-1 recognizes directly-bound fungi, a 'phagocytic synapse' is formed at the surface of the white blood cell. This results in the initiation of antimicrobial responses, including phagocytosis and production of reactive oxygen species. The work gives further insight into the regulation of the immune system.

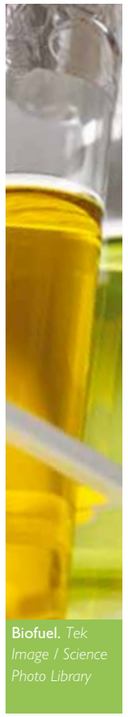
Nature
doi:10.1038/nature10071

Weather warning for cholera

An early warning system that can predict cholera outbreaks months before they happen has been developed by scientists from the International Vaccine Institute in Seoul. The findings could improve medical care in parts of the world where cholera is endemic. By studying climate records and cholera outbreaks from 1997 to 2006 on the two main islands of Zanzibar, the scientists showed a correlation between higher temperatures, increased rainfall and cholera outbreaks. They showed that a rise of 1 °C in average monthly temperatures can indicate a doubling in the number of cholera cases over the following 4 months. With the effects of global warming, cholera is expected to become more of a problem in areas previously unaffected by the disease. Advance warning of outbreaks would allow heath services to raise awareness of the threat and instigate pre-emptive measures such as vaccine programmes and distribution of medications.

Am J Trop Med Hyg
doi:10.4269/AJTMH.2011.10-0277

Ugandan boy carrying water. *Mauro Fermariello / Science Photo Library*



Biofuel. *Tek Image / Science Photo Library*

Making microbes more biofuel tolerant

Product toxicity to microbes is a common problem when developing strains for advanced biofuel production. Scientists from the US Department of Energy's Joint BioEnergy Institute have started to tackle the issue by developing a library of microbial efflux pumps to help make engineered microbes more biofuel-tolerant. Among the many strategies that microbes have for protecting themselves against toxic substances, one of the most effective is efflux pumps which pump toxins out of the cell. The team used bioinformatics to generate a list of all efflux pumps from sequenced bacterial genomes. The resulting library of 43 pumps was heterologously expressed in *Escherichia coli*. From the library, efflux pumps were identified that significantly reduced the toxicity of seven representative biofuels. In a series of survival competitions, the pumps that were the most effective were the native *E. coli* pump AcrAB and a previously uncharacterized pump from the marine micro-organism *Alcanivorax borkumensis*. The authors believe that the work will contribute to improving biofuel production.

Mol Syst Biol
doi:10.1038/msb.2011.21

MICROSHORTS

FUTURE

IRISH DIVISION

Spring 2012
Dublin
26–29 March 2012
www.sgmdublin12.org.uk

Autumn 2011
Institute of Technology Tallaght, Dublin
1–2 September 2011
Microbial pathogenesis: the key to better therapies
Organizer: Dr Siobhan McClean
(siobhan.mcclean@ittdublin.ie)

For details of all Irish Division activities, contact John McGrath (j.mcgrath@qub.ac.uk)

OTHER EVENTS

SGM is supporting the following meetings:

Federation of Infection Societies Conference 2011
Manchester Central Convention Complex
16–18 November 2011
www.fis-infection.org.uk

Bacterial Spore Formers
Royal Holloway, University of London
16 April 2012
www.sporesconference.com

Geomicrobiology
University of Manchester
19–20 April 2012

European Microscopy Congress
Manchester Central
16–21 September 2012

SCIENTIFIC MEETINGS COMMITTEE

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  p.duprex@qub.ac.uk
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Suggestions for topics for future symposia are always welcome.

I. Atherton

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Traditional grain store in Bungoma, Kenya, keeping grain and other produce dry, secure and shaded to minimize microbial spoilage and insect and rodent attack. The building itself is made from local renewable materials. There are millions of such vital structures worldwide; has anyone ever costed their construction and upkeep? *C. Allsopp*

Worldwide wastage: the economics of biodeterioration

DENNIS ALLSOPP

Biodeterioration can be defined as 'any undesirable change in a material brought about by the vital activities of organisms'. But what are the costs and how do we estimate them?

THE ULTIMATE fate of all organic matter is to be consumed by micro-organisms or to be burnt. Many inorganic materials, such as stone and some metals, are also not immune to microbial attack. Each year, billions of tonnes of plant cellulose are produced in nature, most of which is naturally recycled by organisms. Not surprisingly therefore, biodeterioration is a common and ubiquitous process, but one which often goes unrecognized or unacknowledged. Economic factors are implicit within the definition and study of the biodeterioration of materials, as 'materials' are 'matter used by man'. Despite this, there are few hard data available on the costs of biodeterioration, especially at regional and global levels. Much work is needed in this area if planners, politicians and those involved in economic development are to be fully and usefully informed as to the need for the conservation of material resources. The costs of all world commodities are soaring and the costs of losses due to biodeterioration will increase accordingly.

RECOGNITION: A NEED FOR EDUCATION

Instances of biodeterioration must first be recognized as such before any economic costs can be attached. There is much scope for the training of the public-at-large and employees in manufacturing and service industries. This education cannot be left to specialist scientists, in the same way that hygiene training cannot be the sole responsibility of hospital consultants. Some cases of deterioration of materials are obviously of biological origin. Wood reduced to dust by termites, drains blocked by plant growth, and pigeon droppings disfiguring outdoor artwork and buildings are all obvious examples. Less certain to the untrained eye are cases such as the appearance of fruiting bodies of fungi on rotting timber and mould growth on foodstuffs. There is obviously a problem, but not everyone recognizes such 'growths' as living organisms. Sadly, public knowledge of the range and properties of micro-organisms has increased little since the times of Louis Pasteur.

Cases of microbial growth well mixed or dispersed within materials, such as bacteria in metal-working fluids, fungi in hydrocarbon fuels and the disfigurement and breakdown of paint films by microfungi, cyanobacteria and algae, are less easy still to recognize and appreciate, owing to the small size of the organisms involved, their unfamiliarity and the fact that the substrate is chemically very different from animal and human foodstuffs. Instances such as microbially induced corrosion of metals, in which separate physicochemical mechanisms may also be in play, can be even more difficult to recognize and quantify.

RECORDING AND REPORTING: THE ABSENT STATISTICS

Even if damage to materials is recognized as being biological in origin, it may not be listed as such in routine reports, being simply classed with other types of losses as 'spoilage', 'wastage' or 'contamination'. Biodeterioration may even be accepted as inevitable; the legalistic term 'inherent vice' has long been used when writing off losses of perishable materials and commodities. Evidence of the true cost of biodeterioration is therefore often hidden, disguised or even ignored.

Once recognized as such, biodeterioration may be costed in a variety of ways, although collecting the data to make up any costing may be complex and in many cases the final figure may be an approximation.

COST OF PREVENTION

Where materials are known to be at risk, preventative measures can be taken from the outset. Such measures may be physical, such as drying, vacuum-packing, cooling or freezing, or chemical, such as the addition of a biocide or preservative. The costs of such measures can be assessed for individual products by a producer or user, and, on a more general level, the turnover of a 'prevention' industry or company such as a biocide manufacturer or pest controller can be used as an indicator of the cost of biodeterioration in particular material groups or environments.

COST OF REPLACEMENT

The number of materials, especially in the more developed countries, which can be classed as 'cheap' is dwindling rapidly, but where low-cost (usually locally sourced) materials are used, the replacement cost can be used as a guide to the cost of biodeterioration. Palm-thatch roofing renewed every year may be cheaper than tin or tile in the right circumstances.

COST OF REPAIR OR REMEDIAL MEASURES

Any decision to apply repair or remedial measures to restore a material or construction to near its original condition and utility hinges on the cost and practicality of such work, as opposed to that of replacement, always assuming that a replacement is available. For unique or costly items, such as museum specimens, the cost of conservation work can be very high.

"Evidence of the true cost of biodeterioration is often hidden, disguised or even ignored."

Fresh fruit and vegetables on sale in Barcelona, Spain. Good hygiene, handling, cooling and packaging extend the shelf life of this perishable produce, but all at a cost. What is the regional or global cost of bringing such foodstuffs to market in perfect condition? *D. Allsopp*

COST OF LITIGATION

Sometimes, the biodeterioration of a material will be due to neglect by one or more parties in the production/supply/use chain, with the matter being resolved in court. Employment of lawyers, experts and laboratory services will be expensive and the level of fees may well exceed the value of lost goods.

Paint film deterioration, Azores, Portugal. This white-painted public building is disfigured by growths of the alga *Trentepohlia* causing the red stain. Paint films, especially in humid regions, are often subject to deterioration by fungi, cyanobacteria and algae, often not recognized as living organisms. Cost of cleaning and redecoration? *D. Allsopp*

ADDED VALUE DUE TO MANUFACTURING

As any material becomes highly processed, so the value increases and the tolerance to biodeterioration decreases. The classic example is a bag of raw fruit. A single maggot in a single fruit may well be tolerated. The same maggot in a can or freezer pack of pie filling made from the fruit will cause rejection of the whole product. A little mould or insect damage to a stock of raw plant fibres or wool may be of little consequence, but damage to a hand-made luxury carpet made from these fibres, selling at a hundred or more times the cost of the raw materials, will be significant.

Added value in manufacturing. Time, labour and skill in production of goods adds great value to the basic component materials. This Kazak carpet costs more than a hundred times that of the natural fibre raw materials but, without care and protection, is still vulnerable to attack by moulds, insects and rodents. *D. Allsopp*

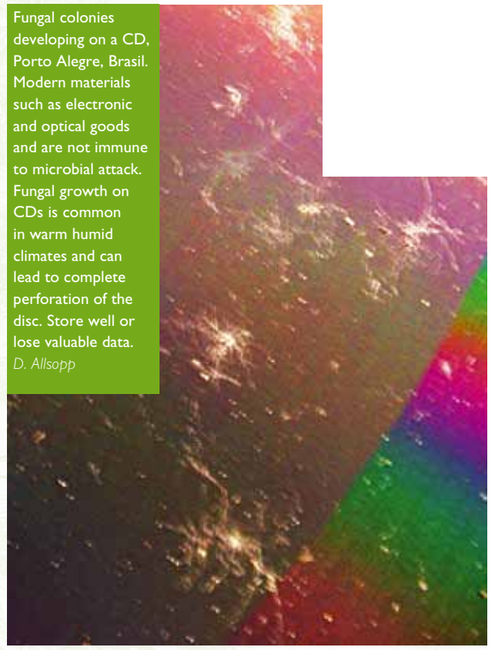
A BROAD CALCULATION EXERCISE

In the life of some materials, costs may be attributed to several methods of costing: initial preservation, repair and eventual replacement being typical. There is no single, universal scheme for costing biodeterioration. However, some calculations can be carried out to reach very approximate global sums which begin to indicate the significant cost of biological attack on materials.

1. Select types of susceptible materials (such as wood, natural fibres, paint, fibre board, packaging and stored foodstuffs). Highly processed products have much higher values than basic materials.
2. Estimate percentage loss expected due to biodeterioration. Most people estimate 5–20%, but decide on 1% to avoid argument for an initial calculation. Post-harvest losses of foodstuffs can be much higher, especially in the tropics.
3. Find the annual value of goods (local, national or world) from trade or government statistics.
4. Take 1% of this figure. However approximate the calculation, a large sum of money is involved.

SOME NUMBERS TO PONDER

Using the format above, the annual world loss of non-food materials due to fungal attack is estimated at US$ 40 billion. Losses of all materials, including post-harvest foodstuffs, due to all types of biodeterioration are estimated at US$ 200–500 billion. Challenges to these (probably conservative) estimates and new ideas on methods of costing are welcome and needed. Readers looking for student project ideas, please note!



Fungal colonies developing on a CD, Porto Alegre, Brasil. Modern materials such as electronic and optical goods and are not immune to microbial attack. Fungal growth on CDs is common in warm humid climates and can lead to complete perforation of the disc. Store well or lose valuable data. *D. Allsopp*

FOOTNOTE: AN EASY CASE TO COST

In April 2011, *BBC News* reported that, in India, termites had penetrated a bank safe deposit box and reduced £130,000 worth of banknotes to dust. A clear case of biodeterioration; easy to recognize and for once easy to cost precisely!

DR DENNIS ALLSOPP is a Consultant Chartered Biologist, a Fellow of the Society of Biology and a former President and Secretary of both the International Biodeterioration and Biodegradation Society (IBBS), of which he is an Honorary Fellow, and the International Biodegradation Research Group (IBRG). He served as Information and Services Officer at the Biodeterioration Information Centre, University of Aston and then as the Head of the Culture Collection and Industrial Services Division at CAB Biosciences. His current interests centre upon biodeterioration problems in the cultural heritage field and he has lectured on these topics worldwide (email dennis.allsopp@yahoo.com).

FURTHER READING

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STEVEN M. MARTIN & ELAINE WHITE

Where there's bugs, there's brass…

Landfill. *iStockphoto*

Burning alcohol. *Hemera*

Nobody likes waste. People like landfill even less. New green technologies offer an exciting opportunity to divert our household waste from landfill and convert it into renewable fuels and a range of valuable bio-based chemicals.

WE ARE ALL part of the waste supply chain. Every person in the UK produces on average about half a tonne of household waste per year with only about a third currently being recycled. This means that every year, each of us produces more than 300 kg of non-recycled household waste, most of which is sent to landfill where it is of little use and produces environmentally damaging greenhouse gases – primarily carbon dioxide and the more harmful methane.

Landfill has for many years been viewed as a cheap way to dispose of waste, but following the implementation of various UK and EU policies this is no longer the case. Rising landfill taxes and increasing transportation costs means that many UK local authorities are paying in excess of £100 per tonne to dispose of their waste. This is a significant cost to local councils and council tax payers, and it is unsurprising that other alternatives are being actively sought.

Mature technologies, like incineration, anaerobic digestion and composting, are available and being deployed commercially, but none provides a completely satisfactory solution. However, modern biotechnology techniques are enabling a new generation of technical solutions to deal with waste. Some of these 'green' technologies are now ready for commercialization and will have a significant benefit not only in treating waste, but also in offering a range of additional economic and environmental benefits.

Biofuels are produced from plant biomass and organic waste and can replace part or all of our conventional fossil fuels. In 2007/8, against a backdrop of rising food prices and environmental concerns about sustainability, biofuels were widely regarded with suspicion by public and politicians alike. Recent studies have shown, however, that many of the fears about biofuels were poorly founded. The major causes were rising oil prices, drought and crop failures, and speculation in the commodity markets. Examination of broad sustainability issues have shown clearly that biofuels can have a major impact on reducing greenhouse gases, decreasing costs of and reliance upon imports of foreign oil, and also help regenerate rural economies.

NOT ALL BIOFUELS ARE CREATED EQUAL – SECOND GENERATION BIOFUELS PRESENT AN EXCITING OPPORTUNITY

Biofuels are generally described as first generation (1G) or second generation (2G), depending on the resource used to produce them.

1G biofuels include biodiesel produced from plant oils or animal fats, and bioethanol produced from starchy grains, such as wheat or corn, or from sugar cane. These processes are an extension of traditional brewing

"The commercial potential of the waste to ethanol process … is huge."

where simple sugars like glucose are fermented to ethanol using yeast – in fact the broth produced after fermentation is still referred to as 'beer'. These 1G biofuels are often criticized for diverting valuable land away from food production – the so-called 'food versus fuel' debate.

2G processes avoid this issue as they use advanced technologies, many of which feature novel, metabolically engineered micro-organisms, to produce biofuel from non-food crops and waste. The most promising of these new technologies are those used to produce cellulosic bioethanol and a UK company is playing a leading role in commercializing this way to deal with waste.

THE TMO WASTE TO ETHANOL STORY STARTED IN 1975

The TMO story begins in the 1970's when a promising young scientist called Tony Atkinson was working on high-temperature-loving (thermophilic) bacteria. He noted that some of these thermophiles would occasionally produce a little ethanol. He published these observations in 1975 in the journal *Biotechnology and Bioengineering* where, with considerable foresight, he concluded that strains like these might be extremely valuable in the conversion of waste to ethanol.

After a highly successful career, Tony co-founded TMO Renewables Ltd in 2002 to further investigate and commercialize those early observations. He recognized that thermophiles offered a number of potential benefits in an industrial process, and drew up a list of desirable characteristics, e.g. ability to grow above 60 °C, safe to use, and amenable to genetic manipulation. Surprisingly, the ability to produce large quantities of ethanol was not on the list – only that candidate strains should produce some ethanol. The most important characteristic was the ability to metabolize the widest variety of plant biomass sugars because, if successful, the technology could then be applied to multiple waste and non-food biomass sources which would greatly increase its commercial value.

