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magazine of
the society
for general
microbiology

microbes and companion animals

Toxoplasma gondii
Prebiotics for pets
Viruses in coldwater ornamental fish
Are our homes safe for cats and dogs?
Decline in global amphibian biodiversity
Zoonotic transmission of viruses

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Cover image Cat's eyes. *Stockxpert / Jupiter Images*

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It doesn't seem that long ago as an undergraduate that my first copy of the, then *SGM Quarterly* landed on my hall floor. In little over 10 years I have progressed from a PhD student in the Laboratory of Glyn Hobbs and George Sharples at Liverpool John Moores University working on development and antibiotic production in *Micromonospora*, to studying *Streptomyces* development in Mark Buttner's laboratory at the John Innes Centre and then on to Maggie Smith's group at the University of Aberdeen, working on bacteriophage defence, again in *Streptomyces*. In 2007, I moved south to Glasgow where I began to set up my own group at the University of Strathclyde, again maintaining my interest in *Streptomyces* and other actinobacteria. In this time, not only have I undergone major progressions but the *SGM Quarterly* has become the award-winning *Microbiology Today*.

It is a great honour and privilege to succeed Matt Hutchings as Editor of *Microbiology Today,* and also quite a daunting task to fill such capable shoes. It is nice to take something from Matt for a change, instead of him taking from me; my reagents when we were postdoctoral researchers together at the John Innes Centre spring to mind!

In recent years *Microbiology Today* has gone from strength to strength and become the flagship of the SGM. I believe the magazine brings the Society's membership together, introducing new ideas and outlooks on diverse areas of microbiology, not only to our academic research active members, but also to our ever-increasing school membership. This area of the SGM is vitally important as we seek to increase awareness and enthusiasm for microbiology within the Society and society at large. This can only help to encourage more students to study microbiology at university and also increase public awareness and combat microbiological misinformation in the mass media.

My vision for *Microbiology Today* is to build on the work of Matt, and Gavin Thomas before him, and showcase the breadth and depth of microbiology as a discipline. As microbiologists we know how important our subject has been to some of the greatest discoveries in the biological sciences. Currently at the forefront of the systems and synthetic biology revolution in biological sciences are microbiologists, pioneering this area along with the help of mathematicians, physicists and modellers. Therefore, the SGM, as our learned society and us, as its members, have the duty to fulfil a key goal of the Society to further 'promote the art and science of microbiology' for the future. Hopefully through *Microbiology Today* we can encourage this.

Paul Hoskisson *(e paul.hoskisson@strath.ac.uk)*

On the ball

The cover photograph of the August issue of *Microbiology Today* provoked an unexpected reaction. Readers may remember that, to illustrate the 'microbes and sport' theme of the magazine, it featured a rugby team. The picture was obtained from a photo library, and chosen for its artistic appeal and because it was appropriate. Little did I and Production Editor, Ian Atherton, know that there was an SGM connection with the team. A phone call from retired member John Garrett revealed that he was ex-President of the Club shown – Long Buckby in Northamptonshire.

The story didn't end there, as the photographer also called quite independently of John to ask if we could send some complimentary copies to the players. Off these duly went and we hope they weren't too scared by the article on 'scrumpox' in the magazine!

Janet Hurst

SGM Prize Medallist 2010 – Sir Paul Nurse

Professor Sir Paul Nurse is to be the recipient of the SGM Medal, awarded annually to a microbiologist of international standing whose work has had a far-reaching impact beyond microbiology. He will deliver his talk *Controlling the Cell Cycle* on Monday 29 March 2010 at the Edinburgh meeting. A special complementary symposium on the same theme is to be held that day, with talks delivered by speakers of international renown in the field.

Paul Nurse's research focuses on the molecular machinery that drives the cell cycle. His major accomplishment was the identification of the genes acting as the key regulators of the cell cycle in both yeast and human cells. The major regulator molecule, called CDK (cyclin-dependent kinase) is essential to life in all eukaryotes and is conserved over hundreds of millions of years of evolution.

For this work he shared the 2001 Nobel Prize with Leland H. Hartwell and R. Timothy Hunt. The Nobel Prize in Physiology or Medicine recognized the three scientists for advancing scientific understanding about the biological process by which cells make copies of themselves both in health and in diseases such as cancer.

Born in 1949 in Norwich, Great Britain, Paul Nurse graduated from Birmingham University in biology. In 1973, he received a PhD in cell biology/biochemistry at the University of East Anglia.

After completing postdoctoral studies at universities in Bern, Edinburgh and Sussex, Paul Nurse joined the Imperial Cancer Research Fund (ICRF) in 1984. For the next 4 years, he headed ICRF's cell cycle control laboratory.

In 1988, he joined the University of Oxford to chair its Department of Microbiology. Five years later, he returned to ICRF as its Director of Research. In 1996, he was promoted to Director General. In 2002, he was appointed Chief Executive of Cancer Research UK, which was formed from the merger of ICRF and the Cancer Research Campaign. He became President of Rockefeller University, New York in 2003.

In addition to the Nobel Prize, Paul Nurse has received the Albert Lasker Award for Basic Medical Research, the General Motors Cancer Research Foundation Alfred P. Sloan Jr Prize and Medal, the Royal Society Copley, Wellcome and Royal Medals (UK), Pezcoller Award (Italy), Rosenstiel Award and Medal, Heineken Prize (Netherlands), Jimenez Diaz Medal (Spain), Jeantet Prize (Switzerland) and the Gairdner Foundation International Award (Canada).

A Fellow of the Royal Society, Paul Nurse is a member of the Council for Science and Technology, which advises the Prime Minister and the Cabinet of Great Britain. He also is a member of the European Molecular Biology Organization (EMBO), a foreign associate of the US National Academy of Sciences, and a founding member of the UK Academy of Medical Sciences. He was honoured with a knighthood in Great Britain in 1999 for services to cancer research and cell biology, and he was awarded the Legion d'Honneur (France) in 2002.

New Honorary Member Professor Julian Davies

Council has been pleased to confer Honorary Membership on **Professor Julian Davies**, in recognition of his long and distinguished service to microbiology and service to the SGM

50 years of microbiology: my life and good times

It is an honour to have been made an Honorary Member of SGM, especially since I have never taken a course of microbiology! I was born in Neath (Nydd), South Wales, and after several 'evacuations' during the Second World War settled in West Wales, receiving my secondary education at Milford Haven Grammar School. Chemistry was my ambition at that time and I received my BSc and PhD in Chemistry at the University of Nottingham followed by postdoctoral stints with Gilbert Stork (Columbia University) and Gene van Tamelen (University of Wisconsin), before joining the UMIST Chemistry Department as a Lecturer in 1959. By this time I was married and a father.

My life was changed when I met Milton Salton at Manchester and became interested in microbial cell wall structure. Milton and I left Manchester in 1962; he went back to Australia and I became an Associate in Bernie Davis' group (Bacteriology and Immunology) at Harvard Medical School to carry out studies on the mode of action and mechanism of resistance to streptomycin. This work led to a fruitful collaboration with Luigi Gorini and Walter Gilbert on the aminoglycosides and the discovery of their mistranslation activity, thus demonstrating the key role of the ribosome in reading the genetic code. This was confirmed in a 1-month visit to Gobind Khorana's laboratory in Wisconsin where the specific effects of aminoglycosides on defined coding triplets were identified.