LETTING NATURE DO THE HEAVY LIFTING

Having determined that a wide substrate range was the most valuable characteristic for their process strain, Tony judged that it would be difficult to genetically engineer this trait and so decided to look for it in nature – essentially letting nature do the hard work. Providing the strain could produce some ethanol, he believed it would be simpler and quicker to develop a process strain if his team could metabolically engineer a single pathway to produce more ethanol.

Following an extensive screening programme, in which thousands of thermophilic micro-organisms were evaluated, one strain of *Geobacillus thermoglucosidasius* was identified as the lead candidate. In parallel with the screening, TMO developed a new molecular biology toolkit which was used to metabolically engineer this lead strain. Application of the toolkit delivered two gene knockouts and the up-regulation of a key promoter, resulting in a process strain, called TM242, which could convert a variety of sugars to ethanol at high yields.

"If successful, the technology could be applied to multiple waste and non-food biomass sources which would greatly increase its commercial value."

Hemera

TM242 SPONSORS A SIMPLER PROCESS

The conversion of municipal waste begins with sorting out the metals, plastics, glass and other recyclables. The remaining material is macerated, pulped and washed to deliver a partially purified organic fibre fraction. Every 3 tonnes of black bag waste yields 1 tonne of organic fibre. The TMO process for converting this fibre fraction into ethanol involves three steps.

The first step, called 'pretreatment', is like pressure-cooking, and uses steam to partially degrade the waste. The second step, hydrolysis, uses mixtures of enzymes to hydrolyse the waste into fermentable sugars. One big advantage TM242 has over other ethanologenic strains, like *Escherichia coli* or yeast, is that the sugars do not need to be completely hydrolysed to monomers, such as glucose and xylose, because it can also ferment the oligomeric forms of these sugars. As a result, the process is faster and uses fewer enzymes, making it cheaper to build and operate. Fermentation at 60 °C follows the enzyme hydrolysis step, where TM242 is added and the sugars are converted quickly and efficiently to ethanol within 24 hours. The bioethanol is then recovered from the beer using traditional distillation techniques.

THE UK'S FIRST CELLULOSIC ETHANOL DEMONSTRATION FACILITY

Having a process strain that works in the laboratory is a long way from demonstrating the commercial viability of the technology. The biotechnology needs to be consolidated effectively with the engineering and the fully integrated process then demonstrated on a large scale. In 2007, TMO began construction of its £8 million automated, industrial-scale Process Demonstration Unit (PDU), which was completed 12 months later and has been in operation ever since.

WASTE TO ETHANOL PLANTS IN CONSTRUCTION

In September 2010, TMO signed its first commercial deal to build 15 municipal waste to ethanol plants in the US. The 20-year deal was reported in the *Guardian* newspaper under the following headline *Where there's bugs, there's brass: UK firm lands $500m biofuel contract. TMO Renewables wins contract with US firm Fiberight using its 'turbo-charged' GM bacteria that convert rubbish into biofuels.* The first commercial plant is already under construction and the production of cellulosic ethanol from household waste will start in 2012. Recently, TMO announced two further deals with large, state-owned companies in China. The commercial potential of the waste to ethanol process, powered by this talented thermophilic bacterium, is huge. For example, in 2010 the EU generated 260 million tonnes of municipal waste with the US generating a further 200 million tonnes. The organic fraction from this waste could generate 45 billion litres of ethanol with a value of more than £70 billion.

WASTE TO ETHANOL IS JUST THE BEGINNING…

Whilst the waste to ethanol process is an important first step in the use of this technology, it is by no means the last. TMO's ambition for TM242 extends beyond ethanol – to this end, the company will launch its Centre of Excellence in 2011 in partnership with leading UK and overseas academics and key industrial clients. Its purpose will be to develop and rapidly commercialize flexible biorefineries that can take in a range of cellulosic materials and convert them into a broad range of valuable fuels and chemical intermediates.

The wisdom in Tony Atkinson's early decision to put wide substrate utilization ahead of product titre and to '*let nature do the heavy lifting*' still defines one of TMO's unique selling points and underpins the value of its technology offering. Tony predicted in 1975 that thermophiles could be useful in converting waste to ethanol – 35 years later he and the team at TMO have delivered on this vision.

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Knowledge Transfer Partnerships

SUSAN MATOS

Polka Dot

SO, WHAT IS KTP? Well, KTP is a government-backed programme that started life back in 1975 as the Teaching Company Scheme. It was developed to build on the idea used by teaching hospitals of 'learning by doing'. The aim was to allow industry to access the knowledge, technology and skills residing within universities, in order to bring greater benefit to the UK. Over the years, KTP has evolved from its early engineering roots into a flexible scheme that now covers a wide range of disciplines within the UK's 'knowledge base' (i.e. Higher Education and Further Education institutions, along with research and technology organizations).

As a Technology Strategy Board programme, KTP is formally described as '*Europe's leading programme helping businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK knowledge base*'. Put simply, it's a highly flexible scheme that facilitates structured partnerships between industry and academics. It attracts significant government funding towards the costs, which makes it a highly cost-effective way for partners to engage.

The partnership aspect is a critical factor, and is key to the scheme's success. Essentially, KTP brings together an industrial partner, academic experts and a recent graduate. Together they work on a project of strategic importance to the industrial partner, while providing tangible benefits to the academic team and the graduate – and that's one of the main motivators for the academics I work with.

HOW DOES KTP WORK IN PRACTICE?

Typically, the industrial partner (a company, charity or even public sector organization) will have identified a project or problem they are unable to progress because they lack expertise in-house. This is where the academic team comes in, as they provide this missing link by applying their knowledge and expertise over the duration of the project. In order to successfully deliver the project, a graduate (known as the Associate) is employed to drive the project. The Associate is based mainly at the industrial partner, with the academic team providing half a day of support and input a week. Having their base within the industrial partner allows the graduate to embed themselves and this new capability within the organization. As a result, the entire team forms a strong relationship that typically extends beyond the project, as links are fostered at a high level, over a prolonged period.

For academics, working with industry can provide valuable, alternative sources of research income and help demonstrate impact. If you're actively looking to engage with industry, then you may want to tap into the Knowledge Transfer Partnership scheme (KTP). If you haven't heard of KTP, then hopefully this article will give you an insight into the benefits and workings of this highly successful scheme.

Hemera

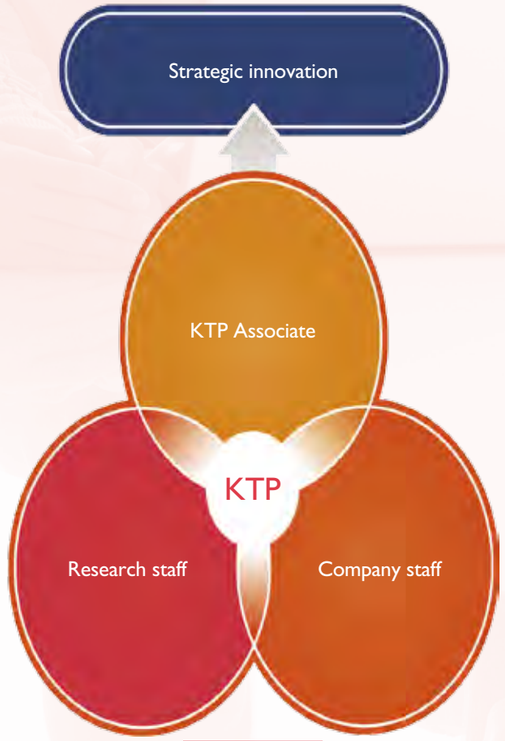

Illustration of the 3-way partnership within KTP. *www.ktponline.org.uk*

KTP FUNDING AND TIMESCALES

The majority of KTP funding is provided by the Technology Strategy Board. However, other sponsors include the Research Councils, Regional Development Agencies and the Devolved Administrations. Additionally, the Technology Strategy Board is working to bring on other potential sponsors, which is particularly good news in the current economic climate. The level of funding on offer depends on the size of the industrial partner, but can cover up to 67% of the standard costs of the project, including a graduate level salary for the Associate.

Nationally, success rates for securing funding are high as projects

are pre-screened before teams start working on a full application, making the effort invested worthwhile. Timescales are also refreshingly rapid as there are nine submission dates per year and results are usually announced within 6 to 7 weeks of submission. So all-in-all, you can see why KTP is popular!

SUPPORT AVAILABLE TO ACADEMICS

As if the package wasn't good enough already, you'll find that the majority of Higher Education institutions and a number of Further Education colleges have some form of local office or team providing support for KTP. The level of support varies by institution, although many, like ours at the University of Reading, offer a full cradle-to-grave service. Typically, a team may help scope projects, facilitate the application process and provide ongoing administrative and project management support, which makes teams like ours very popular. There is also a national network of KTP Advisers who work with the Technology Strategy Board, playing a vital role in developing and supporting partnerships. If your institution doesn't have a dedicated KTP team, then Advisers can also offer more direct support to academics looking to get involved.

THE BENEFITS TO ACADEMICS

Often academics can get hooked on KTP, as it can be such a positive experience, providing a wide array of benefits. A good example is Rachel McCrindle, who has worked on over 20 KTP projects while at Reading, and recently received a national KTP Academic Excellence Award. This was in recognition of her outstanding contribution to KTP and her role on influencing the uptake of KTP throughout the University. Rachel's exceptional KTP efforts have also been recognized internally, playing a key role in her promotion to Professor.

Given the popularity of KTP, we regularly ask academics such as Rachel what attracts them to participate. Primarily, they tell us that it's the opportunity to apply their research to a specific project or situation, but other factors include:

- opportunity to attract research income of typically £60,000 p.a.;
- new research themes that can develop as a result of the collaboration;
- furthering industrial collaborations, either by continuing an existing relationship or providing a springboard for new links;
- dissemination of results through academic papers, as there are usually aspects that can be presented without revealing commercially sensitive information;
- links to teaching and learning, for example through case studies, guest lectures and student projects with the host partners.

"The programme offers excellent employment opportunities for graduates looking to stay in their field of study, while gaining that all-important commercial experience."

Professor Rachel McCrindle, who recently received the national KTP Academic Excellence Award in recognition of her outstanding contribution to KTP and her role in influencing the uptake of KTP throughout the University of Reading. *S. Matos*

KTP in action. An article about the antimicrobial properties of honey will be published in the November 2011 issue of *Microbiology Today*. *iStockphoto*

Background – Brand X Pictures

Additionally, with around 1,000 projects running nationally, KTP is one of the country's largest graduate recruitment schemes. Therefore, the programme offers excellent employment opportunities for graduates looking to stay in their field of study, while gaining that all-important commercial experience.

CHALLENGES AND SOLUTIONS

Time is possibly one of the biggest challenges facing many of the academics we work with. However, a project is normally supported by at least two academics, allowing them to spread the workload. Additionally, where a KTP office is available to take on the administrative burden, this frees the academic team to spend their time working on the parts they enjoy!

A further challenge is finding the right graduate for the role, but that's true of any project where there's a need to recruit. However, most KTP offices will support the partnership with the recruitment process, and will tap into the national network of KTP offices to promote vacancies as widely as possible. Getting the right Associate is the key to success, so it's definitely worth the effort.

KTP IN ACTION

At the University of Reading we support a large number of KTPs, and regularly witness the benefits first hand. Currently, the School of Food & Nutritional Sciences is working with Rowse Honey on a 2-year investigation into the complex properties of honey. The aim is to develop improved processes, leading to sustainable production of both current and new products. This project originally placed a strong emphasis on understanding the antimicrobial properties of honey. However, as the project has progressed, there has been a shift in emphasis as the initial work has provided some exciting results, with Rowse already seeing results through improvements to selected internal processes. Consequently, parts of the project have been refocused, but this will lead to additional benefits to the academic team and the University, as the University is now supporting a PhD to investigate these antimicrobial properties in more detail. As a result, the partners have a stronger relationship, and the outcomes for all involved will be further enhanced.

WHAT SHOULD YOU DO NEXT?

Hopefully this article has given you some insight into KTP. If you'd like to find out more about KTP in your area, then a good starting point is the national KTP website (www.ktponline.org.uk), where you'll find details of you local KTP office and/or Adviser, as well as examples of past and present projects.

Advisers and office teams are a friendly bunch, and will happily discuss KTP with you, even if you don't have a specific project in mind immediately. We appreciate that it's always good to be prepared, as that perfect project could be just around the corner!

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Univeristy of Reading

Dirty money

KOFI AIDOO

There are many things we know about minimizing our risk of exposure to and the spread of infections. We wash our hands after visiting the bathroom; we know how to store and prepare food safely; we know to 'catch it, bin it, kill it' when we sneeze. But how many of us think of the notes in our wallets and purses as a significant source of pathogenic bacteria and viruses?

Digital Vision

iStockphoto

THE INCIDENCE of food poisoning is on the increase worldwide, although it is estimated that only 10% of cases are reported – just the tip of the iceberg. Banknotes play a major role in transmission of pathogenic bacteria. Some mathematical models have been developed to help understand the movements of currency and how this might contribute to the global spread of disease. One of the main sources of pathogenic or food-poisoning bacteria is people. People commonly carry these bacteria in their nose, mouth, wounds and intestines, and on their skin. There are several reports of the occurrence of micro-organisms, in particular bacteria, on cash – banknotes and coins. A study in the US showed that only 6% of banknotes tested were free from microbial contamination.

Banknotes were first developed in China in the Tang Dynasty during the 7th century, and later introduced into the Mongol Empire, Europe and America. In Europe, the first proper banknotes were issued in Sweden in 1664.

Modern banknotes are made from a special blend of 75% cotton and 25% linen with small segments of fibre, so 'paper' money is something of a misnomer. The 'paper' is referred to as the substrate during the manufacturing process; this is an appropriate name as bacteria require a substrate for growth. The cotton/linen/fibre combination of banknotes produce a strong bond and do not pull apart, unlike the fibres of ordinary paper. The average life span of a low denomination paper banknote is about 24 months.

In the early 1980s, an American Bank developed polyethylene fibres for use as currency and they are still in use in some Central American countries. Non-fibrous, non-porous, polymer banknotes, developed by the Reserve Bank of Australia, were first issued as currency in 1988. The banknotes were made from biaxially oriented polypropylene that made them more durable, with security features that rendered them difficult to counterfeit. Polymer banknotes have advantages over their 'paper' counterparts because they are harder to tear, more resistant to folding and more resistant to soiling. Although banknotes are widely used throughout the world, in 2010 only seven countries had converted fully to polymer banknotes (Australia, Bermuda, Brunei, New Zealand, Papua New Guinea, Romania and Vietnam). Some argue that the polymer-based notes last four times longer than paper notes.

SOURCE OF MICROBES ON BANKNOTES

Various routes are known that lead to the contamination of banknotes. Handling of banknotes results in the transfer of bacteria from money onto hands or from hands onto money. Individuals who cough or sneeze into their hands can easily transfer bacteria onto currency when they handle it. Viruses may also be transmitted when infected people touch surfaces, such as banknotes, that are then touched by others.

In the hospitality and catering industry, it is unacceptable for staff to use one hand to handle food and the other to handle money. Food, either cooked or uncooked, may contain bacteria which can be transferred either directly or indirectly through a medium such as a work surface onto currency. This may occur particularly with street food, mobile food vendors and in retail outlets at the counter. Obviously, the transfer of pathogenic bacteria to food that is ready to be eaten and that requires no further heat treatment could have serious consequences. Should money be handled between hand washing and food handling, then it is equally important to repeat the process of hand washing before handling high-risk food.

Wallets, purses, cash registers and other 'closed' environments are conducive for microbial growth because they create warm and moist conditions. Transfer of micro-organisms from one banknote to another in such closed environments may also be common.

BACTERIA ASSOCIATED WITH MONEY

Micro-organisms commonly associated with banknotes include *Staphylococcus aureus*, α-haemolytic *Streptococcus*, *Enterobacter* spp., *Acinetobacter* spp., *Pseudomonas* spp., *Bacillus* spp., *Escherichia coli*, *Salmonella* spp., viruses, yeasts and moulds. Some of these bacteria are pathogenic, while others may cause opportunistic infections. The predominant, recurrent pathogenic bacteria found on banknotes are *S. aureus*, *Bacillus* spp. and *Escherichia* spp.

Many members of the *Enterobacteriaceae* are found in the gut

of animals and humans, and their presence in food or on inanimate objects and surfaces is a good indicator of poor hygiene. Members of the genera *Enterobacter*, *Escherichia* and *Klebsiella* isolated from banknotes may not themselves cause serious illness; however, their isolation from money may indicate the presence of other pathogenic organisms. *Escherichia coli* is an important member of the faecal coliform group and its presence on banknotes is of public health concern, especially as some strains can of course cause serious illness.

Species of the Gram-negative genus *Pseudomonas*, which can cause serious opportunistic infections, have also been isolated from banknotes.