I was fortunate to meet François Jacob at Harvard and he invited me to spend a year at Institut Pasteur working on genetic mapping of the regulatory region of the *lac* operon. We used X-Gal as a screen for mutants in the repressor gene and the identification of trans-dominant repressor mutations. Now, I was a microbial geneticist! In 1967 I accepted a faculty position in Biochemistry at the University of Wisconsin in Madison: another deception since I had no training in biochemistry. Over the next 13 years, with excellent students and postdoctorals we developed a number of successful projects, including ribosome mapping, mechanisms of antibiotic resistance to antibiotics, the discovery of antibiotic resistance genes in antibiotic-producing streptomycetes, the mode of action of a variety of translation inhibitors and the development of selective markers for gene cloning studies, in particular geneticin (G418) for use in recombinant studies in eukaryotic cells. We also discovered the restriction enzymes *Pst*I and *Kpn*I. Talk about being a dilettante!

In 1980, the thrilling prospects of the fledgling biotechnology industry led me to join Biogen in Switzerland for a very exciting (but often frustrating) 5 years during which the company developed several valuable recombinant pharmaceuticals. In 1986, academia called and I joined the new biotechnology department at Institut Pasteur, Paris, where I was able to set up an active international group in 'microbial engineering', working on many topics, including *M. tuberculosis*, *L. monocytogenes*, *Bacillus* spp., yeasts, and of course antibiotics and a number of *Streptomyces* strains! This was another productive chapter in my life, in terms of science, scientists and the pleasures of living in Paris.

I moved to the University of British Columbia in Vancouver to become Head of Microbiology and Immunology in 1992, never having been the chair of a department. UBC offered many opportunities, including starting a small centre to investigate microbial diversity in collaboration with the National University of Singapore. This involved metagenomic studies of soil bacterial communities and other environments, with the objective of direct cloning and expression of the biosynthetic pathways for novel antibiotics. The centre then became TerraGen Diversity, a small biotech company focused on finding antibiotics using metagenomics; in 2000 the company was acquired by Cubist Pharmaceuticals.

My laboratory at UBC has continued to develop methods for antibiotic discovery and has explored the microbial diversity associated with lichens, mosses and liverworts. (British Columbia is a rich source of these organisms.) In the course of studies of antibiotic resistance, we were prompted to examine the transcriptional effects of antibiotics at sub-inhibitory concentrations. This led to the notion that antibiotics behave as cell–cell signalling agents in nature. Methods to detect diffusible chemical signals in microbiomes are being explored and applied to the discovery of potential therapeutic agents.

It has been a privilege to have had so many people to learn from; osmosis is better than textbooks. Microbiology as a science has evolved through many conceptual phases in a half century: DNA, the genetic code, molecular biology, genetic engineering, biotechnology, sequencing, cellular microbiology, genomics, proteomics, metagenomics, chemical biology and others. Where next?

Throughout my career the friendship and aid of numerous established scientists, constant and essential encouragement from my wife Dorothy and my family, together with financial support from NIH and NSF in the US, several European agencies, and CIHR and NSERC in Canada, have allowed me to enjoy the benefits of being a member of the wonderful and changing world of microbiology.

Julian Davies
(e jed@interchange.ubc.ca)

July meeting highlights

The SGM Prize Medal

Council devoted a significant amount of time to careful consideration of nominations for the SGM Prize Medal to be awarded in 2010. Council agreed that the President should approach **Professor Sir Paul Nurse** (Rockefeller University, USA) and he has been pleased to accept. A profile of Sir Paul appears on p. 179 of this issue of *Microbiology Today*.

European Society of Virology (ESV)

Council agreed that SGM should become a corporate member of the newly formed ESV. Members of SGM will then have all the privileges of ESV membership apart from individual voting rights, but SGM will have 20 votes. **Professor Mark Harris** noted that the Virology Division intended to apply for a grant from the SGM Joint Meetings Fund and to organize a joint session at the Eurovirology Congress at Lake Como in April 2010.

SGM finances

Despite the continuing low return on investments and general global economic uncertainties, the Treasurer reported that Society finances were in good order and that commercial journal sales were holding up well. It was agreed that a sum of money being held in cash, on which the return was currently very low, should be transferred to a corporate bond fund with a much higher rate of interest. Council agreed to the membership subscription rates for 2010 proposed by Treasurer's Committee, which represent very modest increases on the 2009 rates.

Retiring members of Council

The President **Robin Weiss** thanked the retiring elected members of Council, **Professor Petra Oyston** and **Professor Neil Gow** and the retiring officers, **Dr Ulrich Desselberger** as General Secretary, **Dr Sue Assinder** as Education Officer and **Dr Matt Hutchings** as Editor of *Microbiology Today* for all the excellent work they had done for the Society. He also conveyed his gratitude to the three Editors-in-Chief, **Professor Charles Dorman**, **Professor Richard Elliott** and **Professor Charles Penn** who were retiring from Council, but not from their editorial positions or Publications Committee. **Professor Hilary Lappin-Scott**, although completing her term as Scientific Meetings Officer during a very challenging time for the Society, would be returning to Council as President in September after the AGM. She would be overseeing changes in this role, as the newly structured Council evolved its practices.

***Janet Hurst**, Deputy Chief Executive*

SGM Council

New member of Council

Dr Karen Robinson, University of Nottingham, has been elected to serve on Council for a term of 4 years from 8 September 2009. She writes:

I obtained a BSc in Bacteriology and Virology, followed by a PhD on synthetic peptide vaccines, from Manchester. Since then I have been studying host–pathogen interactions and vaccines at Cambridge and Nottingham. I have worked on mucosal vaccine technologies and delivery systems, such as recombinant lactic acid bacteria, and studied a variety of infectious organisms, including *N. meningitidis* and intestinal nematode parasites. My research group is currently focused on *H. pylori*, attempting to understand how the infection persists, and why some people develop stomach ulcers or gastric cancer as a consequence of their infection. We are also studying *H. pylori*-mediated protective effects against asthma and allergy. We are examining how the host is influenced by virulence factors expressed by the bacteria, and human mucosal immune responses to the infection.

Letter to the Editor

Dear Editor

Review of SAW Showcase *(Anne Osbourn) by Gemma Sims*

As a contributor to the *SAW Showcase* book and participator in the SAW events, I was pleased to see this review, but disappointed by its content. The reviewer 'had concerns' about the project and feared that 'it did little to enhance the learning and understanding of scientific concepts'. This was not the case, the children hugely enjoyed the exercise and, from my experience, gained considerable insight into the scientific issues concerned with their projects. She comments that maybe '*some of the topics were too difficult for the age group*' and exemplifies this by saying that '*your average 8-year old will be none the wiser about topoisomerases*' (my own research area). Again this is wrong. In this case the theme concerned 'packaging', i.e. how you package DNA into cells, and they looked at other ways of packaging objects. The children had no problem grasping this concept and had huge fun wrapping diverse objects to make unexpected shapes, and making DNA from onions. She quotes a poem about DNA and asks '*where is the science?*' The science was in the classroom and in the images the children saw, discussed and wrote about. The output was generally not terribly scientific, but that was not the intention; the children created artwork and poems that were inspired by the scientific images. I recommend that the reviewer hosts a SAW day at her school and it will be readily apparent what the benefits are.

Yours faithfully,

Professor Anthony Maxwell
*Head, Department of Biological Chemistry, John Innes Centre, Colney, Norwich NR4 7UH (**t** 01603 450771; **f** 01603 450018; **e** tony.maxwell@bbsrc.ac.uk)*

Society of Biology launched

On 5 October the Institute of Biology and the BioSciences Federation united to form the Society of Biology.

The new body aims to be a single, unified voice for biology, advising government and influencing policy, advancing education and professional development and encouraging public engagement with the life sciences. The Society represents a diverse membership of over 80,000, as individuals or through learned societies and other organizations. For further information: **www.societyofbiology.org**

People

Congratulations to…

Professor C. Neil Hunter, Department of Molecular Biology and Biotechnology, University of Sheffield on his election to Fellowship of the Royal Society.