S. aureus is the predominant bacterium present on the surface of banknotes and it is also a common cause of food poisoning. This organism is indicative of poor standards of hygiene particularly during food handling and/or preparation. Many people in the adult population carry *S. aureus* on their skin, in their nasal cavity, and in septic cuts, boils and spots. Coagulase-positive *S. aureus* is readily isolated from banknotes and the toxins it produces may cause toxic shock syndrome. It has also been implicated in pneumonia.

Streptococci are part of the normal microflora in the mouth, skin, intestine and upper respiratory tract of humans. Although many streptococcal species are non-pathogenic, some have been implicated in meningitis and pneumonia.

Bacillus spp. are spore-formers and can withstand harsh, adverse conditions, such as drying. Some species, for example *Bacillus cereus*, cause two types of food poisoning: diarrhoeal (heat-labile toxin) and emetic (heat-stable toxin).

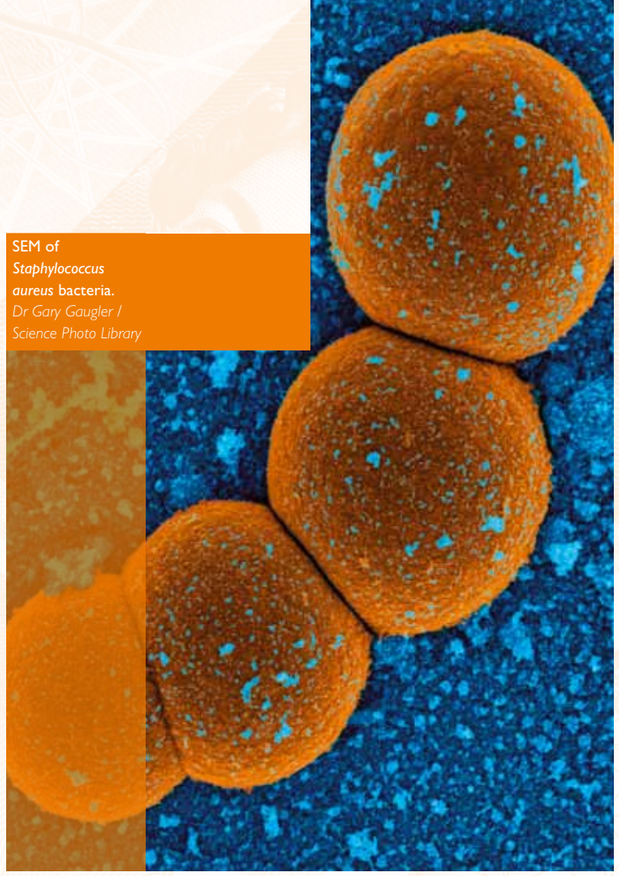
Colonies of bacteria isolated from banknotes. *K. Aidoo*

VIRUSES AND OTHER MICRO-ORGANISMS

The potential role of influenza virus on banknotes in the spread of this disease has been documented. One strain, H3N2, can remain infective for up to 3 days on banknotes, and other strains may be active for up to 17 days. Typically, humans carrying the influenza virus may shed copious amounts of virus during sneezing, contaminating any money they may be in contact with.

Yeasts and moulds are usually associated with spoilage in foods, but they may also produce toxins that can make us ill and thus their presence on banknotes is also undesirable.

The eggs and larvae of parasitic worms or helminths have been recovered from currency. Banknotes, particularly from developing economies where street foods are common, have been found to contain eggs of *Ascaris*, *Trichuris* and *Taenia* species. Intestinal helminths represent one of the most prevalent forms of parasitic disease and it is estimated that about 1.5 billion people – about a quarter of the world's population – may be infected with parasitic worms. Farm animals and domestic pets also carry helminths. Again, thorough hand washing is an effective way of reducing the transfer of eggs of parasitic worms onto cash.



SEM of *Staphylococcus aureus* bacteria. *Dr Gary Gaugler / Science Photo Library*

ATTACHMENT OF BACTERIA TO BANKNOTES

The surface of 'paper' banknotes is not smooth, but irregular, and can harbour many different types of micro-organisms. The two main factors that determine the occurrence of bacteria on currency are (i) the material that the banknotes are made from and (ii) the age of the banknote. Bacteria have enormous capabilities to allow them to survive in adverse conditions. Two of the most important strategies for survival are their ability to adhere to surfaces and the ability to form biofilms (multicellular aggregates). Members of some genera, such as *Bacillus*, may form spores and can survive attached to banknotes for many years. Formation of a biofilm or a spore is controlled by genetic activity of the bacterium.

Bacterial cells on banknotes are measured by the number of colony-forming units (c.f.u.) per cm^2 of banknote. A banknote may contain up to 10^6 c.f.u. cm^{-2}, whilst a coin may have up to 10^3 c.f.u. cm^{-2}. Studies have shown that polymer-based banknotes often have a relatively low bacterial count compared with the cotton-based 'paper' banknotes. This may be due to various physicochemical parameters of polymers. For example, a negatively charged and hydrophilic synthetic polymer would adversely affect bacterial attachment.

Banknotes may be categorized as mint (new or recently produced and obtained directly from the bank), clean (clean appearance without obvious damage) and dirty or mutilated (damaged, soiled, held together with Sellotape). Irrespective of whether it is polymer-based or cotton-based, more bacteria are likely to be recovered from a dirty banknote than a clean or mint note. A mint banknote would normally contain no or only a negligible number of bacteria. However, by the time it has passed through at least four pairs of hands, numerous bacteria can be recovered.

"Is polymer-based currency the best way to combat the spread of micro-organisms on banknotes?"

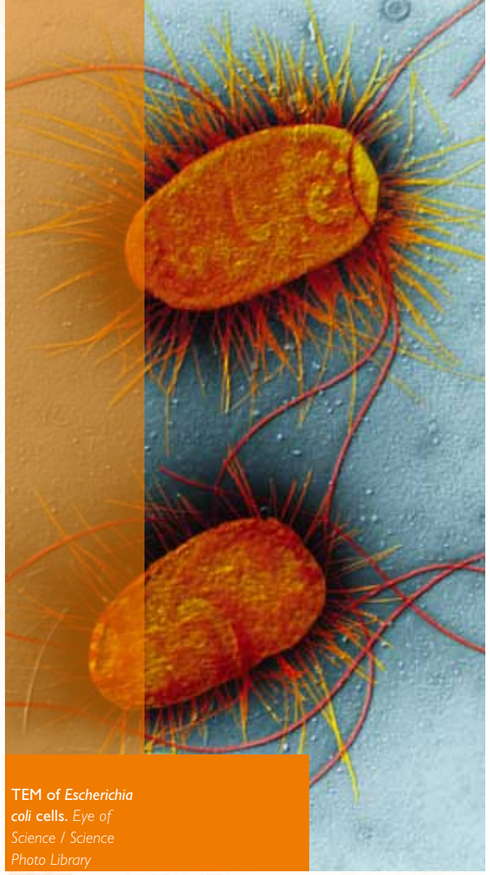
MINIMIZING THE ADHERENCE OF BACTERIA TO BANKNOTES

Adherence of bacteria and other micro-organisms to surfaces like paper money depends on factors that include surface roughness, surface charge, hydrophobic properties and stiffness. Potentially, the stiffness of banknotes could be altered with polymer films or electrolyte polylayers which might be coated with antimicrobial compounds, or by embedding metal nanoparticles which can disrupt the bacterial cell wall. Such a film, about 50 nm thick, would contain layers of poly-electrolytes or charged polymers at different pH levels to offer varying degrees of stiffness. Furthermore, the use of negatively charged and hydrophilic synthetic polymers would decrease bacterial attachment to surfaces.

So, is polymer-based currency the best way to combat the spread of micro-organisms on banknotes? In order to answer this question, more research work needs to be done.

CONCLUSION

Money, in particular banknotes, is an agent for the transfer of pathogenic bacteria which may cause food poisoning when they are transferred onto food or water in an environment conducive to microbial growth. Coins usually contain metals such as copper, silver and lead, and these are known to have inhibitory effects on some bacteria. For those in the food and catering industry and healthcare professions, hand washing after handling banknotes is essential. On a daily basis, millions of bacteria are transferred from person to person through the handling of money. The simple take-home message is that hands should be washed and thoroughly dried after handling money and before handling food.



TEM of *Escherichia coli* cells. *Eye of Science / Science Photo Library*

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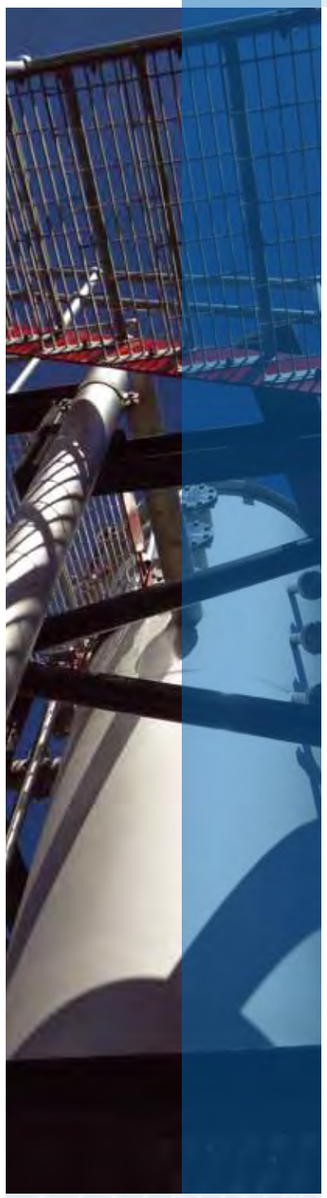
FURTHER READING

Vriesekoop, F., Russell, C., Alvarez-Mayorga, B., Aidoo, K.E. & others (2010). Dirty money: an investigation into the hygiene status of some of the world's currencies as obtained from food outlets. *Foodborne Pathogens & Disease* 7 (12), 1497–1502.

Survival of viruses on currency. www.newscientist.com/article/dn12116



Spinning-out x4

Entering the world of business can be a daunting prospect for a lab-based researcher with an exciting idea. Interacting with investors, patent lawyers and university bureaucracy, as well as learning new management skills in parallel with your continuing research are beyond the normal realms of experience for most academics. But with the right idea, backed by the right people, a lot of application and a little bit of luck, spinning-out can be very rewarding…

Full-scale prototype expanded bed biofilm reactor. *M. Dempsey*

Kim Hardie and the *Glo-Yo*, *K. Hardie*

MIKE MATTEY

SOMEWHERE ON THE JOURNEY from starry-eyed postgraduate to grey-haired academic many of us dream about making money from our research. That moment came for me when what I thought was a good idea, to immobilize bacteriophages to prevent bacterial spoilage, was rejected by the company I was working with. I still thought it was a good idea, so off to the University's Research and Whatever (don't worry, they'll change the name several times before my story ends!) to get a patent (for the University!); and wait for the money to roll in.

Well, no! '*First secure your IP*', they said. So no conferences or papers, at least not yet, otherwise the patent will fail. In fact, I spent quite a long time fighting with the Patents Office whose job is to make sure the patent really is novel and inventive because they thought of 101 reasons why it wasn't!

When you get the patent you have a choice – you can go back to the bench and get on with your research, in which case your patent will probably disappear into the basement of unfulfilled dreams, or you can find a champion to promote it, who will probably be you!

Luckily for me the University of Strathclyde was very supportive; they pushed, prodded and cajoled me into action. '*Let's licence the technology to companies with background expertise*', they said. '*OK*', I said, but the sort of response we had, things like '*We think the technology is interesting … when you have a company that threatens our market share we will buy you*', was not encouraging.

The beast in the corner; the Fixed-Phage corona discharge machine. It's good for T-shirt logos as well! *M. Mattey*

"When you reach the stage of seeing your idea commercialized it will dawn on you … that it's not the end, it's just the beginning!"

FIXED Phage

Getting stuck in to getting stuck on

Eventually a licensee emerged. All went well, then a change of plan, then not so well, then not at all! False dawns happen!

Plans B and C went by and eventually the University decided on plan D, a spin-out company!

By this time, I had reached the gold watch stage (well, University tie stage!), so would I be the CEO? Did I have any experience of running a company? Well no, but how difficult can it be?

At this stage, you meet with INVESTORS! From now on they will dominate your life because, without finance, nothing will happen. Dragons or knights in shining armour? Probably both, but they want to see proven business experience leading the company, not some pensioned-off academic. An MBA or hire some managers, that was my choice.

Luck was on my side – an experienced management team, with a track record and expertise in the bacteriophage field, joined the company because they thought it was a good idea (*thanks guys, I love you too!*). The investors thought we were OK and off we went!

Did it all end happily ever after? Well, when you reach the stage of seeing your idea commercialized it will dawn on you, as it did on me, that it's not the end, it's just the beginning!

So it's back to the bench in Fixed-Phage Ltd, with the rather grand title of Chief Scientific Officer, still dreaming of the pot of gold!

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Advanced Bioprocess Development Ltd

MIKE DEMPSEY

"Make sure there's a market for your product before developing it!"

19th Century trickling filter with 21st Century expanded bed biofilm reactor in background. *M. Dempsey*

Full-scale prototype expanded bed biofilm reactor for tertiary nitrification of wastewater. *M. Dempsey*

ADVANCED BIOPROCESS DEVELOPMENT LTD (ABD) was incorporated in 2002 to exploit my research on expanded bed bioprocesses. Having developed high-rate processes for the production of enzymes, antibiotics and plant cell metabolites, I had a group of Business Studies students conduct a market survey of the pharmaceutical industry for me. The message came back loud and clear: we've used stirred tank fermenters for 50 years; they last 30 years; and our staff have a wealth of experience operating them. So, we're not going to throw all that away to use an untried technology. Besides which, the fermentation step is only a small part of our costs. This was my first harsh commercial lesson: make sure there's a market for your product before developing it!

Fortunately, the European Community came to my rescue by publishing the *Urban Wastewater Treatment Directive*, which identified ammonia as a significant problem. This ammonia arises from microbial action to mineralize nitrogenous matter in sewage, such as urea and proteins, and is toxic to aquatic life, with fish being especially sensitive. Furthermore, nitrifying bacteria in the receiving waters consume 4.6 g dissolved oxygen to oxidize 1 g of ammonia to non-toxic nitrate. This large oxygen demand can result in oxygen depletion, causing the death of fish and other aquatic organisms, further degrading water quality.

Our solution to this problem consisted of an intensified nitrification process, where the bacteria are grown as a biofilm on small particles suspended in upflowing wastewater. This is a 'fixed film process' or, more specifically, an expanded bed biofilm reactor (EBBR). Using this technology allows a high biofilm surface area, of about 2,800 m^2 per m^3 of bioreactor, which is responsible for the high rates of reaction. We developed a successful process at lab scale and then brought activated sludge (AS) final effluent in from a local wastewater treatment works and found that the EBBR process was able to nitrify AS effluent at an even higher rate than with the synthetic wastewater that we used in the lab. I used this encouraging result to persuade the university to fund a project to investigate the performance of the process at a larger scale, which the wastewater works engineer allowed us to operate on-site. This was an invaluable relationship, as it allowed us to evaluate performance under real conditions, an essential step towards commercialization. However, we discovered that although the process was capable of nitrifying at a high rate, the amount of oxygen required led to complete depletion in only 1 m bed depth, which was too shallow for scale-up.

Full-scale expanded bed biofilm reactor treated effluent. *M. Dempsey*

Fortunately, I saw an 'oxygen generator' exhibited at a wastewater conference where I was presenting a paper on the nitrification process. Having found a potential solution to the problem of oxygen supply, I set about finding ways to fund more development. I entered the inaugural BBSRC/MRC Bioscience Business Plan Competition in 1999, to learn how to commercialize my research and was delighted to win a first round prize. Ultimately, ABD was founded and won a DTI SMART Award to develop the process to pilot scale. Following the success of this project, we now have our first Licensee, who has manufactured a full-scale prototype using my three patented inventions on expanded bed process technology improvements that is currently on trial at a sewage works in Northern Ireland.

MIKE DEMPSEY is Managing Director of Advanced Bioprocess Development Ltd and a Senior Lecturer at Manchester Metropolitan University (email m.dempsey@mmu.ac.uk; web www.bioprocesses.co.uk)

To spin-out or to license? That is the question.

KIM HARDIE

USING UNIVERSITY OF NOTTINGHAM FUNDING we were able to go from concept to prototype in 6 months. That was in 2009, and hard work because development required focus groups in primary schools and a collaboration across five different disciplines/university schools. Then came a few months of questions about whether the design could be patented. Discussion between University Innovation support teams finally decided we were covered by copyright and design rights. So, you will be pleased to hear, I can tell you about our invention. Our aim was to take the novel approach of educating children in hand hygiene to encourage long lasting compliance and attitude change. This will reduce the spread of life-threatening infections from the community into the hospital and also within the hospital since hand cleaning is the single most effective measure to prevent infection.