Professor Anne Glover, University of Aberdeen and Chief Scientific Adviser for Scotland, on her appointment as chair of the UK Collaborative on Development Sciences, an organization that aims to provide a more co-ordinated approach to development sciences in the UK.

Professor Hugh Pennington, former SGM President, for his appearance on *Desert Island Discs* on BBC Radio 4 in July.

Professor Mark Buttner, John Innes Centre, Norwich on being elected as a Fellow of the American Academy of Microbiology.

Deaths

The Society notes with regret the death of **Dr Donald Black** (member since 1972) who worked at the Institute of Animal Health, Pirbright for many years before moving to the Sir William Dunn School of Pathology, Oxford, from which he retired in 2001. An obituary of Dr Black appears on the *Microbiology Today* website (www.sgm.ac.uk/pubs/micro_today/obituaries.cfm)

Sadly, **Professor Tom Barrett** (member since 1980), who also worked at the Institute for Animal Health, Pirbright where he had been head of the Morbillivirus Group since 1985, died on 19 September. His work on rinderpest (cattle plague) was integral to the success of the Global Rinderpest Eradication Programme and the forthcoming formal announcement in 2010 that the virus has been eradicated. This will make rinderpest the first virus in veterinary science and only the second virus after smallpox, to have officially been eradicated from the planet. He was a Member of the Editorial Board of *Journal of General Virology* and a regular contributor to SGM meetings.

SGM Staff

Welcome to **Jane Maguire** (right) who has been recruited to the journals sales office to help with the tiered pricing project and new marketing initiatives. Her experience with introducing new computer systems will also be very helpful.

Welcome also to new External Relations Administrator **Laura Udakis** (below), who joined SGM in September on completion of an MSc in Science Communication from the University of the West of England. Laura's first degree was in Biochemistry from the University of York and she has extensive experience of hands-on science promotion activities and writing.

We are also pleased to see staff editor **Ashreena Osman** back after a period of maternity leave.

Congratulations to **Gemma Sims** and her husband Tom on the birth of twins, Charlotte Constance and Robert Thomas, on 9 October. Gemma, a qualified science teacher, worked at the SGM for a year to develop a microbiology teaching resource for post-16 students.

On the plinth

Artist Anthony Gormley's *One and Other* project took 2,400 randomly selected people from across the UK to make up a living piece of artwork. His vision was for the '…uninterrupted occupation of the fourth plinth for 100 days and nights…'. Each 'plinther' spent 1 hour alone on the usually empty fourth plinth in Trafalgar Square, London. Plinthers undertook a range of activities; from political speeches to sleeping, nudity to painting.

SGM staff editor **Rachel Walker** successfully applied for a place…

'*My randomly allocated slot (8–9 pm on Thursday 8 October) was on my Mum's birthday, so a birthday party seemed like a good choice of activity! A lot of other people I know were also born on 8 October, so my party included them. I also invited people to text me birthday wishes for their friends born that day; I received 16 birthday wishes, including one for a Canadian man who was celebrating his 97th birthday.*

Once people were decked out for the party with hats, balloons and glow sticks, we played some games! Grandma's footsteps and a rocket balloon race proved very popular, and the party-goers were very eager to join in the 'hokey-cokey' (amazing what people will do for someone shouting instructions from up high). We ended by singing happy birthday to my Mum and then I proved very popular by giving out cakes!

Rachel on the fourth plinth. *Pauline Stevenson*

Lucy being a bee. *Lucy Goodchild*

Since I first heard about this project, I have been fascinated by the concept. I was incredibly lucky to have been able to take part in this crazy adventure and feel immense pride in having done so. Being on the plinth was exhilarating and it was an experience that will always be with me. And it was so much fun!'

www.oneandother.co.uk/participants/rachiegwalker

Lucy Goodchild, who used to work in the SGM External Relations Office but is now a press officer at Imperial College London, also took to the plinth. For Lucy, science writer, beekeeper and self-confessed professional geek, this was a dream come true. '*When I heard about this project, my initial reaction was 'great … get me up there and give me a megaphone!' It's an exciting, off-the-wall, innovative venture and I was so excited I'd been chosen! I really wanted to be part of something that would make history.*' Lucy dressed as a bee and talked mainly about the plight of bees, spiced with bee tales galore, plus some exciting, fascinating scientific research news thrown in for good measure. For example, did you know that the pheromone a queen bee makes to tell her workers to attack an enemy smells like bananas?

www.oneandother.co.uk/participants/lucy_googlechild

Grants

Medical Trainee Support Grants

Funding for medical microbiology trainees (during foundation or specialist training) to carry out short lab-based projects on a microbiological topic. The grant covers a contribution towards consumables costs only. Closing dates: **19 March** and **24 September 2010**.

Scientific Meetings Travel Grants

This scheme is open to a range of early-career microbiologists resident within the EU, ranging from postgraduate students through to first postdocs and newly appointed lecturers. Funding is tiered according to the location of the meeting. The maximum grants are: UK (or country of residence) – £200; within Europe – £350; Rest of World – £500. These grants may also be used to support attendance on short courses.

President's Fund for Research Visits

Grants are available to support short research visits (1–3 months) by early-career microbiologists resident within the EU, ranging from postgraduate students through to first postdocs and newly appointed lecturers. Funding is limited to a maximum of £3,000. Retrospective applications will not be accepted. Closing dates: **19 March** and **24 September 2010**

Student Schemes

Hayes–Burnet Travel Award

A limited grant of up to £3,000 is available to present work at the Annual Scientific Meeting of the Australian Society for Microbiology (ASM) and make a short research visit of up to 3 weeks at a laboratory in Australia. This scheme is offered jointly with the ASM and supports the reciprocal exchange of one postgraduate student member to present their research at the other society's main conference and to visit a research lab in that country. Closing date: **12 February 2010**

A similar scheme, the Heatley–Payne Award, has been set up with the American Society of Microbiology, but the deadline for applications has passed for this year. Watch out for the next closing date to be announced in 2010.

Student Meetings Grants

Grants contribute towards travel, registration and accommodation expenses for attendance at one SGM meeting each year. Applicants must be Postgraduate Student Associate Members resident and registered for a PhD in an EU country, or Undergraduate Members based at a university in the UK or Ireland accepted to present work at the meeting. Closing date for Edinburgh Conference: **26 March 2010**.

SGM has a wide range of grant schemes to support microbiology. See **www.sgm.ac.uk/grants** for details and closing dates.

Enquiries should be made to the: Grants Office, SGM, Marlborough House, Basingstoke Road, Spencers Wood, Reading RG7 1AG (t 0118 988 1821; f 0118 988 5656; e grants@sgm.ac.uk).

Elective Grants

Funding for medical/dental/veterinary students to work on microbiological projects in their elective periods. The closing dates for applications in 2010 are **19 March** and **24 September**.

Vacation Studentships

The 2010 scheme is now open for applications. As described on pp. 226–228 the scheme offers a great opportunity for undergraduates to work on microbiological research projects during the summer vacation before their final year. The awards, which are made by competition, aim to give students experience of research and to encourage them to consider a career in this area. The studentships provide support at a rate of £185 per week for a period of up to 8 weeks. An additional sum of up to £400 for specific research costs may also awarded. Applications must be from SGM members on behalf of named students. The closing date for applications is **20 February 2010**.

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.

Other schemes

Public Engagement with Science Awards

Are you planning any projects to promote the public understanding of microbiology? Have you got a National Science Week event in mind? SGM can help. Grants of up to £1,000 are available to fund appropriate activities. Applications are considered on a first come, first served basis throughout the calendar year.

Lister Institute Research Prizes

Applications are now invited from young clinicians and biomedical scientists for the 2010 Lister Research Prizes. The Prizes offer £200,000 to be spent on the recipient's research in whatever way they choose, other than for personal salary. Further information and application forms are available from the website: **www.lister-institute.org.uk**. Closing date for applications: **4 December 2009**.

Livestock infectious diseases and zoonoses

The Royal Society has devoted the current issue of *Philosophical Transactions B* to the topic of livestock infectious diseases and zoonoses. Edited by Professors Martin Shirley and Fiona Tomley, Director and Deputy Director (Science), respectively, of the Institute for Animal Health, the papers look at viruses, bacteria, protozoa and helminths that cause disease in animals or have originated in animals and spread to people. Areas where technology can be brought to bear to minimize the adverse effects of emerging pathogens are covered, such as state-of-the-art approaches to diagnoses and surveillance, and vaccine development. The introduction is available free of charge and sets out the social changes in our modern world that facilitate the movement of pathogens.

For details of how to access this special issue and to read the introductory chapter see: **http://rstb.royalsocietypublishing.org/site/2009/livestock_disease.xhtml** (please note that to qualify for the special offer, you will need to enter the code TB 1530 on the online shop).

SGM membership subscriptions 2010

The following rates were agreed at the AGM of the Society on 8 September 2009.

Membership category		Annual subscription		Additional subscriptions for publications (print only)							
				Microbiology		*JGV*		*IJSEM*		*JMM*	
		£	US$	£	US$	£	US$	£	US$	£	US$
Ordinary		55	108	108	212	108	212	108	212	63	120
Associate *Postgraduate Student* *Retired* *Microbiologist with annual salary <£27.5k*		25	50	50	96	50	96	50	96	50	96
Undergraduate		10	NA	NA	NA	NA	NA	NA	NA	NA	NA
School		10	NA	NA	NA	NA	NA	NA	NA	NA	NA
Corporate	Tier 1	350	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Tier 2	500	NA	NA	NA	NA	NA	NA	NA	NA	NA

For airmail despatch of *Microbiology Today*, add £20/US$36 to subscription.

Members are reminded that their 2010 subscriptions are due for payment by **1 December 2009**.

As in previous years, no journal or meetings information will be despatched to members who are in arrears, and there will be no guarantee of provision of back numbers of journals for members who pay their subscription late.

Payment against invoice

Invoices were despatched recently to all members who pay by this method. If you did not receive one, please inform the Membership Office.

Secure online credit card renewal payment

If you pay against invoice, you can renew your subscription online via the SGM website (www.sgm.ac.uk/members) with either a credit or debit card. Please see your invoice for details.

Payment by direct debit

Subscription notices were despatched recently to all members paying by direct debit. To continue your present status and journal requirements, no further action is necessary. To change your membership status or journal requirements for 2010 you should have amended your subscription notice and returned it to the membership office by **12 November 2009**. However if you have missed this deadline, your amended notice will be accepted if it is submitted immediately.

Please note

Continuous credit card payments are no longer available. Alternative methods are by direct debit (for UK bank account holders) or one-off credit/debit card payment online.

Income tax relief on membership subscriptions

Members who are liable for UK income tax are reminded that their annual subscriptions to the Society have been approved by the HMRC as qualifying for income tax relief. Any member who would like further information or has difficulty in obtaining this relief should contact the Chief Executive (r.fraser@sgm.ac.uk).

microshorts

Laura Udakis checks out some recent microbiological news stories.

Save the red squirrel

Squirrelpox virus is thought to be one of the reasons why the red squirrel population is in rapid decline. A better understanding of squirrelpox may help reduce its spread and potentially prevent extinction of the red squirrel. Epidemiologists at the University of Liverpool are investigating why the disease can be lethal in red squirrels, yet grey squirrels are relatively unaffected by it. The study based at Formby near Liverpool will also look at how the disease is spread between the grey and red squirrel populations. Around 160,000 red squirrels remain in the UK, compared to 2.5 million grey squirrels.

www.liv.ac.uk/news/press_releases/2009/10/red-squirrel-research.htm

▲ Little brown bat with white-nose syndrome in Greeley Mine, Vermont, USA, in March 2009. *Marvin Moriarty / US Fish and Wildlife Service*

◀ Red squirrel (*Sciurus vulgaris*). *Simon Fraser / Science Photo Library*

Nanoparticles reduce burn infection

A nanoemulsion lotion developed and patented by the University of Michigan has been shown to curb bacterial infection and reduce inflammation of burns. The promising results from first-stage laboratory studies show the lotion is able to successfully penetrate the skin to kill bacteria below the surface – a feat that current creams are unable to accomplish. In addition to treating bacterial infection, the lotion appeared to reduce inflammation by suppressing two key cytokines that play a vital role in the body's inflammatory response. The emulsion is comprised of soybean oil, alcohol and detergents, emulsified into droplets less than 400 nanometers in diameter. Other uses for nanoemulsions include treatments for cold sores (now in phase 3 clinical trials) and toenail fungus as well as vaccines against influenza and bioterrorism agents.

www.sciencedaily.com/releases/2009/09/090914151627.htm

Hot microbes slow down decontamination

Microbes that degrade contaminants in groundwater are being inhibited by dangerously high temperatures underground. Researchers at CSIRO in Perth, Australia showed that in areas of diesel fuel contamination, at 3.5 metres below the ground surface, temperatures reach as high as 47°C. Growth of microbes found at this depth is compromised at 52°C. The study shows groundwater remediation systems may need to be redesigned if they are to be effective. Contaminants such as fuel and household chemicals are consumed by micro-organisms and metabolized with the help of air injections in a technique called 'biosparging'. Growth of the microbes is enhanced further by the addition of extra nutrients and it is this practice that can raise temperatures underground. Simply increasing the flow of air in groundwater to decrease temperatures is not feasible as this air can also generate hazardous vapours. Optimization of operating conditions and careful timing nutrient addition is currently the best solution for keeping microbes cool.

www.sciencedaily.com/releases/2009/09/090918100006.htm *and* www.csiro.au/science/Hot-Microbes.html

Fungal threat to bats

A mysterious fungus that has wiped out one million hibernating bats in the north-east USA could have fatal consequences for the bat population. Although the fungus that causes 'white nose syndrome' has been isolated, scientists still have no idea how to prevent it from destroying the entire bat population in the US.