The Glo-yo shows children the correct way to wash their hands. One side of the Glo-yo is pushed to dispense a non-toxic lotion which the child rubs into their hands. On the other side are some UV lights that enable the child to see where the lotion is. There is also a screen which shows the six steps that the child should follow to wash their hands. After hand-washing, the child checks that all the lotion is gone with the UV lights, and has clean hands.

Our team of academics needed funding to take the Glo-yo to market, but we didn't know how to do this. We made approaches to companies asking whether they would invest and help us manufacture the Glo-yo and applied for research grants. Unfortunately, we were too far advanced for proof of concept and not mature enough for trials. Luckily, displaying the Glo-yo at a University Expo sparked attention from the media which was great, and companies began to approach us to help develop it further. We were in the process of preparing a spin-out company business plan to identify the potential market forces, i.e. potential profit, likely investors, risks and competition. Our initial feeling was that we needed to find a company with the ability to manufacture (including developmental improvements) and then find investors via *Dragon's Den*-like elevator pitches. Fortunately, we have found a company that is happy to work with us to develop the Glo-yo for the educational market and provide the financial backing in return for the profits from selling it through their existing network. To enable this to go forward, we are currently negotiating a licensing agreement. This is not a speedy process, and there is the risk that the license will eventually be too broad and prohibit us from further development, so we are seeking legal advice through the University to ensure that we will be able to continue developing second generation Glo-yos for specialized niches.

Of course, there are horror stories of licensing contracts never being signed and the search for partners continuing for years, but we are hopeful of a more productive outcome so that we will be able to use this as a springboard to other niche markets via designing more novel interactive educational devices with our established team.

"We were too far advanced for proof of concept and not mature enough for trials."

The team: *Kim Hardie (School of Molecular Medical Sciences), Joe Segal (School of Engineering), Jacqueline Randle (School of Nursing and Midwifery), Brigitte Nerlich (School of Sociology and Social Policy) and Caroline Windrum (Learning Sciences Research Institute).*

KIM HARDIE is Associate Professor in Molecular Microbiology, School of Molecular Medical Sciences, Centre for Biomolecular Science, University Park, University of Nottingham, Nottingham NG7 2RD (email kim.hardie@nottingham.ac.uk; web http://glo-yo.co.uk)

Why start a biotech company?

DAVID HARPER

Biocontrol Limited

SOMETIMES (THOUGH BY NO MEANS ALWAYS), an idea is just too good to let it get away. In my case, it started when it occurred to me that biological agents should be more flexible and adaptable than the available chemicals that, while in wide use, were often either ineffective or problematic.

An initial idea was to look at bacteriophages – cunning little viruses that destroy bacteria very specifically and effectively – as control agents against superbugs, including MRSA. That went quite well. I got a couple of friends in (one of whom is now a thoroughly eminent professor) and we picked a name and started a company – Biocontrol Limited. For the first 3 years, it was more of an idea than a company. Then, in 2000, I learned about some UK government grants and we were on our way. These (eventually) kick-started our continued interest in bacteriophages. And the rest, as they say, is history!

In addition to the grants, we worked very hard to find some business angels – individual investors looking to pick promising companies. Angels are a good way to get that first investment. Venture capital is difficult to get at that stage. That got us moving.

Things got tricky for a while, but eventually we had enough proof that our idea actually worked to be able to go for our first clinical trial. That really is the 'make or break' point for biotechs – at least for those that can make it that far. In our case, it turned out to be 'make'.

On the back of the positive clinical results, things really got moving – even though we got our results just as the crash of 2009 poked its nose out of the rubble of the banking sector into the wider world. But in time, we got some useful venture capital investment and interest from some potential partners, and things moved on. In January 2011, just over a decade after our first investment, Biocontrol became part of AmpliPhi Biosciences. The combined company has a listing on the US markets, and a lot of possibilities have opened up as a result.

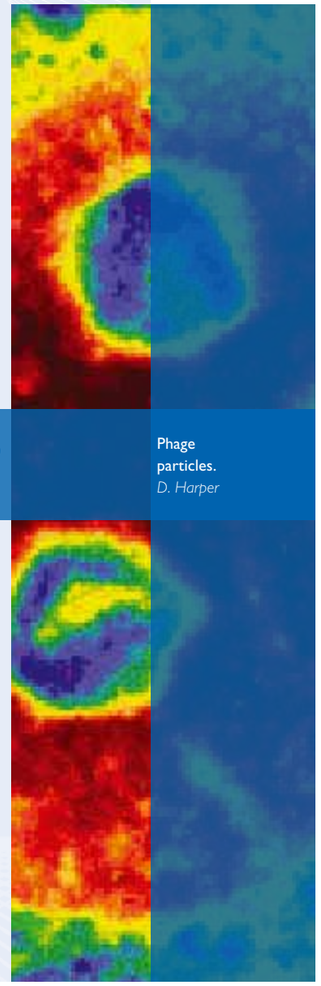
Of course, as a wise teacher once said, it is only once you get the black belt that you start to learn. So, here are a few pointers picked up along the way…

1. Spinning-out a company from a university lets you have a real, paying job as well as doing the entrepreneurial thing. But while a safety net is nice, there can be big drawbacks if you get tangled in it; for example, if you and the University disagree.

2. Keep at it. You WILL get discouraged, despondent and probably debt-ridden. But if your idea is good (and do try to pick a good one!), it is worth sticking with.

3. Sometimes it doesn't work. Be prepared for that. To quote another wise teacher, '*Know when to hold 'em, know when to fold 'em, know when to walk away and know when to run*'. Sometimes walking away can be the best thing to do.

4. And then sometimes (just sometimes), it works. Then you get to look around you and think, '*Wow!*' And smile!



"Keep at it … if your idea is good, it is worth sticking with."

Phage particles. *D. Harper*

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LAURA UDAKIS

"By speaking to the media, scientists enable society to make good or bad decisions."

Standing up for science

THESE WORDS BY JULIA WILSON from Sense about Science are illustrated nicely by the recent *Escherichia coli* outbreak in Germany. When stories of this 'deadly new strain' hit the headlines, it was SGM members and other microbiologists taking time out to talk to the media that helped the public to decide: *Should I worry about contracting this infection? Do I need to stop eating salad?*

The 2011 Public Attitudes to Science survey found that most people's regular sources of science information tend to be traditional media, such as television (54%) and print newspapers (32%). The media clearly influence people's knowledge and perception of science and are public engagement outlets that scientists can't afford to ignore.

As important as it may be, the prospect of talking to the media can be a scary one. Why do science stories get crowned with such hyped, misleading headlines? Do journalists really listen to scientists anyway? And how does science even get into the news in the first place? Delegates at the SGM Spring Conference had the chance to learn the answers to these questions and more at a whole session dedicated to *Working with the Media*.

Julia Wilson started by sympathizing with scientists who sometimes choke on their cornflakes at newspaper headlines. But she stressed that scientists shouldn't just be ranting to their colleagues about it, but instead have a duty to the public to explain the context and the facts behind confused or hyped science stories.

She explained how scientists are better than non-scientists at picking apart science in the media, because they know 'how science works' – and have an understanding of processes such as peer review and clinical trials. She argued that by speaking to the media, scientists can share these insights to help the public decipher good and bad science. Julia's presentation nicely set the tone for the rest of the session.

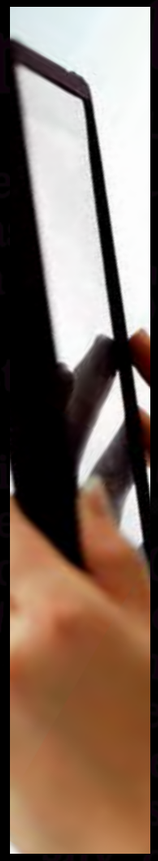
To give insight into the mechanics of how the media actually works, Richard Gray, from the *Sunday Telegraph*, and I spoke about our roles as press officer and journalist, respectively. Between us, we tried to convey what science makes a good story and the importance of 'selling' it to your audience, whilst keeping the science accurate and contextualized.

Richard certainly didn't come across as a ruthless journalist not letting the facts get in the way of a good story. Instead, he described the newsroom environment, the time-pressured deadlines that journalists have to work to and how they expect scientists to be able to talk to them without jargon and respond to their emails promptly. He also revealed why some science stories get crowned with wild headlines: the responsibility for the headline lies with the sub-editor and the journalist rarely sees it before the story goes to press.

A 2010 report on the state of science in the media showed that more scientists are engaging with journalists than ever before and, for most, their experiences are positive. Dr Gerard Fleming's presentation was a great example. He gave both a touching and amusing account of how his initial trepidation at the thought of dealing with the media was allayed after the story of his research (published in the January 2010 issue of *Microbiology*) went global in a matter of hours.

The audience was spellbound as he regaled us with how he turned into a *Google*-alert junkie and how his Christmas break was hijacked by continuous interview requests from global reporters. Punctuating the story of his rise to fame was practical advice for the audience, including lists of 'top tips' both for doing radio interviews and for talking to print journalists, which have different requirements. Gerard finished with the unexpected consequences of his media limelight, such as being asking to write scientific reviews, comment on other science stories in the news and the positive implications for his funding.

Gerard's presentation was certainly encouraging for the other microbiologists in the audience. If anyone still needed convincing, Jonathan Webb from the Science Media Centre (SMC) reminded the audience that there is support out there for scientists who engage with the media. The SMC was formed in 2002 following the major scientific controversies that were played out across the front pages, including the GM debate and MMR. The SMC's aim is to facilitate evidence-based scientific information in the news media by bringing scientists and journalists together – either over the phone or face to face.



The feedback from delegates who attended the session was really positive. Some great conversations ensued with young microbiologists who said they could now see the value of the media in communicating with the public. As Fiona Fox, Director of the SMC said, '*The media have a unique role in questioning and scrutinizing science. Far from threatening to undermine science it can make science better, more honest and more accountable.*' But this can only work if scientists are willing to stand up for science.

LAURA UDAKIS, Press and Public Affairs (email l.udakis@sgm.ac.uk)

The *Working with the Media* session from the SGM Spring Conference 2011 is now available as a vodcast on the SGM video portal – **www.sgm.ac.uk/NEWS/videoportal.cfm**

FURTHER READING

Science and the Media Expert Group (January 2010). *Science and the Media: Securing the Future.*
Ipsos MORI/Department of Business, Innovation and Skills (May 2011). *Public Attitudes to Science 2011*

By being listed on the SGM Experts database for media work, SGM can facilitate your work with the media. The SGM press office can offer support, guidance and help with professional media training. By working with us you can help ensure all aspects of microbiology are represented in the media in the best possible way. To be registered as an SGM Expert, or for further information on any aspect of working with the media, please contact Laura Udakis at l.udakis@sgm.ac.uk

BUDDING WRITERS NEEDED!

Are you interested in science writing?

Want to put your media training skills into practice?

We are giving SGM members the chance to get their writing published in *Microbiology Today*. Each quarter, the *Microshorts* section of *MT* reports on recent, often quirky, scientific research through a series of short, non-specialist, news-style articles (see p. 146 in this issue). We are looking for guest writers to write one or more articles each quarter. This is a great opportunity to practice your writing skills – and get your name in print in our award-winning magazine.

If you think you can communicate scientific research in eight sentences or less, without getting too technical, get in touch by emailing Laura Udakis at **l.udakis@sgm.ac.uk**

Stockbyte

Guarding microbial diversity – the debate continues

PAUL HOSKISSON

THE SGM SPRING MEETING IN HARROGATE was the venue for a special afternoon symposium to discuss the future of culture collections and systematics, and was entitled *Guarding microbial diversity: the importance of fundamental infrastructure in underpinning the microbial sciences*. The aim of the session was to discuss the importance of culture collections, the loss of expertise in systematics and how we can move forward to assure that standards are maintained and cultures are protected for use by the whole microbiology community. The session consisted of seven talks from experts in the field – Prof. Erko Stackebrandt, Prof. Peter Kämpfer, Prof. Iain Sutcliffe, Dr Brian Tindall, Dr Amanda Jones, Dr Pippa Bracegirdle and Dr David Smith – and generated some lively discussion and questions throughout. The session ended with a discussion on how these issues can be brought to the attention of all microbiologists. The discussions led to some consensus points, which are outlined below.

- Taxonomy expertise is declining and it is getting more difficult to maintain standards in submitted manuscripts to all journals that handle such papers. The majority of taxonomy research is now being conducted in Asia, with UK and European expertise declining.
- Interest in this area is likely to be revived in the wider microbiological community due to the wealth of data emerging from next-generation sequencing projects, metagenomic studies and comparative genomics. Systematics underpins all branches of fundamental biology.
- There is a need to deposit strains cited in publications for the pursuance of good science to ensure published work can be validated and followed up. Researchers need to work with culture collections to identify the needs of both communities.
- SGM, SfAM and other learned societies should be using their influence to lobby policy-makers to improve funding in this area and highlight the wider importance of culture collections.
- Perhaps deposition funds should be requested in funding applications and highlighted in the data-sharing statements on grant/funding proposals for the long-term storage of key strains – this would go a long way to highlighting the importance of collections to RCUK.
- Interestingly, the possibility of sequencing unculturable organisms is now becoming a reality and raises a problem in terms of deposition in culture collections.
- The disparate research communities should embrace the new technologies and work with bioinformaticians to develop methods to incorporate whole-genome studies into taxonomic studies. The incorporation of phenotypic data into species descriptions is still a fundamental requirement. The sequence can only tell you so much – demonstration of functionality is still required. DNA–DNA pairing is controversial when differences between the strains are obvious from 16S rRNA sequence and phenotypic data.
- The extent of, as yet, undescribed microbial diversity remains an enormous challenge. The wider dissemination of minimal standards, such as those of the International Committee on Systematics of Prokatyotes (www.the-icsp.org) for characterizing novel species should become an important goal, given that some referees are demanding maximal standards unnecessarily. Perhaps journals such as *International Journal of Systematic & Evolutionary Microbiology* (*IJSEM*), *Systematic and Applied Microbiology* and *Antonie van Leeuwenhoek* (the primary vehicles for publishing new species descriptions) should regularly remind authors (and referees!) about the ICSP framework for these minimal standards. There is perhaps a need for the Bergey's Manual Trust to establish an ad hoc committee to examine these issues.

ACKNOWLEDGEMENTS

Thanks to all the participants at the meeting and to Dr Barry Holmes for helpful comments.

PAUL HOSKISSON, Strathclyde Institute of Pharmacy and Biomedical Science, University of Strathclyde, Glasgow G1 1XW (email paul.hoskisson@strath.ac.uk)

Florence Nightingale inspecting a hospital ward during the Crimean War. *Photos.com / Thinkstock*

> "It may seem a strange principle to enunciate as the very first requirement in a hospital that it should do the sick no harm." *Florence Nightingale*

Florence Nightingale: the life and times of the first advocate for good hygiene

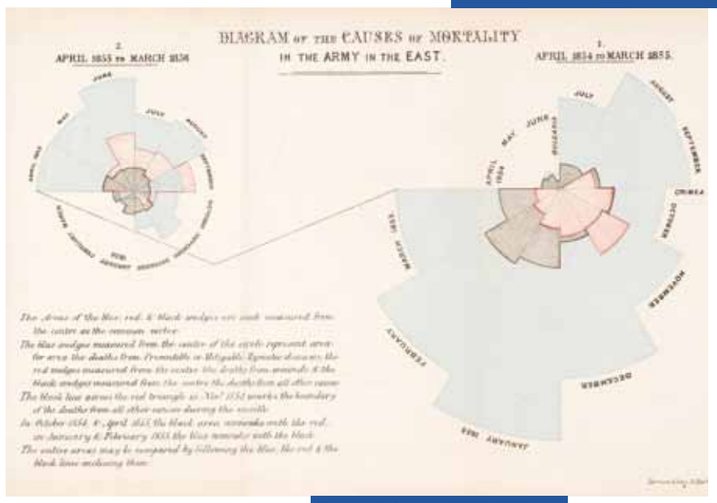
SERVING THE POOR, sick and wounded, campaigning for – and accomplishing – healthcare reform, and developing new statistical graphics; just a few of the achievements of one of the most remarkable and influential women of Victorian Britain. August 13 marks the 100th anniversary of the death of Florence Nightingale. The 'Lady with the Lamp' dedicated her life to the care of others.

Florence grew up in a wealthy household during a period of immense social change – surrounded by liberal and reforming ideas, she was interested in the affairs of the day. Florence and her sister, Parthenope, were educated by their father. His curriculum included Latin, Greek, history, philosophy, mathematics, modern languages and music. The education they were given was in line with that more often accorded to sons. However, due to her social standing and sex, the opportunities for Florence to use her education were limited.