White nose syndrome is so-called because of the white fungus found on the snouts and wings of affected bats. Since 2006 the disease has killed 90% of the bats in affected caves in nine states according to federal authorities.

www.nj.com/news/index.ssf/2009/07/federal_lawmakers_ask_obama_ad.html

Automating evolution

A new automated method of genome engineering capable of 'evolving' bacteria very quickly to produce useful compounds has been developed in the USA. Researchers from Harvard Medical School, Boston produced 15 billion different strains of *E. coli* in just 3 days using this method. Strains were tested for their ability to produce the protein lycopene – a process involving more than 20 genes. Strains capable of producing five times as much protein were isolated. The novel technique, called Multiplex Automated Genome Engineering (MAGE) uses a single-stranded section of synthetic DNA designed to target a region of the bacterial chromosome. A jolt of electricity to the cell allows the DNA to enter, where upon it is taken up into the bacterial genome. By repeating this process many times, with different sections of synthetic DNA a huge variety of strains can be produced very quickly. The researchers think that MAGE could be more useful for isolating industrially useful bacterial strains than designing genomes from scratch, as the process is much less complicated.

www.wired.com/wiredscience/2009/07/cellfactories/

www.newscientist.com/article/mg20327194.800-superevolved-bug-factories-could-yield-drugs.html

▶ Schoolchildren get the first glimpse of 'Sue' at the unveiling ceremony at the Field Museum of Natural History in Chicago, USA. *John Zich, AFP / Getty Images*

Sore throat Sue

Rather than dying in mortal combat, researchers now think that the world's largest *Tyrannosaurus rex* may have died from a throat infection that commonly affects birds. The dinosaur known as 'Sue', on display at the Field Museum in Chicago, is the largest and most complete example of the prehistoric predator ever found. Gouge marks in her jaws, thought to be battle wounds, were examined by a team of researchers led by Dr Ewan Wolff from the University of Wisconsin, Madison and Dr Steven Salisbury from the University of Queensland, Australia. The holes resembled those seen in the jaws of modern birds such as pigeons and doves, which are caused by a common protozoan parasite causing mouth and throat infection. The disease called trichomoniasis may eventually lead to bone loss in the jaw and was probably spread between dinosaurs through their bites.

www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0007288

Commuters spread mosquito-borne disease

A mathematician from the University of Bath has teamed up with researchers in Hawaii to study how commuting patterns in large cities affect the spread of mosquito-borne diseases such as Dengue fever. Ben Adams from Bath, together with experts from the University of Hawaii at Monoa, has developed a mathematical model to examine how human movement between patches of infected mosquitoes impacts on persistence of vector-borne diseases on a large urban scale. Traditional studies of the epidemiology of such diseases have focused on the vector rather than the host, yet this study highlights the important role of the host in transmitting infection. In comparison with mosquitoes, people inhabiting urban areas move over much larger spatial scales and this movement between unaffected and affected areas will keep the disease circulating. The study helps to explain why despite great resources being invested in vector control the incidence of vector-borne diseases is still high.

www.sciencedaily.com/releases/2009/09/090918101238.htm

www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0006763

SGM Council and other companion animals

Robin Weiss looks back with affection to his term as SGM President.

In his first book, *My Family and Other Animals,* the zoologist Gerald Durrell included many amusing stories from his boyhood in Greece about the live animals he collected and about his older brother Lawrence who became a renowned author. David Attenborough is the younger brother of actor–director Richard and he continues to entertain and educate us about the natural world. Well, I am the youngest of four siblings and, like these illustrious biologists, I was fascinated by natural history as a child, and eventually graduated in zoology at university. My first research post, before enrolling for a PhD that eventually led me into virology, involved population genetics of *Rattus rattus*, the black rat. I was drawn to the project because it offered a free trip to the backwaters of Kerala in India where certain regions had high levels of radioactivity owing to thorium deposits in the sand.

Regarding rats, shouldn't we regard these nimble creatures as companion animals? They seldom live far from human habitation, and Kerala has one of the highest human population densities in the world. Rats carry the plague, Weil's disease, typhus, *Leishmania*, and a host of virus infections.

▲ A black rat (*Rattus rattus*). *Tom McHugh/ Science Photo Library*

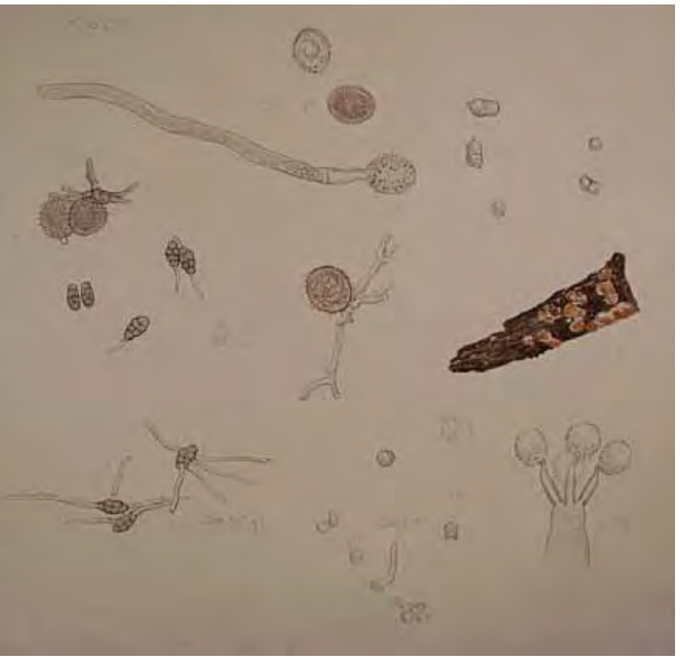
But space alone would preclude the inclusion of infections of rats from this issue of *Microbiology Today*.

Like Durrell, I am tempted to look back on my 3 years as President of the SGM to view my fellow Council members with the baleful eye of an ethologist noting the behaviour of his companions. I must desist of course, other than to remark that my colleagues on Council really were most companionable indeed. While they maintained a healthy scepticism against following the lead of the alpha-animal, supposedly the President, they unfailingly considered the good of the Society as a whole rather than their special interests. Debate was vigorous, but never personal or ill-tempered. The occasional nudge by our zoo keeper, Ron Fraser and our trainer, Janet Hurst, ensured that common sense prevailed. In retrospect, I think we achieved some useful reforms, of the format of the Society's meetings, our journals, management of our financial reserves, and the structure of the Council itself. Perhaps the most important investment for the future is the support SGM offers to young microbiologists, and the best infection that we can transmit is enthusiasm.

Due acknowledgement

I am most grateful to the three groups of people who have ensured and continue to promote the success of the Society. First, there are the staff at our headquarters, Marlborough House, who provide the day-to-day running of the Society's affairs with quiet and competent professionalism. Conferences don't just happen, neither do journal issues automatically appear, company regulations have to be noted, and best charitable practice needs to be monitored. The Society offers advice nationally and internationally on all matters microbiological and seeks good relations with sister organizations, such as the student exchanges recently instituted with the Australian and American Societies.

Second, there is the important contribution of the members of Council that I have mentioned already. Last but not least, a much wider body of microbiologists give their time and wisdom to Society activities. One must thank all those who are willing to organize the various symposia and sessions that comprise our meetings, suggesting topics and speakers.



◀ Examples of Beatrix Potter's illustrations of lichens. Top. Classified as a crust fungus or Corticiaceae. Bottom. Classified as *Cladonia filiformis* or *pixidata*. These pencil and watercolour images date from December 1896. *Reproduced with permission of the Armitt Gallery, Museum and Library, Ambleside (www.thearmittcollection.com)*

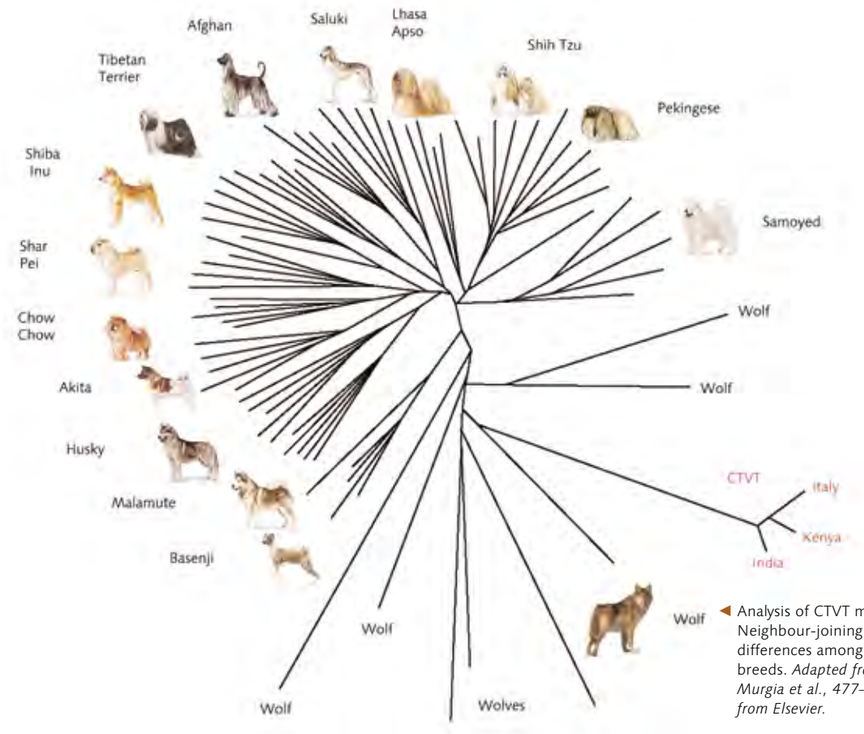
We must be equally grateful to editors and referees for upholding the high standards of our journals. It has truly been a most rewarding privilege to preside over the Society's affairs.

Women and microbiology

In my first column in *Microbiology Today* as President, I commented on the peculiar and rather shameful situation that the Society has only once elected a woman as President. Marjorie Stephenson was our second President, succeeding Alexander Fleming. She was a leading microbiologist and enzymologist who was one of the first two women to be elected a Fellow of the Royal Society in 1945 (the other was the chemist Kathleen Lonsdale). The Society's biennial eponymous Lecture commemorates her name. So it is a particular pleasure that 50 years later we finally have a second woman President. Hilary Lappin-Scott is an eminent microbiologist who has pioneered research into the bacterial communities we call biofilms. Moreover, Hilary has already served the Society with dedication and distinction in a number of roles, most recently as Scientific Meetings Officer, and her leadership led to the successful re-organization of our lively conferences.

Among the best known fictional companion animals are Beatrix Potter's Peter Rabbit, Jemima Puddle-Duck and friends who have been in print for more than 100 years. However, I didn't realize until Marilyn Roosinck told me at September's SGM Meeting that Beatrix Potter (1866–1943) was a distinguished microbiologist before she published her *Tales of Peter Rabbit*. She studied germination of fungal spores, and over 450 of her beautiful watercolour illustrations of lichens, fungi, and other natural history and archaeology subjects are now housed in the Armitt Collection, based in Ambleside, Cumbria. Until recently, it was thought that Potter supported Simon Schwendener's theory that lichens were symbiotic forms of fungi and algae, but she actually rejected dualism. Her uncle, the chemist Sir Henry Roscoe, encouraged her mycological investigations and helped her to obtain a student pass at the Royal Botanic Gardens at Kew where William Massee was the Keeper of Fungi. In 1897, Potter's paper on spore germination was read to the Linnean Society by Massee because women were refused attendance. But it is worth recalling that papers were often communicated by non-authors, including the papers in 1858 postulating evolution by natural selection by Charles Darwin and by Alfred Russel Wallace.

Beatrix Potter continued microbial illustration until 1902 when the success of her books preoccupied her. I suppose that while the world was deprived of the benefit of her further mycological studies, as few women became professional scientists at the time, we gained the wonderful tales of



◀ Analysis of CTVT microsatellite DNA. Neighbour-joining tree based on pairwise differences among wolves and 'old' dog breeds. *Adapted from Cell (2006), 126, Murgia et al., 477–487, with permission from Elsevier.*

Peter Rabbit and companions. Yet even in the field of publishing children's stories, Beatrix Potter faced a struggle. Like J. K. Rowling's *Harry Potter* nearly a century later, she had to tout her tales to nine publishers before Frederick Warne accepted them. I might reflect upon this next time a journal rejects one of my papers! Beatrix Potter stopped writing animal stories in 1918 and turned to sheep farming and environmental conservation in the Lake District. She managed large tracts for the National Trust in the 1930s and bequeathed all her farms and land to the Trust, which constituted the largest ever gift at that time. Clearly, she was a far-sighted and resourceful woman.

A shaggy dog story

I shall end with an anecdote about a most extraordinary 'microbe' causing a disease of companion animals. It was unravelled by Claudio Murgia when he was a research student in my laboratory. The disease is canine transmissible venereal tumour (CTVT) which was first described by the Russian veterinarian, Mstislav A. Novinsky, in 1876. For many years in the late 19th and early 20th centuries, CTVT was a model tumour in cancer research because it was transplantable from dog to dog, and even to other canine species. Experimental transfer of this tumour was a unique phenomenon before the establishment of inbred strains of rats and mice in the 1920s. Suspicion grew from chromosome studies in the 1970s and the discovery of a unique LINE-1 insertion in 1987 that the transmissible agent was not an oncogenic virus or bacterium, but was none other than the tumour cell itself. We decided to check out this notion using modern forensic DNA markers. We collected CTVT specimens from dogs in five continents and demonstrated that all tumours represent a single cell clone. The most recent common ancestor of the extant tumours appears to date from about 1,000 years ago. We analysed the relationship of CTVT's microsatellites to 85 breeds of dog and found that it probably originated from a grey wolf rather than its domesticated, companionable host in which it now spreads.

Our findings on CTVT raise a number of intriguing questions. This tumour represents the oldest known somatic cell lineage in mammals. How can a host cell emerge as a transmissible eukaryotic microbe which parasitizes its own host species? How does it cross the major histocompatibility barrier to spread among outbred dogs throughout the world? Has the tumour lost non-essential genes during its evolution to become a parasite, for example, the thousands of 7-transmembrane receptor genes that a whole dog needs to maintain its sense of smell? And why haven't somatic cells of other species evolved to become transmissible parasites? In fact, another example has recently emerged, a tumour of the marsupial carnivore, the Tasmanian devil. This tumour is spread via biting rather than sexually, and it now threatens the survival of an already endangered species, for the devil is certainly not a companion animal.

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Acknowledgement

I am grateful to the biographer Dr Linda Lear for information about Beatrix Potter.