Throughout her life, Florence had a strong Christian faith; at the age of 17 she believed that God was calling her. She felt that her vocation, and her calling, was to become a nurse. Initially, she was dissuaded by her parents from entering the nursing profession; at this time, only old women were nurses and it was not an appropriate career for a woman of her intelligence, looks, status and social standing. Against her parents' wishes, at the age of 30, Florence travelled to Kaiserswerth, near Düsseldorf in Germany, to complete her nursing training. Following this, she spent 3 years visiting hospitals in the UK and Europe in her study of public health. It was not until 1853 that she took up her first employment, which her mother had secured for her, in a private institution for sick gentlewomen at No. 1 Upper Harley Street, London.

The Crimean War began in 1853 and, by the autumn of 1854, the conditions in military hospitals were horrific – soldiers were dying in agony and there was public outcry. Sidney Herbert, the Minister for War, whom Florence had met in 1847, invited her to lead a group of female nurses to the army hospital in Scutari, Turkey. This was an unprecedented idea; no woman had previously held an official position in the army and it became the focus of great publicity. On arrival, the

Florence Nightingale c. 1854. *Photos.com / Thinkstock*



Florence's diagrams showing the causes of mortality in the army (1858). *Wellcome Library, London*

conditions in Scutari were much worse than expected; more soldiers were dying from disease and from the cold conditions, than were dying in battle. Florence worked tirelessly to improve hospital management, the quality of the sanitation and nutrition and to increase much needed supplies. Her programme of work dramatically reduced the death rate of patients within the hospital. Her nickname 'Lady with the Lamp' came from her night rounds of the hospital, which covered 4 miles of hospital corridors, with her Turkish lamp.

In order to avoid publicity, an exhausted Florence returned to Britain under the pseudonym of 'Miss Smith'. She was in poor health, but continued to lobby those in power, including Queen Victoria, for healthcare reform and to investigate mistakes made during the war. During these investigations, she discovered that there were 16,000 deaths as a result of disease and, by contrast, only 4,000 from battle injuries. Working with statistician

Dr William Farr, she created iconic diagrams, now known as polar area diagrams, to illustrate her findings. These were some of the first pie charts.

The germ theory of disease, which states that microbes are the cause of many diseases, was not established until 1867 and, like many of her contemporaries, Florence believed that 'miasma' (foul air) caused disease. Elimination of these miasmas led to improved hygiene and sanitation and thus removal of pathogens. Although the science was inaccurate, the intervention was successful. Florence ultimately accepted the germ theory of disease, though stressed a need for prevention rather than cure, and continued to advocate good hygiene and sanitation practices. She also believed that poor hospital design would undermine even the best nursing practices.

Florence contracted brucellosis, also known as Crimean Fever, during the war. She continued to suffer from the disease for the rest of her life and was frequently bed-ridden. It is likely that she contracted the disease from goat's milk or cheese infected with the bacterium *Brucella*. Her symptoms included fever, insomnia, loss of appetite, back pain and exhaustion, and she often appeared close to death.

Life expectancy for a baby born in 1820 was 35; however, Florence lived a long and productive life, dying at the grand old age of 90. Her legacy remains today due to the changes in attitudes towards the nursing profession and the reform of the healthcare system.

VICKI SYMINGTON, Education & Outreach
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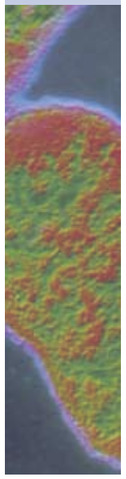
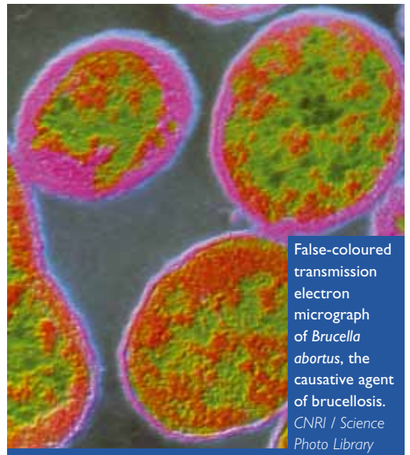




False-coloured transmission electron micrograph of *Brucella abortus*, the causative agent of brucellosis. *CNRI / Science Photo Library*

If you are, or would like to be, involved with education and outreach activities in your community, your Society is here to help you!

Reaching out

SGM produces a comprehensive range of microbiology teaching resources for all age groups from primary to post-16. These are free to all SGM members involved in outreach work. The material is carefully targeted to meet curriculum requirements and fit with the science/biology specifications. These resources can be used to support public engagement activities as they cover a variety of microbiological subject areas and are published in various formats.

Short comic-style resources for primary age school children include **THE WHY, WHEN & HOW OF HAND WASHING** and **MARVELLOUS MICROBES: THE PASTEURS**.

COLD WARS is a resource for age 11+ which describes the common cold and includes an activity to illustrate the spread of cold viruses in a population.

Our posters can be used to brighten up your exhibition stand, or indeed your lab, and include

MICROBIOLOGY, **CLASSIFYING MICROBES**, and **EFFECTIVE HAND WASHING**.

Practical manuals (**BASIC PRACTICAL MICROBIOLOGY** & **PRACTICAL MICROBIOLOGY FOR SECONDARY SCHOOLS**) provide introductions to practical microbiology techniques and a range of microbiological investigations which may be of interest to members who are looking to put on workshops in schools or take part in school visits. These manuals are supported by short films on **www.microbiologyonline.org.uk/what-s-hot/podcasts-and-vodcasts**.

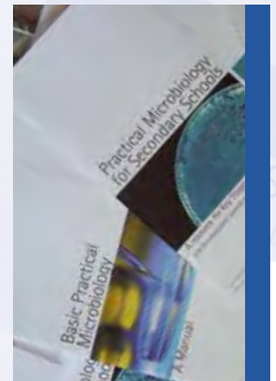
A range of fact files deliver overviews of **MICROBES AND CLIMATE CHANGE**, **HIV & AIDS**, **CHOLERA**, **TUBERCULOSIS**, **INFLUENZA** and **SWINE FLU**. These resources are aimed at post-16 students and their teachers and could be used to introduce your subject area to science festival attendees or to support a specific outreach event.

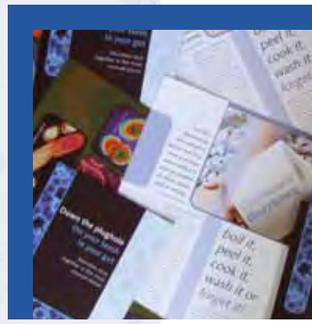
New for 2011, **THE SECRET WORLD OF MICROBES** is a hardback book suitable for pupils from age 9, although it would serve as a basic introduction to the world of microbes up to early secondary school. Further publications such as **THE GOOD, THE BAD AND THE UGLY – MICROBES** and **MICROBIOLOGY A RESOURCE FOR KEY STAGE 5** are fantastic, comprehensive sources of ideas for talks and workshops which would be well received in secondary schools or at public events. A CD-ROM accompanies all three books, providing comprehensive, full-colour PowerPoint™ presentations and a range of student activities.

On the SGM educational website, there are videos of SGM public events, monthly podcasts, an STI quiz, and microbe passports which introduce some of the microbes we all know and love, or indeed hate! Other resources include **DOWN THE PLUGHOLE** – a short booklet introducing biofilms, **TRAVELLERS' DIARRHOEA** – a 2-page article describing the most common illness that affects international travellers, and **SUPERBUGS** – a brief fact file explaining about the different types of superbugs and how they are treated.

If you would like copies of any of our publications for your science outreach activities, please email **education@sgm.ac.uk** or visit the SGM resources page for more information – **www.microbiologyonline.org.uk/teachers/resources**.

If you have any ideas for future resources or have any questions about getting involved with science outreach, please do not hesitate to get in touch with Vicki Symington, Education and Outreach (v.**symington@sgm.ac.uk**).





BIOTECHNOLOGY YES ... CAN BE GOOD FOR YOU!

Gradline aims to inform and entertain members in the early stages of their career in microbiology. If you have any news or stories, or would like to see any topics featured, contact **careers@sgm.ac.uk**

Brand X Pictures / Thinkstock

WHAT IS THIS YES 'THING'?

All microbiologists are aware that many different microbes are, or have been, commercially exploited in fermentation processes and in enzyme and antibiotic production. Over 3,000 PhD and postdoctoral researchers have already taken the opportunity to learn how science becomes commercial by taking part in the Biotechnology YES Competition (YES). This is an annual event jointly organized by the University of Nottingham Institute for Enterprise and Innovation and the BBSRC with the support of the MRC, NERC and other sponsors. As 2011 is the 16th year of the competition, it is not surprising that it is now widely known and has welcomed participants from all the research-led universities in the UK. If it is new to you, then I'm afraid you are now in a minority! YES is also widely known in the biotech, pharmaceutical and food industries and many of our past participants are now working in these sectors.

So what is YES and what is its purpose? Simply, it's a competition which embodies a unique learning experience by which participants develop an understanding of the processes required to achieve effective commercialization of discoveries in the biosciences and biotechnology. This is achieved by teams of participants developing an idea, which stems from real science that is exploited through an imaginary business. In 2010, more the 500 researchers drawn from universities and institutes took part and a similar number are expected again this year.

... AND HOW IS THE LEARNING ACHIEVED?

Experiential learning is achieved by individuals using their own resources to find relevant knowledge and through the sharing of experiences with experts in the field. At the outset, participants attend a briefing session where the wheels are set in motion, directing them to the preliminary work that is desirable before attending one of the five regional workshops. These are held mostly in hotels or conference centres, thus getting the teams away from their academic environment and into a more business-like atmosphere. The latter are 3-day events held through September to November and involve structured sessions of presentations from practitioners in biotechnology and the support sectors, e.g. patent lawyers, investors and commercialization experts. Case studies delivered by bioscientists who have spun-out biotech companies from universities or research institutes add to the reality of the process.

This breadth of knowledge is expanded in afternoon sessions when mentors, again people actively involved in biotech business support, meet with teams working in their 'board rooms'. On the third day, the teams are called upon to give an oral presentation of the business plan for their imaginary company to panels of experts (potential investors) from the biotech community. The winning teams from each workshop (two or three depending on the venue) proceed to the final which is held in London the following December. A cash prize of £1,000 goes to the winning team, and more specific prizes which reflect the understanding of teams of the specific aspects of commercialization are handed out.

... AND THE OUTCOMES?

Not surprisingly, some of our participants have discovered their entrepreneurial flair and have gone on to launch a business, some based on their research and others in a completely different field. For the majority, participation in the competition opens their minds to the many opportunities for careers outside of academia and they can be found working in biotech or pharma companies and the various support businesses involved in intellectual property, accountancy and technology transfer – the list of opportunities is almost endless. A few words from a past participant (Dr Joanna Entwistle: Senior Consultant, Bridgehead International Ltd) expresses this in a more personal way.

'Biotechnology YES offers participants an excellent opportunity to learn about commercialization of science and technology, something that many don't come across as part of academic research. It was an eye-opening experience for me when I took part during my PhD, providing a good introduction to business activities, and giving me confidence to apply for a consulting role with a company specializing in pharma, biotech and medical devices. I've been with the company now for nearly 11 years and our team actively recruits alumni from Biotechnology YES.'

Winners in 2010 from the University of Manchester.
J. Peberdy

JOHN PEBERDY MBE lectured and engaged in research in microbiology at the University of Nottingham for more than 30 years, ending his career as Professor of Microbial Biotechnology. From 1999 until 2004 he worked in both the School of Biological Sciences and the University of Nottingham Institute of Enterprise and Innovation, which is part of Nottingham University Business School. On retirement, he was made Emeritus Professor of Enterprise. He was awarded the MBE in 2000 for services to entrepreneurial training for scientists.

BUDDING WRITERS NEEDED!

Are you interested in science writing?

Want to put your media training skills into practice?

We are giving SGM members the chance to get their writing published in *Microbiology Today*. Each quarter, the *Microshorts* section of *MT* reports on recent, often quirky, scientific research through a series of short, non-specialist, news-style articles (see p. 146 in this issue). We are looking for guest writers to write one or more articles each quarter. This is a great opportunity to practise your writing skills – and get your name in print in our award-winning magazine.

If you think you can communicate scientific research in eight sentences or less, without getting too technical, get in touch by emailing Laura Udakis at **l.udakis@sgm.ac.uk**

KNOWLEDGE TRANSFER PARTNERSHIPS

A KNOWLEDGE TRANSFER PARTNERSHIP (KTP) IS A THREE-WAY COLLABORATION BETWEEN A COMPANY (THE INDUSTRIAL PARTNER), A UNIVERSITY OR RESEARCH INSTITUTE (THE ACADEMIC PARTNER) AND A GRADUATE (THE ASSOCIATE). THE ASSOCIATE ACTS AS A LINK, UTILIZING THE KNOWLEDGE AND EXPERTISE OF THE ACADEMIC PARTNER TO AID THE INDUSTRIAL PARTNER WITH A SPECIFIC ISSUE THEY CANNOT SOLVE WITH THEIR IN-HOUSE EXPERTISE. IN HER ARTICLE ON P. 158, SUSAN MATOS PROVIDES MORE INFORMATION ON KTPs AND DETAILS OF HOW TO GET INVOLVED.

PROFILE – SHAUN ROBERTSON

We asked SGM Member Shaun Robertson to give us an idea of the KTP experience from an Associate's point of view. He is involved in a KTP between the University of Aberdeen and Novabiotic, a biotechnology company developing anti-infective therapies for fungal infections.

- **Present occupation**
  Knowledge Transfer Associate at NovaBiotics Ltd and the University of Aberdeen
- **Education**
  MSc Medical Biotechnology and Bio-business (University of Aberdeen)
  BSc Biomedical Science with Physiology (University of Aberdeen)

Q Can you give some background to your project?

A *Candida* infections have a mortality rate of 32% in immunocompromised patients. Resistance to current antifungals is clinically significant. *Candida albicans* used to be the most common *Candida* species to cause infection but there has now been a rise in infections from other species. To combat this growing challenge, we need more, and improved, antifungal therapeutics. The human body produces antimicrobial peptides to protect us from the microbes we are in constant contact with. These are even effective against microbes that have resistance to more traditional drug treatments, such as antifungals, so they are ideal templates for developing new treatments.

Q What's your project about?

A My project is focused on Novamycin®, a new antifungal peptide for the treatment of *Candida* spp. infections. Determining how it works against *Candida* spp. forms one key part of my project and is my current focus. Later in the project, understanding more about its interaction with complex biological systems *in vivo* will become the main focus, e.g. how synthetic antifungal peptides interact with natural antimicrobial peptides secreted by the body. Recent data also point, for the first time, to Novamycin® having potential as a therapy for oral fungal infection.

Q How did you hear about KTPs and what made you want to do one?

A I was contacted by my former masters project supervisor who had compiled an outline for a KTP project with NovaBiotics. I read through and discussed the project, and at the same time investigated KTP via their website. The chance to develop new skills that would be needed as part of the project, and the opportunity to work between academic and industrial workplaces was very attractive.

Q Can you describe a typical day in your job?

A My mornings are usually spent in the lab; mainly at NovaBiotics or at the university when access to specific equipment or expertise is required. I'll work through until the afternoon, then prepare for the next day's practical work and also ensure lab books and other paperwork (any posters, company reports or presentations) are up to date. My plans can change at short notice if a specific piece of work becomes a priority for the company, or if the commercial partner requests particular experiments. This means I sometimes might have to work out of hours or at the weekend to carry out experiments and process data – but that's all part of the challenge of commercial research!

Q How is your time split between the business and science aspects of the KTP?

A Both parts are very much interlinked. The science provides the platform for the business, but the commercial requirements of the business set the scientific milestones I need to reach with my project. Adaptability and planning are crucial for this and for success in commercial research, drug discovery and development overall.


Saskia

Vydeki

Richard


Chandrika & Steph

REACHING OUT WITH SGM

YOU NEED TO STAND OUT FROM THE CROWD IN THE CURRENT JOB MARKET, BUT EXPERIENCE IS OFTEN HARD TO COME BY, WHETHER THAT EXPERIENCE IS WORKING IN INDUSTRY, ATTENDING CONFERENCES OR RUNNING PUBLIC ENGAGEMENT EVENTS.

In the run up to the Cheltenham Science Festival, it quickly became apparent that we needed help to staff the SGM hands-on activities in the Discover Zone. We needed people with brains, enthusiasm and, most of all, staying power – so, we turned to the SGM membership and we were not disappointed. After advertising the vacancy by email and on *Facebook*, *Twitter* and our website, we were overrun with people wanting to help out!