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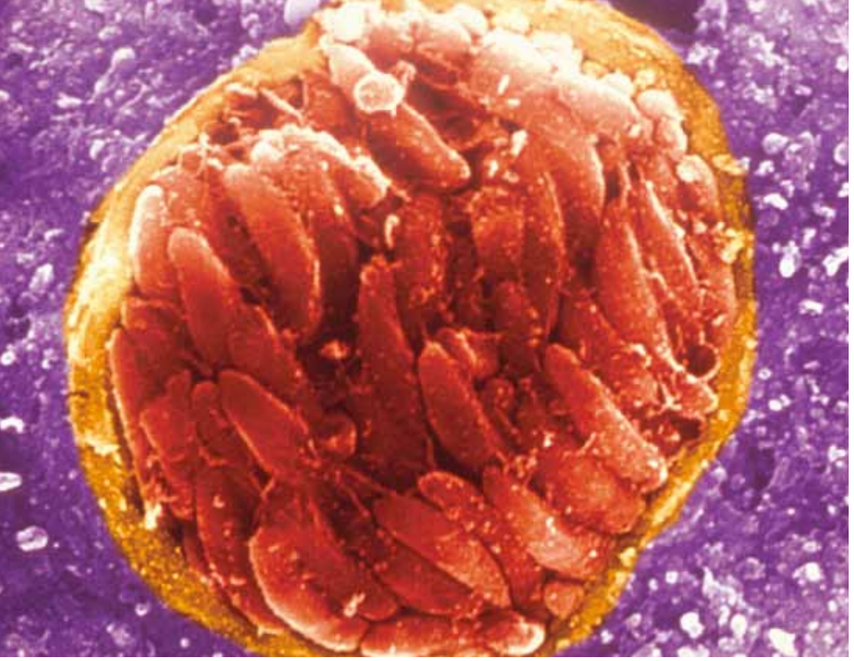
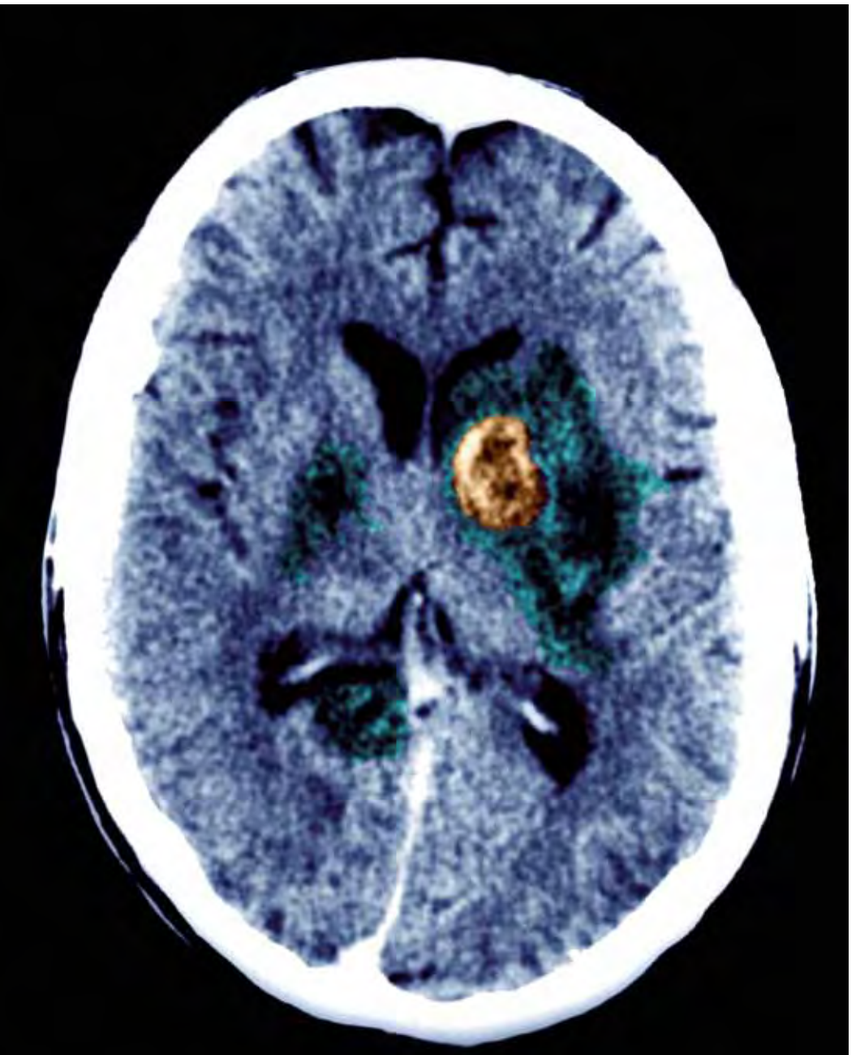




Toxoplasma gondii (Fig. 1) is a protozoan parasite that can be transmitted directly from cats to humans through faecal contamination of food, or indirectly from cats to livestock and then to humans through undercooked meat. Around 30% of humans in the United Kingdom are infected, and as such, harbour dormant cysts in their brain, but few have overt symptoms of disease. Neurological disease can occur in these people if they become immunosuppressed (Fig. 2). The possibility that apparently healthy people with infection are more likely to develop psychiatric disease, including schizophrenia and depression, is under investigation. Infection during pregnancy can cause abortion or foetal infection. Congenital disease can result in systemic, neurological and progressive eye disease. No vaccine exists for prevention of infection or disease and current drug treatments are not entirely effective.

100 years of *T. gondii* research

T. gondii (Fig. 1) was discovered about 100 years ago in a rodent in North Africa by Nicolle and Manceaux, and later the same year in Brazil as an infection in a rabbit by Splendore. The protozoan was initially thought to be a new species of *Leishmania* (originally *Leishmania gondii*, but it was soon realized to be an entirely new entity). Its name was derived from the Greek words *toxon* (bow- or crescent-shaped) and *plasma* (cell). Studies into the morphology of *T. gondii* by electron microscopy began in the 1950s, and the complete life cycle with the identification of the feline family as the definitive host was only elucidated in the 1960s. Hutchison and his team from the University of Strathclyde in Glasgow played a crucial role in the discovery of the sexual cycle occurring in the intestinal tissue of the cat. Since then, *T. gondii* has become a model parasite to dissect host–pathogen relationships and the immune system.

▲ Fig. 1. A cyst containing tachyzoites bradyzoites of *T. gondii*. *F.L. Henriquez*

◀ Fig. 2. Coloured computed tomography (CT) scan of the brain of an AIDS patient with toxoplasmosis (orange area). *Sovereign, ISM / Science Photo Library*

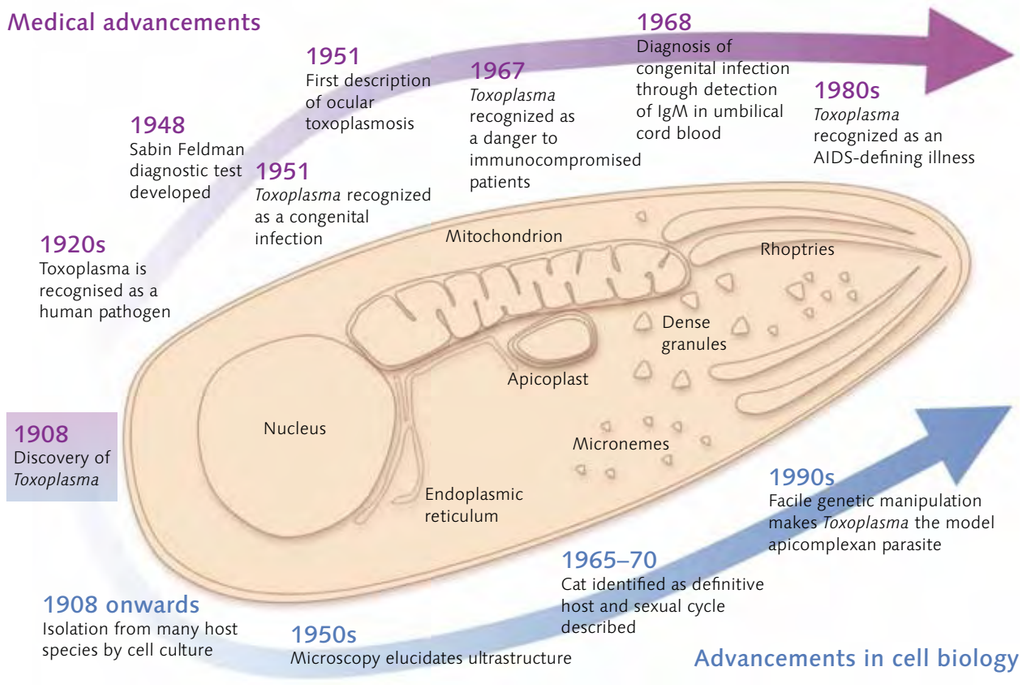
T. gondii was recognized as a human pathogen in the early 1920s. Initial observations could not identify the parasite, but in 1939 the first cases of human toxoplasmosis were described. In the same year, Albert Sabin isolated *T. gondii* from two patients, one of which was the virulent type I RH strain, named after the patient's initials and used in many laboratories worldwide to this day. Sabin and Harry Feldman developed a serological test in 1948, advancing diagnosis in humans dramatically. The severity of the disease during pregnancy was recognized in the early 1950s, with a detailed account of fatal toxoplasmosis cases in infants with hydrocephalus. Studies into congenital transmission elucidated that mother seroconversion during each trimester impacts on the severity of foetal infection, with primary infection during the first two trimesters the most damaging. Until the late 1960s, the diagnosis of congenital infection depended on seroconversion of the mother, but IgM detection in the umbilical cord greatly improved the diagnosis of congenital toxoplasmosis. Congenital disease is usually associated with post-natal brain disorders and ocular toxoplasmosis. The recognition of ocular toxoplasmosis, as a result of adult-acquired infection, was described by Reiger in 1951. The danger of *T. gondii* infection in immunocompromised patients was described in the late 1960s, but it was not until the 1980s that reactivation of toxoplasmosis was seen as critical if not treated in immunocompromised patients with chronic HIV infection (Fig. 3).