To whittle down our many volunteers, we asked them to submit a short paragraph describing why they wanted to get involved; some had never been involved with public outreach activities; others had run their own stands at local science festivals or even written undergraduate dissertations on aspects of science communication! Holger, a postdoc from Bristol, said '*… I don't have much experience in public science communication… volunteering at Cheltenham would give me an excellent opportunity to gain that experience.*'

Across the 6 days at the festival more than 12,000 people passed through the doors of the Town Hall venue – 19 of these were our volunteers. They came from all backgrounds of microbiology and from all areas of the UK, united in their desire to share their knowledge of microbiology with the wider public. Laura, who has just completed her degree in microbiology at Cardiff said '*we are becoming increasingly aware of the immense and intricate roles that microbes play in our daily lives and to help spread the word would be an amazing opportunity*'. Richard, a PhD student from Bristol, said '*This is a chance to make science as fun as possible for non-scientists! … I like the eureka moment when you show non-scientists some of the amazingly clever things that microbes can do as well as how gross they can be!*' Another volunteer, Steph, from Rothamsted Research, remarked that she would not have this opportunity where she studied: '*…some of my work is under strict confidentiality agreements so I don't get to talk about my work very often … any prospect to talk about …microbiology* [is] *tremendously attractive…*'

> *"Such opportunities allow me to develop key transferable skills required as a medical researcher and are, just as importantly, also extremely rewarding on a personal level."*
> Vanessa Wong, PhD Student, University of Cambridge

It was an exhausting week and we couldn't have survived without the wonderful help of our fantastic volunteers! When they returned home after the festival we asked them about their experience. Chandrika, a PhD student from Imperial College, admitted to being nervous when she arrived but went on to say that '*the briefing was more than enough preparation for the day*'. When remarking on the children who attended, Holger said '*a little boy, after explaining to him that most bacteria around us are not harmful, asked, "but why do some bacteria make us sick and some don't?"… just this one question made me realize that it was totally worth coming to the festival!*' Another child asked Steph '*if yeast needs sugar to eat, can it grow legs too?*'

> *"I recently went to an informal talk given by Joanna Verran. It has made me more passionate about communicating science in an accessible (and fun) way."*
> Zoe Seager, PhD student, Imperial College London

The Festival can be a hive of media activity. Saskia, a postdoc from Leeds was interviewed by BBC *Radio Gloucester*!

We were thrilled to be able to work side by side with our members at this event and we sincerely hope that our volunteers have gone back to the lab having taken something from this activity. The volunteers remarked that their outreach experience had exceeded their expectations and that they had gained new-found transferable skills and confidence as science communicators. Other bonuses associated with volunteering included making new friends and gaining a better insight into the SGM and how we could support them through their career. They intended to get involved or to do more public engagement work. Vydeki, a postgraduate student at Nottingham, enthused '*this has inspired me to look more in to the Public Engagement grants provided by SGM to carry out events in my local area to inspire children to get more involved in science*'.

If you are interested in volunteering for SGM in any future public outreach activities, please get in touch with Vicki Symington, Education & Outreach (**v.symington@sgm.ac.uk**).

See the photo report of our time at the festival on p. 186.


Laura

SGM BRIEFINGS

BIOFUELS, **HIV**, **ANTIMICROBIAL RESISTANCE** and **H1N1 (2009) 'SWINE FLU'** are some of the topics covered in the SGM briefing series.

These 2-page documents provide need-to-know information on a range of microbiology subjects. Briefings are sent out to parliamentarians as part of our campaign to raise the profile of microbiology and the work of microbiologists to government and to enable policy-makers to make informed, evidence-based policy decisions.

These resources are also distributed to journalists to provide background facts for news or feature articles in the media. Our briefings are prepared with the help of our members and are usually issued to coincide with key dates, such as World AIDS Day and World Environment Day.

All of our briefings can be downloaded from the SGM website at www.sgm.ac.uk/news/briefings.cfm

If you have suggestions for future topics to cover in our briefings series, please send an email to l.udakis@sgm.ac.uk

LAURA UDAKIS, Press & Public Affairs
(email l.udakis@sgm.ac.uk)

PROMIOTNG UNDERSTANDING AMONGST PARLIAMENTARIANS

SGM AT THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE – P&SC

THE COMMITTEE is a recognized parliamentary body at Westminster, with a membership of MPs, peers and representatives of universities, companies and scientific institutions such as SGM. It holds regular discussion meetings on topics of current scientific interest. When I enquired of the committee secretary how SGM might suggest a microbiological topic for discussion, I found myself committed to organizing a meeting on *Influenza: What are the likely threats of flu for the UK? How can science help ameliorate the consequences?* at rather short notice. I quickly engaged the support of SGM member Professor Wendy Barclay (Imperial College), who provided advice on the choice of speakers and persuaded them to participate.

The event took place on 26 April, at Portcullis House in Westminster, with an audience of around 50. Wendy herself spoke on *The emergence of influenza pandemics*. She was followed by Dr Sarah Gilbert (Jenner Institute, University of Oxford) on *Universal influenza vaccination strategies*, then by Professor Maria Zambon (Health Protection Agency) on *Translating good science into public health practice in the face of an influenza outbreak*. All three talks were excellent, and together conveyed the complexity of the issues, the need to base decision-making on how to handle pandemics on sound scientific understanding, and the fact that possible new and exciting methods for disease control will still require further research and development. The meeting finished with a very lively question and answer session, in which the robustness of the questions was ably matched by the spirited and expert responses of our speakers.

We then adjourned to the House of Commons for a reception, followed by a dinner for the speakers, parliamentarians and invited guests. The P&SC chairman, Andrew Miller MP, somewhat surprised the speakers by announcing that once people had finished their starters, the question and answer session would get under way again, but they held their own in fine style as before. The three talks, including matters raised in discussion, will be published in a future issue of the committee's journal, *Science in Parliament*.

RON FRASER, Former Chief Executive Officer


Westminster. *Ian Atherton*


Pierhead Building, Cardiff Bay. *iStockphoto / Thinkstock*

SCIENCE AND THE ASSEMBLY

ONCE AGAIN SGM took part in the *Science and the Assembly* event organized by the Royal Society of Chemistry – this year celebrating the International Year of Chemistry. The annual event brings the scientific and engineering community together with Assembly Members to discuss advances in science and topical issues.

Our experience this year started off a little unusually when we arrived to a gathering of a couple of hundred individuals with placards outside the Senedd, protesting against wind farms. There was no disturbance to the event taking place next door in the Pierhead Building in Cardiff Bay, although it was certainly a talking point!

Professor John Harries gave an update after one year in post as the first-ever Chief Scientific Officer for Wales. The new Science Advisory Council for Wales has been set up, comprising 17 leading figures from Welsh academia, industry and the third sector. Professor Harries was very positive about the group's progress in putting together a new science strategy and policy for Wales.

A series of presentations on some exciting scientific developments in Wales took place throughout the afternoon. Topics covered included graphene biosensors and how palaeoclimatologists are reconstructing past climate change from isotopes.

An exhibition and drinks reception rounded the event off nicely. This was a great opportunity for SGM to talk to scientists, Assembly Members and other organizations about the work that we do – particularly in raising awareness of microbiology among policy-makers and parliamentarians. Our exhibition stand was packed with resources that we received many compliments for – particularly our 2-page briefings.

LAURA UDAKIS,
Press & Public Affairs
(email l.udakis@sgm.ac.uk)

TAKING MICROBIOLOGY TO THE PUBLIC

SGM at Cheltenham

THE TIMES CHELTENHAM SCIENCE FESTIVAL IS A 6-DAY CELEBRATION OF SCIENCE, ENGINEERING AND THE ARTS WHICH REGULARLY ATTRACTS OVER 10,000 VISITORS. SGM IS A MAJOR PARTNER OF THE FESTIVAL AND, FOR THE SECOND YEAR RUNNING, WE HOSTED A SERIES OF PUBLIC EVENTS AND HAD A STAND IN THE POPULAR 'DISCOVER ZONE' WHERE MEMBERS OF THE PUBLIC WERE ABLE TO LEARN ABOUT THE POSITIVE AND NEGATIVE ASPECTS OF MICROBES THROUGH OUR INTERACTIVE EXHIBITS.

LOOK INSIDE FOR PHOTOS OF SGM AT THIS YEAR'S FESTIVAL. DON'T MISS OUR VIDEO OF THE FESTIVAL AS WELL AS A RECORDING OF THE 'MICROBES ON THE MENU' PUBLIC EVENT: WWW.SGM.AC.UK/NEWS/VIDEOPORTAL.CFM

Interactive workshop in the Discover Zone

The SGM stand focused on microbes and food – microbes as food producers and microbes as food poisoners.

Microbes as food producers
Yeast plays an important role in the production of bread and brewing and, like all living things, needs food and water to grow. Visitors were able to feed yeast with sugar and warm water in a test tube. As the yeast grows it produces carbon dioxide which can be collected in balloons using 'microbe power' to inflate them.

Microbes as food poisoners
The majority of people will have suffered from food poisoning at some point in their lives through eating undercooked or contaminated food. It is easy to prevent cross-contamination of cooked foods from raw foods by maintaining good kitchen and personal hygiene measures. UV glow powder was used to model the spread of microbes through cross-contamination of raw food with cooked food.

SGM Events

Microbes and Climate Change
There's more to climate change than simply carbon dioxide from fossil fuels. Plants, animals and even micro-organisms react to a changing environment and, in turn, they can alter the balance of greenhouse gases in the atmosphere to a surprising extent. Dave Reay, Ian Joint and Andrew Whiteley revealed the secret life of microbes and how they are contributing and responding to climate change, and discussed how they might be able to help us.

Life at the Extremes
It is hard to believe that anything could live in harsh extreme conditions such as volcanic vents or sub-zero temperatures. We certainly couldn't survive, but incredibly some microbes are thriving. David Pearce, James Chong, Malcolm White and Thorsten Allers went to the extremes to find out how microbes are able to survive and whether we can harness their superpowers for our own gain.

Microbial Taster Menu
You may find the thought of eating anything associated with microbes a revolting prospect but without their help, our diet would be very dull indeed. Food microbiologist Anthony Hilton explored the microbiology behind some of our tastiest treats from salami and olives to cheese and after dinner mints. And whipping up some samples for the attendees to try, local chef Wayne Sullivan served up a wide range of microbes on the menu.

Photos Ian Atherton, Vicki Symington, Laura Udakis & Cheltenham Science Festival

DOWN THE PLUGHOLE IN HARROGATE THEATRE

TAKING SCIENCE from the conference venue into the public domain is the aim of the *Public Event* at SGM Conferences. This allows us to fulfil our charitable remit of promoting modern microbial science. In Harrogate, we decided to break the tradition of holding the *Public Event* in the conference venue, so we ventured beyond the gates of the Harrogate International Centre to the pleasing surroundings of the 111-year-old Harrogate Theatre.

Famous names to tread the boards of Harrogate Theatre include Charlie Chaplin, Sarah Bernhardt, Martin Shaw and Ben Kingsley. But on Wednesday 13 April a star was born. Fresh from her appearance on BBC1's *The One Show*, SGM's very own media personality Professor Joanna Verran took to the stage in the *Café Scientifique* style event *Down the plughole: on your teeth, in your gut – microbes stick together in the most unusual places*.

The event addressed the complex and beautiful biofilm communities at the micro- and macroscopic levels, from initial surface colonization to the unpleasant consequences of unwanted biofilms.

Questions from the audience were fielded with Joanna's usual flair with many staying at the end for further discussion.

The idea behind taking the event off-site was that the surroundings of a theatre would be more familiar to the general public, as opposed to a vast conference centre during an academic conference; by doing this we were hoping to engage new audiences. Having advertised the event far and wide, we are very happy to announce that the event was a huge success with almost every seat in the theatre filled! Where appropriate, we will be looking to hold future public events off-site in 'neutral territory'.

While chatting to people as they left the venue we were asked, on more than one occasion, how often we would be holding such an event in the theatre. Although we didn't want to disappoint, we thought that a regular trip to Harrogate was perhaps out of our remit!

To support this event, an A5 booklet about biofilms was launched, entitled *Down the plughole: on your teeth, in your gut.* To order your free copy, email education@sgm.ac.uk

VICKI SYMINGTON, Education & Outreach

THE GOOD, THE BAD AND THE ALGAE

DURING THE 2011 National Science and Engineering week, Manchester Metropolitan University Faculty of Science and Engineering held a *Hands-on science* event. Postgraduate student James Redfern held a series of microbiology workshops over the course of the day, along with his colleagues, supervisor Professor Joanna Verran and members of the technical staff.

The workshop was entitled *The good, the bad and the algae*. Algae are often overlooked by the public and scientists alike in terms of their status as important micro-organisms, but they are vitally important to us, as a potential source of biofuels and for photosynthesis, and algal products are put to a surprising range of uses. On the negative side, eutrophication, algal blooms and biofilm formation on buildings and statues are also of importance. Algae are safe to use, fascinating to look at and easy to find under a microscope – an obvious choice for the public engagement activity.

The workshop was split into two sections. After a brief introduction to the world of algae, members of the public were presented with nine 'unknown' species of algae. Each of the species had been chosen due to its distinctive shape or characteristics. Along with the unknown algae they were provided with a *Microalgae identification key* which had been developed for this event. The participants were then shown how to use a light microscope and were challenged to identify the unknown species.

The second part of the workshop involved using 'Model Magic', an easy-to-use, air-drying clay, to reproduce models of their favourite algae which they had seen down the microscope. Images of each were provided to assist in the modelling. Once the models were complete, they were placed in a Petri dish to take home and keep.

In addition, there was an opportunity to enter a photo competition, entitled *Manchester's best algal biofilm*. The families at the event were encouraged to seek out and photograph any algal biofilms they found, and enter the photo at the web address provided. The winner, Jenny Gee, age 7, won a giant algae microbe soft toy for her picture of algae in her garden.

The event received a lot of positive feedback on the day. The majority of people participating in the workshops were families (parents and children), who had not previously visited a university lab. Parents commented that using scientific equipment such as microscopes, wearing lab coats and being in a scientific environment had inspired their children. The use of the microscopes was particularly exciting, especially because the algae were so distinctive – and sometimes motile as well. Overall, *The good, the bad and the algae* workshop proved a success and the team hope to build on it for future public engagement events.

JAMES REDFERN is a postgraduate at Manchester Metropolitan University (email 06187817@stu.mmu.ac.uk)

2010 ANNUAL MEETING OF THE SPECIALIST REGISTRARS IN MICROBIOLOGY AND VIROLOGY CLUB: *INFECTIONS IN PREGNANCY*

Infection specialty trainees at the annual meeting of the Specialist Registrars in Microbiology and Virology Club, The Strand Palace Hotel, London. *V. Wong*

CARRIE LATET WROTE, '*Pregnancy is a disease from which you recover in 18 years and 9 months*'.

Whether or not you agree with this particular view of pregnancy, diseases in pregnancy are relatively common and present an interesting challenge to clinicians. In the case of a pregnant patient with suspected or confirmed infection, the clinical team will often call Microbiology, Virology or Infectious Diseases for specialist advice. It therefore seemed appropriate to have an *Infections in pregnancy* theme for this year's annual meeting of the Specialist Registrars in Microbiology and Virology Club. This 1-day event was held at the Strand Palace Hotel in London on 12 November 2010. Originally set up by microbiology and virology trainees, this national meeting was established to aid the education and training of its members.

The day was packed with informative lectures ranging from *Hepatitis B in women of child-bearing age* to *Management of syphilis in pregnancy*. The lecturers presented evidence-based medicine to address the current issues frequently encountered clinically. There was also an interesting session on *The consultant interview* which provided tips on interview preparation and what to expect in the interview. All the lectures were very well structured and interactive with plenty of opportunity to ask questions. Overall, the feedback was positive: one person remarked, '*…excellent teaching that was relevant for answering clinical calls*'; another reported, '*…good speakers that covered the topics in a concise manner*'.

The Specialist Registrars in Microbiology and Virology Club meeting is one of only a few national trainee-organized events for the infection specialities in existence and, by placing training into our own hands, we have been able to address our educational needs in a more targeted fashion. Furthermore, trainees have found that the meetings are not only useful for training purposes, but also provide an opportunity to get away from the hospital environment and meet-up and network with colleagues. Given that there were many excellent suggestions for future meeting themes, including *Updates in tropical diseases*, *New molecular technology in clinical microbiology* and *Infections in the immunocompromised patient*, we hope to continue the tradition of this annual meeting in the years to come.

ACKNOWLEDGEMENTS

I wish to thank the SGM for supporting this event with a Regional Meeting Grant, and Astra Zeneca, Novartis, Merck Sharp & Dohme Limited (MSD), Eumedica, Astellas and Pfizer for sponsoring the event.

VANESSA WONG is Specialist Registrar in Medical Microbiology at the Queen's Medical Centre, Nottingham and a Wellcome Trust Clinical PhD Fellow, Wellcome Trust Sanger Institute, University of Cambridge, Cambridge (email vanessawong@doctors.org.uk)

Bugs in your pocket

Karen Rowlett, SGM

You don't expect to find a novel species clinging to the change in your pocket. But this is precisely where researchers found *Roseomonas pecuniae*, a newly identified bacterial species. Even though coins are generally made of copper alloys, which are naturally antimicrobial, they have a transient microbial community. In a study financed by the International Copper Association as well as the Portuguese government, researchers at the University of Coimbra, Portugal, and University of Nebraska-Lincoln, USA, have been identifying the life that lives on money.

Among the diverse bacteria they found, the pink-red spherical cells of one strain from a €0.50 coin stood out. They appeared to be a species of the genus *Roseomonas*, but unlike any previously reported. Many species in this genus have recently been re-classified, so the researchers decided that the pink cells were worth a closer look. They applied a battery of tests, ranging from checking whether the strain would grow on laboratory media containing common salt (it would not) and identifying the fats in its cells to determining the sequence of one of its genes. The result was that although it was indeed a member of the genus *Roseomonas*, it was sufficiently different to be classed as a novel species.

The researchers had tested supposedly authentic representatives of other species of the genus *Roseomonas* as a controls alongside the novel isolate. This made it obvious that *Roseomonas fauriae*, as some other researchers had suspected, was in fact a misidentified strain of *Azospirillum brasilense*, illustrating the difficulties in identifying bacteria.

See also the article in this issue by Kofi Aidoo, p. 162.

Lopes, A., Espirito-Santo, C., Grass, G., Chung, A.P. & Morais, P.V. (2011). *Roseomonas pecuniae* sp. nov., isolated from the surface of a copper-alloy coin. *Int J Syst Evol Microbiol* 61, 610–615.

Novel virus from dragonflies

Arvind Varsani, University of Canterbury, New Zealand

The classic image of DNA is that of a double helix. However, there are viruses with a single circular strand of DNA for genetic material. They have been found infecting plants and their insect pests, in mammalian faeces and scattered in environmental samples as diverse as soil and Antarctic lake water. Now, researchers have found some within dragonflies, opening up more questions about the natural role of viruses and the behaviour of dragonflies.

The dragonflies studied were three species from the islands of Tongatapu and Vava'u that lie 300 km apart in the Kingdom of Tonga in the Pacific Ocean. Two of the species (*Pantala flavescens* and *Tholymis tillarga*) lived on both islands, while the third, *Diplacodes bipunctata*, was only encountered on Tongatapu. After purifying virus particles from the abdomens of 15 dragonflies, the researchers were able to obtain the full genome sequences of 21 viruses that fell into 11 very similar subtypes. The viruses matched the characteristics of the genus *Cyclovirus* and belong to a novel species that the researchers named dragonfly cyclovirus (DfCyV). Surprisingly, the most closely related species was one described in 2010 from human faeces. One well-known feature of circular single-stranded DNA viruses is that they are very prone to recombination between subtypes, generating new genetic diversity. Among the small number of viruses examined in this project, three had undergone obvious recombination, supporting the idea that this is a very common event.

This study highlights how little is still known about some aspects of virus biology. For example, DfCyV is evidently widespread, as an identical subtype was found on both islands, and two other subtypes were present in more than one dragonfly species. The virus is probably specific to dragonflies, although because they are top predators in the food chain and eat many other insects, even including their own species, it might originate from a prey species. In addition, all three of these species are found across the Pacific islands; *P. flavescens* is found worldwide, providing opportunity for extensive distribution of the virus. Finally, the question of how DfCyV affects the health of the dragonflies remains unanswered.

Rosario, K., Marinov, M., Stainton, D., Kraberger, S., Wiltshire, E.J., Collings, D.A., Walters, M., Martin, D.P., Breitbart, M. & Varsani, A. (2011). Dragonfly cyclovirus, a novel single-stranded DNA virus discovered in dragonflies (Odonata: Anisoptera). *J Gen Virol* 92, 1302–1308.

MERIEL JONES HIGHLIGHTS HOT PAPERS IN RECENT SGM JOURNALS

Virus persistence in leeches

Leeches (*Hirudo medicinalis*) have a long history in medicine. The fact that they can suck several times their body weight in blood in a single meal, in part through secreting an anticoagulant, is the reason for the interest. In the past, when bleeding was a favoured medical procedure, leeches were an effective option. They are now valuable for their anticoagulant properties, especially in treating vascular diseases and in reconstructive and plastic surgery. Leeches are also used in veterinary practice. The number in use is surprising; around 100,000 patients in Germany experience leeches in their medical treatments each year. These leeches are either imported from natural habitats in the Near East, or bred in European aquaculture facilities.

An important aspect of leech therapy is ensuring that the leeches do not transmit infections to the patients. Medicinal leeches are kept in isolation after their last meal of animal blood for this reason. Infections can be caused by *Aeromonas* bacteria originating from the brackish water where the animals live. Antibiotics can control bacterial infections, but another concern is whether viral diseases can be transmitted to humans via the leech from animal blood. Researchers from Justus Liebig University Giessen and the Friedrich-Loeffler-Institut in Jena have collaborated with a company that breeds medicinal leeches (Biebertaler Blutegelzucht GmbH) to investigate how well viruses survive within the leech gut.

The researchers fed the leeches on pig blood contaminated with viruses that are very sensitive to environmental conditions, such as equine arteritis virus, and others, like bovine parvovirus, that withstand some disinfectants. Although these particular viruses cannot infect humans, their properties with respect to survival span the range of those that do. An important aspect of the study was that the researchers had to test for viability of the viruses by infecting a laboratory cell-culture system, rather than just looking at the presence of virus particles that might be harmlessly inert.

Medicinal leech. *iStockphoto / Thinkstock*

Some infectious viruses remained in the leeches for up to 29 weeks and even the most delicate lasted 23 weeks. Keeping the leeches at a higher temperature brought the time down a little. One intriguing fact was that the viruses almost always survived longer in the leeches than in contaminated blood. As the researchers commented, this might be because the leeches secrete something into their gut to keep the blood meal fresh, and this has the side-effect of conserving virus infectivity as well. The recommendation from this study is that leeches should be kept in quarantine for 31 weeks at 10 °C after their last blood meal to remove the risk of transmitting viral infections.

Al-Khleif, A., Roth, M., Menge, C., Heuser, J., Baljer, G. & Herbst, W. (2011). Tenacity of mammalian viruses in the gut of leeches fed with porcine blood. *J Med Microbiol* 60, 787–792.

JMM Special Issue

The August 2011 issue of the *Journal of Medical Microbiology* is a special issue on *Clostridium difficile*.

It contains reviews on clostridial glucosylating toxins and the immune response to *C. difficile*, and a collection of offered papers that were presented at the *Third International* Clostridium difficile *Symposium* held in Bled, Slovenia, in September 2010. An editorial linked to the symposium has been written by Ian Poxton and Maja Rupnik, and, coming out of discussions at the meeting, a consensus paper on a proposed standardized nomenclature for cell wall proteins of *C. difficile* is also included in the issue.

***Clostridium difficile* colonies.** *George Broukhanski, PHL-Ontario, Canada*

Why does *Candida parapsilosis* succeed where others fail?

Candida yeast live harmlessly on mucosal membranes in many people, but can also cause infections on these surfaces and throughout the body. Treatment can be difficult since there are very few antifungal drugs and some *Candida* species are resistant. Increasing attention to these infections from both researchers and industry has revealed significant new information.

One species, *Candida albicans*, was originally thought to cause all the problems. However, as researchers have analysed the infections in more detail, they realized that several species are actually involved. One is *C. parapsilosis*, currently termed an emerging pathogen since understanding of its significance and epidemiological importance continues to develop. It causes about 25% of *Candida* infections in European hospitals. In addition to living on humans, it is also present in soil, fresh and marine water, insects and domestic animals.

One reason why it can live in these other environments is that *C. parapsilosis* differs in several genetic and physiological features from other *Candida* species. One is its ability to use compounds like hydroxybenzenes and hydroxybenzoates as carbon sources. These hydroxyaromatic compounds are like those found in decayed wood, maybe indicating that the fungus has a role in decomposition within soil. Researchers at Comenius University in Bratislava, Slovak Republic, have identified exactly how this yeast copes with these compounds using a combination of traditional microbiological tests and the latest molecular genetic methods. One practical reason for wanting to know more is that *C. parapsilosis* is highly tolerant to the antifungal drug terbinafine (also known as lamisil) even though it has a chemical structure containing the naphthalene nucleus, which can be degraded via metabolic pathways for hydroxyaromatic compounds. Obviously, understanding a possible cause of drug resistance is important.

The most interesting discovery is that *C. parapsilosis* uses biochemical pathways that turn out to be absent from most other yeasts to remodel these complex chemicals into compounds suitable for use within the fungus. The researchers identified how the fungus uses variations on two distinct biochemical routes (the gentisate and 3-oxoadipate pathways). In tests, most yeast species were unable to grow on hydroxyaromatic chemicals because they lacked one or more of the genes required for these pathways. The only ones that could live on these compounds were some members of the closely related 'CTG clade' which includes two species (*C. orthopsilosis* and *C. metapsilosis*) that were only recently distinguished from *C. parapsilosis*.

Another interesting feature was that *C. parapsilosis* adopted a distinctive appearance when growing on laboratory media containing hydroxyaromatic compounds, showing that their use results in a global effect on the fungus. Further experiments by the researchers showed that *C. parapsilosis* only switched on these pathways once it had detected hydroxyaromatic compounds in its surroundings, but not in media with glucose. This hints at why the fungus remains tolerant to terbinafine in the human body.

Holesova, Z., Jakubkova, M., Zavadiakova, I., Zeman, I., Tomaska, L. & Nosek, J. (2011). Gentisate and 3-oxoadipate pathways in the yeast *Candida parapsilosis*: identification and functional analysis of the genes coding for 3-hydroxybenzoate 6-hydroxylase and 4-hydroxybenzoate 1-hydroxylase. *Microbiology* 157, 2152–2163.

Save the date

The SGM Spring Conference will take place in Dublin's brand new Convention Centre, 26–29 March 2012.

Preliminary programme includes:

- Zoonoses
- Innate barriers
- Medical devices & biomaterials
- Phylogeography
- Climate change
- Food microbiology
- Oral infection & cardiovascular disease (jointly with American Society for Microbiology)
- Hospital-acquired infections (jointly with Royal College of Surgeons in Ireland)
- Biocontrol
- Nitrogen cycling
- Waste management and recycling
- Molecular proofreading
- Imaging the living microbe
- New media
- E-Learning
- …and a range of virology workshops

Further details and call for abstracts will be announced in the autumn on

www.sgmdublin2012.org.uk

Microbiology: An Evolving Science, 2nd edn

Authors J.L. Slonczewski & J.W. Foster
Publisher W.W. Norton & Co Ltd (2011)
Details US$171.25 | pp. 1,097 | ISBN 978-0-39311-824-7
Reviewer Alison Graham, University of Sheffield

Joan Slonczewski is a published science fiction writer, but here, with John Foster, she is imparting pure science fact. *Microbiology: An Evolving Science* is a substantial textbook aimed at undergraduates. The book is divided into logical sections with complexity growing throughout. However, this does not preclude the reader from 'dipping' into it at any point. The core text is clearly written and easily understandable with key concepts summarized at the end of each section and thoughtful questions posed to encourage critical thinking in more depth. The material is made relevant and accessible by referring to examples of current research. Boxes set apart from the main text present 'special topics' (which include quorum sensing, DNA vaccines and horizontal gene transfer) and there are interviews with prominent scientists too.

A strong point of the book is the abundant use of detailed and easily understandable diagrams and pictures that serve to enhance the text. The accompanying website (www.microbiology2.com) contains a wealth of information for instructors and students. All of the figures and animations can be downloaded from the website for use in lectures and are also available on the Instructor's Resource Disc. Highlights of the 'StudentSpace' part of the website include some excellent quizzes and flash cards to aid revision.

There is a very useful and extensive glossary included, as well as two appendices summarizing the structure and function of biological molecules for those who need to review the basics before embarking on the main book. This second edition has introduced new research topics which has given, for example, chemotaxis and immunology more space, and others have been transferred online as eTopics. However, the book is still substantial, although an ebook version is available.

The book is aimed at undergraduate students who will find it very useful, easy to read and targeted at the right level. The wealth of accompanying online material for both students and lecturers alike is a real bonus. It is a must for university libraries and should definitely be considered for individual purchase.

Salmonella: From Genome to Function

Editors S. Porwollik
Publisher Caister Academic Press (2011)
Details £159.00 | pp. 294
ISBN 978-1-90445-573-8
Reviewer Robert Poole, University of Sheffield

We know so much about *Salmonella*, but it is wrong to assume of course that this information derives exclusively from genome sequencing – the anchor of this book; indeed the first sequenced *Salmonella* genomes were only published in 2001. The history of *Salmonella* genetics can be traced much, much further back to the efforts of Milislav Demerec who, in the late 1940s, abandoned work on *Drosophila* and began the study of genetic fine structure in *Salmonella* by transduction. Also, the first grant awarded (a princely US$3,780 per annum in 1948) to Joshua Lederberg, discoverer with Norton Zinder of transduction, was on the genetics of *Salmonella*, not *E. coli*.

This book is firmly rooted in genomics and, in particular, how sequence information influences today's research in fundamental bacteriology, *Salmonella* detection, identification and typing, pathogenesis and host–pathogen interactions, virulence factors, adaptation to environmental pressures and bacterial cancer therapy. All these topics are covered here by international experts. This is a fast-moving field and it is a credit to the editor, contributors and publishers that updates were made as late as July 2010. It is expensive, but indispensable to the serious student of this organism.

Essentials of Veterinary Parasitology

Editors H.M. Elsheikha & N.A. Khan
Publisher Caister Academic Press (2011)
Details £59.00 | pp. 214 | ISBN 978-1-90445-579-0
Reviewer Olivier Sparagano, Northumbria University

With such a title I was expecting to receive a book around 800 pages as it is a colossal task to write about what is important in veterinary parasitology. The mere 214 pages unfortunately miss their objective: giving the readership some key information about veterinary parasites. To see that *Trypanosoma*, *Theileria* and *Leishmania* are covered only in just one page each is extremely frustrating as nothing can be said in such a small space that would help students to understand the diversity within these three groups. There is no mention of how *Theileria parva* kills almost a million cattle every year in sub-saharan Africa. The single page does not allow the readers to understand the difference between *Theileria parva*, *Theileria annulata* and *Theileria hirci* that affect different hosts and are transmitted by different tick species.

I read with horror that authors mentioned *Ixodes ricinus* as the main vector for *Theileria* species which is so misleading. *T. parva* is mainly transmitted by *Rhipicephalus appendiculatus* and *T. annulata* mainly by several *Hyalomma* tick species. Unfortunately, the tick-borne disease section was even more frustrating as only *Ixodes ricinus* was mentioned in this small section of 6 pages to cover all tick-borne diseases; nothing on *Amblyomma*, *Hyalomma* or *Rhipicephalus* ticks. There is also no information about *Dermanyssus* or *Ornithonyssus* in the mite chapter.

Why write about *Naegleria fowleri* and primary amoebic meningo-encephalitis, which is not a major problem in veterinary sciences? It is not even useful for medical colleagues as this amoeba kills only a few dozen patients every year. I think the authors have their priorities wrong in terms of which veterinary parasites to write about. Too many times the description remains at the genus level and does not provide species names for students and teachers on which to base differential diagnostic or epidemiological features.

The figures are often in colour, which is nice, but too many times scales are missing, not allowing the readers to understand the size of a nematode, trematode or cestode worm, for instance.

In my view, it is a most frustrating, sometimes inaccurate and often superficial book, which I do not understand the purpose of. The word 'essentials' in the title is over-enthusiastic. I suggest the authors reconsider writing the next edition on a smaller number of parasites but in more depth. I'm unsure who could benefit from such a book.

Molecular Microbiology: Diagnostic Principles and Practice, 2nd edn

Editors D.H. Persing, F.C. Tenover, Y.W. Tang, F.S. Nolte, R.T. Hayden & A. Van Belkum
Publisher American Society for Microbiology (2010)
Details US$189.95 | pp. 952
ISBN 978-1-55581-497-7
Reviewer Christopher Ring, Middlesex University

This book thoroughly describes the basis of molecular-based techniques and their applications to human microbial disease, highlighting the vast impact that these technologies have had on the diagnosis, treatment and pathogenesis of infections. These techniques not only enable us to detect and quantify known infectious agents, but have also allowed us to discover new ones. Furthermore, molecular methods can enable us not only to track the transmission of agents between and within hosts, but also to characterize them in terms of their virulence and their susceptibility to antimicrobial agents. In addition, such methods can allow us to study the host susceptibility and immune response at the molecular level. Use of such technologies can define the precise molecular effects of a pathogen on the host and thus can lead to the identification of new drug targets and the development of novel therapeutic approaches. Since molecular techniques have such a broad application in microbiology, this book will prove of interest to all those involved in the diagnosis and treatment of infectious disease, whether they be students, established laboratory-based researchers or infectious disease clinicians. The highly specialized and detailed nature of the book is, as expected, reflected in the price, and therefore it is unlikely to be purchased by individuals.

Deadly Choices: how the anti-vaccine movement threatens us all

Author P.A. Offit
Publisher The Perseus Books Group (2011)
Details £18.99 | pp. 256 | ISBN 978-0-46502-149-9
Reviewer Ulrich Desselberger, Cambridge

This is an insightful review of the historic successes of various childhood vaccines and a plea for their application in universal mass vaccination (UMV) programmes.

Whilst anti-vaccine campaigners have scored intermittent triumphs with various claims of causal relationships between vaccines and various acute and chronic diseases (indicting pertussis vaccine, MMR vaccine and/or vaccine adjuvants as causes of encephalitis, autism or other diseases), these claims did not stand up to scientific scrutiny and were refuted after extensive discussions in specifically established courts under a Vaccine Injury Compensation Program (VICP). The stories of recent anti-vaccine campaigns make fascinating narratives, and gain additional analytical depth by demonstrating that anti-vaccine campaigns are as old as the first vaccine (vaccinia virus against smallpox) and that the arguments made are repetitive. When claims, such as of serious side effects of vaccines, inadequate safety testing, dangerous vaccine ingredients or inadequate transparency of the licensing process, did not stick, individual religious or philosophical views as fundamental rights were raised against UMV programmes. Medical practitioners are the first to admit that no vaccine is perfect. They pay close attention to potential side effects by exploration during the licensing procedure, by comprehensive post-licensure surveillance and by careful data collation in Vaccine Adverse Events Reporting Systems (VAERS), and initiate changes in vaccination programmes as may be required.

Paul Offit has the rare gift of explaining complex scientific and biomedical issues in clear, common sense language without becoming flat on arguments. He is good at taking anti-vaccine campaigners' arguments seriously when dissecting them. In addition, he shows great courage in standing up for this central preventive measure of child health. In a remarkable last chapter entitled 'Trust', he lists possible measures to disarm anti-vaccine movements, such as publication of documents firmly corroborating UMV programmes in doctors' offices, deflection of flawed or simply wrong arguments of anti-vaccine advocates, or demonstration of compassion of doctors and scientists working in industry for this cause. Trust of parents in their children's doctors is rightly emphasized as the key element for UMV programmes to succeed.

This book's appeal reaches far beyond microbial vaccinology. It addresses the complex practical issues encountered during establishment or expansion of UMV programmes. The book should be in the hands of a wide range of physicians, paediatricians, health care and social workers and, last but not least, all young childrens' parents who make decisions on their vaccinations.

Reviews on the web

Reviews of the following books are available on the website at www.sgm.ac.uk/pubs/micro_today/reviews.cfm

Magic Bullets To Conquer Malaria: From Quinine to Qinghaosu

Author I.W. Sherman
Publisher American Society for Microbiology (2010)
Details US$39.95 | pp. 312 | ISBN 978-1-55581-543-1

Hepatitis C: Antiviral Drug Discovery and Development

Authors S.L Tan & Y. He
Publisher Caister Academic Press (2011)
Details £180.00 | pp. 390 | ISBN 978-1-90445-578-3

The Fecal Bacteria

Editors M.J. Sadowsky & R.L. Whitman
Publisher American Society for Microbiology (2010)
Details US$159.95 | pp. 302 | ISBN 978-1-55581-608-7

Bacterial Pathogenesis: A Molecular Approach, 3rd edn

Authors B.A. Wilson, A.A. Salyers, D.D. Whitt & M.E. Winkler
Publisher American Society for Microbiology (2010)
Details US$89.95 | pp. 508 | ISBN 978-1-55581-418-2

To join our panel of book reviewers, email y.taylor@sgm.ac.uk

Research Methods for Science

Authors M.P. Marder
Publisher Cambridge University Press (2011)
Details £19.99 | pp. 223 | ISBN 978-0-52114-584-8
Reviewer Pat Goodwin, The Wellcome Trust

This book is billed as an essential undergraduate textbook which is '*a unique introduction to the design, analysis and presentation of scientific projects*'. It is designed to accompany an introductory course on scientific research developed at the University of Texas, and includes assignments and instructors' notes which may not all be particularly applicable to UK courses. A large part is devoted to statistics and mathematical modelling, which can be rather dry topics, but the use of examples, ranging from the traditional flipping a coin to a study of the length of spines in fish from different locations, makes it readable and understandable. The chapter on Scientific information contains some useful dos and don'ts for authors and presenters. At £19.99 it is not expensive but, with a bit of searching on the web, much of the same ground is covered for free, so I doubt that it will be a bestseller in the UK.

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Professor Noreen E. Murray CBE FRS FRSE
(26/02/35–12/05/11)

NOREEN ELIZABETH MURRAY was a distinguished and highly respected British geneticist. She made a major contribution to the development of gene cloning technology by developing modified bacteriophages for use as gene cloning vectors and for high-level expression of proteins in bacteria.

Noreen enjoyed a rural upbringing, initially in the village of Read, near Burnley in Lancashire, and from the age of 5 in Bolton-le-Sands. Noreen attended primary school in Bolton-le-Sands, where her father was headmaster, followed by Lancaster Girls' Grammar School. The family spent much of their time outdoors, playing tennis, cycling, swimming or rowing on Lake Windermere or on the canal at the bottom of their garden. Their home in Read was close to the cricket ground, and Noreen particularly remembered watching Learie Constantine, the much-admired West Indian cricketer. Noreen said that as a child she was a little tomboy, and she loved climbing trees. She also liked to help her father with gardening, and she had her own section of their garden, which was the beginning of a life-long love of plants. Her father was a strong disciplinarian and she and her older brother had a strict but loving upbringing. He was particularly concerned about punctuality and, as a result, Noreen said she always tried to be on time.

Noreen's brother, Neil, also had a strong influence on her. He was a keen naturalist (he later studied forestry at Edinburgh University) and he encouraged Noreen to collect pressed flowers and birds' feathers. In her 5th form at school, Noreen studied physics and chemistry, biology not being an option available to her at that stage. However, her brother introduced her to biology, teaching her Mendel's Laws and encouraging her to read biology books. Thus, at the age of 15, Noreen changed from thinking of becoming a domestic science teacher to studying biology.

Noreen won a number of prizes at school and in 1953 was awarded a London Intercollegiate Scholarship for entry to King's College London, and a State Scholarship. She went on to obtain a BSc in Botany and became interested in microbial genetics. She was therefore pleased to have the opportunity to study for a PhD at the University of Birmingham with David Catcheside, who was head of the new Department of Microbiology. She was very interested in the nature of the gene and whether genes concerned with a biochemical pathway were closely linked in *Neurospora* as had been found for some pathways in bacteria. She studied the genes of the methionine biosynthetic pathway, performing extensive fine-structure analyses. She became interested in the mechanism of genetic recombination, finding evidence for polarized gene conversion.

Noreen occasionally recalled with amusement that, when she first arrived with her luggage at the large house where she was to stay in Birmingham, she was mistaken for a maid going into service. In Birmingham she met her future husband, Kenneth Murray, who was studying for a PhD in chemistry. In addition to their shared passion for laboratory work, they enjoyed hill walking, camping and climbing, especially in the Scottish Highlands. They married in 1958 and were later to become close scientific collaborators.

After completing their PhDs, they took up postdoctoral positions at Stanford University. Noreen continued her studies of *Neurospora* for 5 happy years in David Perkins' laboratory, describing her time there as being outstanding. She found the environment at Stanford intellectually stimulating, meeting many leading microbial geneticists. It was during this time that she first met Frank Stahl, who was interested in her studies of polarized gene conversion and who later collaborated with Noreen during sabbatical visits to the UK.

In 1964, she and Ken returned to the UK, Noreen to work with Harold Whitehouse in the Botany School, Cambridge, and Ken to the MRC Laboratory of Molecular Biology. Noreen was shocked that her degrees were not recognized by Cambridge University. It seemed that she was expected to work for a Cambridge PhD and, during her 6th year as a postdoctoral researcher, she appeared on the photograph of the Cambridge PhD students.

In 1968, Noreen took up a position in Bill Hayes' MRC Unit of Molecular Genetics in the University of Edinburgh, and Ken became a Senior Lecturer in the Department of Molecular Biology. Noreen decided to turn her research to systems that were more accessible to molecular studies. She had become interested in the phenomenon of host-controlled restriction (the ability of bacterial cells to 'restrict' foreign DNA) and decided to study this phenomenon in *Escherichia coli*, using bacteriophage lambda and her knowledge of bacteriophage genetics learned from Frank Stahl. Ken, at the end of his time in Fred Sanger's laboratory, had begun to determine short DNA sequences at the ends of the lambda genome, and they became excited by the prospect of combining their genetic and molecular skills to identify the DNA sequences that are cleaved by DNA restriction enzymes within the phage lambda genome.

Noreen and Ken were among the first to realize that the ability to cut DNA with restriction enzymes opened up the possibility of joining together different DNA molecules that had been cut in this way, to produce recombinant DNA molecules, and thereby to clone DNA sequences. Noreen used elegant genetic approaches to modify the chromosome of phage lambda, reducing the number of restriction enzyme cleavage sites, so that it could be used as a DNA cloning vector. Noreen, Ken and their close colleague, Bill Brammar, used these modified bacteriophages to clone defined fragments of DNA from a variety of organisms.

During the 1970s and early 1980s, Noreen produced a series of increasingly sophisticated lambda cloning vectors and bacterial strains in which to grow them. She also realized at an early stage that the protein products of cloned genes could be expressed in bacterial host cells, and her clever use of the quiescent, lysogenic state of phage lambda allowed the expression of proteins that may be toxic to the bacterium. This facilitated the high-level production of proteins in bacteria, including enzymes such as T4 DNA ligase, polynucleotide kinase and *E. coli* DNA polymerase that were of major importance for the new recombinant DNA technology.

The practical aspects of Noreen's work were always supported by scholarly exploration of the biochemical and genetic properties of the systems used, and it is notable that many of her publications have only one or a few authors, because she was generally the main instigator and often the sole technical contributor to the work. In the collaborative work with her husband, Noreen's contributions were clearly identifiable; she being the geneticist, he the biochemist.

She was generous with her time, both with her colleagues and by serving on many committees, including the Executive Advisory Board of the Scottish Higher Education Funding Council, the BBSRC Council, the Council of the Royal Society, the Cabinet Office Science & Technology Honours Committee, as Vice President of the Royal Society and President of the Genetical Society of Great Britain. She was also a trustee of the Darwin Trust of Edinburgh, a charitable organization founded by Ken and Noreen to support research in the natural sciences.

In 1988, Noreen was promoted to a personal chair at Edinburgh University, as Professor of Molecular Genetics. Her many contributions to science have been honoured by Fellowships of the Royal Societies of Edinburgh and London, Membership of the European Molecular Biology Organization and Honorary DScs from the Universities of Birmingham, UMIST, Warwick, Lancaster, Sheffield and Edinburgh. She was awarded the Gabor Medal of the Royal Society, the AstraZeneca Award of the Biochemical Society, the SGM Fred Griffith Prize, the Nexxus award (jointly with her husband) and, in 2011, she received a Royal Medal from the Royal Society of Edinburgh. She was awarded a CBE for services to science in 2002. Noreen's achievements came at a time when it was not always easy for women to make a career in science and it is a measure of her ability, hard work and determination that she reached the very top of her profession.

Although she had no children, Noreen thought of her students and postdocs as her family. She was a caring mentor and a great source of inspiration to all who worked with her, and she earned widespread admiration and affection.

Noreen loved to work at the bench and continued to do so long after her official retirement. She was extraordinarily hard-working, and held very high standards not only in her work but also in her personal life. She loved classical music, fine art and plants. The garden at their house in Edinburgh was her favourite place to escape to and it always looked magnificent. Noreen also took a pride in her appearance and dressed elegantly and stylishly. She was an excellent cook. She and Ken enjoyed good food, fine wines and the company of others, and they were very warm-hearted and generous hosts.

Despite her eminence as a scientist, Noreen was always very unassuming and quietly spoken. However, she was also strong-minded and extremely determined. Noreen's strength of character showed clearly during her recent illness from motor neurone disease, which caused very rapid deterioration in her health over a period of about 9 months. She demonstrated great courage, determination and dignity during this very difficult time, seeming more concerned about others than about herself.

Noreen will be remembered with huge affection and admiration by so many, and she will be greatly missed. She is survived by her husband, Professor Sir Kenneth Murray, and her brother, John Neil Parker, who lives in Australia.

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Open educational resources

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Open educational resources should be made use of – why re-invent the wheel? But how does one deal with copyright and assess quality? A new project – OeRBITAL – has been set up to overcome these issues.

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SHARING educational resources can be a great time-saver for busy academics. While it's unlikely that you will find an entire microbiology course that exactly fits your local needs (and would you get any credit from your institution if you did reuse someone else's course?), valuable course components that have been developed elsewhere can and should be reused. Martin Weller at the Open University makes the distinction between 'big' and 'little' open educational resources (OERs) – institutionally generated courses with explicit teaching aims versus individually produced, low-cost resources. Big OERs would include projects such as the MIT *Open Courseware* project and Apple's *iTunes U*, while little OERs are generally distributed via the internet and can be discovered by simple tools such as *Google* searches.

Aside from the issue of institutional credit, many people are put off using OERs because of concerns about copyright and other legal issues. Items which carry conventional copyright cannot legally be reused without explicit permission from the copyright holder (which is usually not the original author), and this is often difficult, slow and sometimes costly to obtain. In recent years, new types of intellectual property protection have appeared. These are intended to promote reuse where the author wishes this to happen. The best known of these is the *Creative Commons Licence*, which comes in a variety of forms, each of which specifies what can be done with the attached content – anything ranging from a single image to an entire course.

- CC-BY: Attribution-only licence – users can do what they want with the content as long as credit is attached for the original creator.
- CC BY-SA: Attribution-ShareAlike – allows reuse as long as credit is given and derivatives are licensed under identical terms. This is the license used by *Wikipedia*, and is recommended for materials that would benefit from incorporating content from *Wikipedia* and similarly licensed projects.
- CC BY-ND: Attribution-NoDerivs – reuse permitted, but no derivative works allowed.
- CC BY-NC: Attribution-NonCommercial – forbids commercial exploitation. This is not as simple as it seems. Educational institutions (which charge fees) are generally regarded as non-commercial, but this is open to challenge, so the confusion around CC BY-NC licences inhibits reuse and means they are best avoided (likewise CC BY-NC-SA and CC BY-NC-ND).

The problems surrounding reuse of intellectual property means that in spite of considerable investment in the UK (and worldwide), uptake and reuse of teaching materials has been generally disappointing. There is also the issue of quality – just because an item has been labelled for reuse does not mean that it is any good! To try to counteract these problems, the Higher Education Academy (HEA) and the Joint Information Systems Committee (JISC) have funded a series of projects aimed at promoting reuse. For bioscientists, the UK Centre for Bioscience is currently running the OeRBITAL (*Open Educational Resources for Bioscientists Involved in Teaching and Learning*) project, which aims to discover, collate, annotate and release OERs covering a range of disciplines within the biosciences, including microbiology. Ten discipline consultants have been recruited from across the biosciences to handle their own specialist subject specialties. I am the microbiology consultant for the project. The carefully selected, fully annotated outputs of the OeRBITAL project are available online, including the microbiology collection: **http://heabiowiki.leeds.ac.uk/oerbital/index.php/Microbiology**

We encourage you and your colleagues to explore and exploit the full range of resources highlighted on the OeRBITAL website, and if you or your colleagues have or know of resources that might usefully be added to this collection, please email me at **alan.cann@le.ac.uk**

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FURTHER READING AND RESOURCES

Apple *iTunes U*: www.apple.com/education/itunes-u
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MIT *Open Courseware*: http://ocw.mit.edu
OeRBITAL project: http://heabiowiki.leeds.ac.uk/oerbital/index.php/Main_Page
UK Centre for Bioscience: www.bioscience.heacademy.ac.uk
Weller, Martin (2010). Big and Little OER. In *Open Ed 2010 Proceedings*. http://openaccess.uoc.edu/webapps/o2/bitstream/10609/4851/6/Weller.pdf