Epidemiology

The incidence of *T. gondii* infection varies considerably in humans according to geographical region. In the UK, the incidence has been reported as around 30%. In contrast, it is significantly greater in other European countries (e.g. France, 80%; Austria, 50%). In these countries, antenatal screening is compulsory and in recent years a decrease in cases has been reported. High incidence in certain European countries has been attributed to differences in food preparation with the increased risk being thought to be due to eating

A century of *Toxoplasma gondii* research

Cats are the main source of the parasite *Toxoplasma gondii* which infects many people but rarely causes disease. **Fiona L. Henriquez** and **Craig W. Roberts** describe the harmful effects of toxoplasmosis on the unlucky few and the latest scientific research into this fascinating microbe.



▲ Fig. 3. A century of *Toxoplasma* research. *F. L. Henriquez*

undercooked meat. In spite of the high level of infection in adults in some European countries, the occurrence of clinical disease is generally not perceived as a significant problem. This is at least partially due to the relatively avirulent nature of the strains of *T. gondii* causing infection in Europe. However, the general increased exposure in these countries poses a greater risk to expectant mothers and their foetuses. This is borne out by the statistics for congenital infection, which is reported as 1 in 2,000 births in Scotland, but as high as 1 in 500 births in France. Atypical and/or recombinant strains of *T. gondii* are associated with significant disease manifestations, including pulmonary involvement, splenomegaly and ocular disease in a number of non-European countries, most notably Brazil.

Disease

Disease outcome is dependent on a number of factors, including host genetics and immune status, parasite strain and mode of transmission. *T. gondii* infection in the immune-competent host is generally not seen as a major problem. Mild 'flu-like symptoms are experienced at the onset of infection which coincide with the presence of the rapidly dividing tachyzoite form of the parasite. As the immune system controls the tachyzoite stage, the parasite transforms to the bradyzoite form that encysts in various tissues throughout the body, predominantly in the brain (Fig. 2). These tissue cysts, in spite of being long-lived, are generally not perceived to cause overt disease. However, data are emerging that the cysts might contribute to psychiatric disease, including schizophrenia and depression. More subtle effects have been reported in humans, including reduced reaction times and personality changes.

Immunocompromised people, such as those infected with HIV or undergoing immunosuppressive therapy, who are infected with *T. gondii* can develop severe systemic, ocular or most commonly neurological disease. This can be due to reactivation of a chronic infection or due to a newly acquired infection.

The severity of congenital infection varies according to several factors, including time in gestation at which infection occurs, parasite strain and most probably host genetics. Foetuses infected early in gestation tend to be severely affected with overt neurological and ocular involvement at birth, whereas those infected late in gestation may not exhibit disease at birth. Essentially, all of these individuals will develop ocular lesions at some point in their life, usually during puberty. Again, the long-term management of these people is difficult due to the previously mentioned limitations in current chemotherapeutics.

Eukaryotic microbe dependent on 'prokaryotic' biochemical processes

T. gondii is a eukaryotic pathogen that has been shaped through endosymbiotic events and evolution into a 'mosaic' made up of multiple components and processes derived from eukaryotic and prokaryotic organisms. Thus in addition to the commonly found mitochondrion (derived from an alphaproteobacterial endosymbiont), *T. gondii* has an apicoplast organelle, which was obtained through secondary endosymbiosis, most probably of a red alga. Consequently, *T. gondii* has a number of biochemical processes normally found in plants and or prokaryotes, including type II fatty acid biosynthesis, isoprenoid biosynthesis and haem biosynthesis. As these are generally absent, or evolutionarily distinct from the mammalian host, they have received a great deal of interest as potential antimicrobial targets. In addition, a number of drugs with known efficacy against *T. gondii* are now known to target prokaryote-like targets within the parasite. For example, drugs such as ciprofloxin, clindamycin and spiramycin target prokaryotic DNA replication.

Model apicomplexan and a tool to understand other important related pathogens

T. gondii is evolutionarily related to a number of other important human pathogens including *Cryptosporidium* and *Plasmodium* (the parasite that causes malaria). *T. gondii* has proved to be one of the most tractable organisms to study and has consequently shed light on these related pathogens. It has sometimes been used as a surrogate experimental system. The *T. gondii* research community has also developed some systems that have been directly applied to, or altered to work in other pathogen experimental systems. Thus it is now possible to perform targeted gene deletion, episomal expression, and inducible gene knock-down, and produce parasites containing reporter constructs, such as green fluorescent protein (GFP).

Immunological lessons

The immune response to *T. gondii* is complex and multifaceted. The organism has several pathogen-associated molecular patterns (PAMPS) that interact with Toll-like receptors (TLRs) in the mammalian host to initiate an rapid immune response by innate immune cells, such as dendritic cells and macrophages. IL-12 produced by these cells stimulates natural killer (NK) cells to produce IFNγ which in turn acts on infected cells to kill parasites through the induction of reactive nitrogen intermediates, or restrict their growth through selective depletion of tryptophan, which is required by the parasite. These initial interactions control parasite replication, but are not sufficient to provide complete protection – for this, T cell activation and expansion are required. T1 helper cells, which also provide IFNγ, and cytolytic CD8 T cells, which can specifically recognize and kill infected cells, play an important role in mediating long-term immunity. Antibodies might also have a minor role in preventing invasion of the host cell.

Current treatments and future prospects

Most people receive antifolate therapy which normally comprises a combination of pyrimethamine and sulphadiazine. This is usually administered with folinic acid to reduce bone marrow toxicity. Several other therapies have been used, but none of these are able to eliminate the cystic stages. Targeting the 'prokaryotic' processes mentioned previously may offer better drugs.

Vaccine prospects

A vaccine has been sought for many years. Not surprisingly, studies have been technology-dependent (and arguably driven). Early studies used killed or homogenized parasites, or attempted attenuation. This was followed by crude extracts and then ever-increasingly enriched or purified parasite components. The advent of recombinant DNA technology allowed parasite proteins to be expressed and tested in experimental systems. Ultimately, synthetic peptides were tested in some systems. During this time, when technology allowed progressively more defined and pure antigenic components to be produced, it was noted that immunogenicity was markedly reduced. To some degree this instigated vaccine adjuvant research, but also encouraged people to contemplate viral delivery systems, naked DNA vaccination or a return to parasite attenuation. Notably, a tissue culture attenuated strain of *T. gondii* (S48) has been used as a commercial vaccine for livestock. Although such a vaccine would never be used in humans, a defined, rationally attenuated parasite produced through gene deletion techniques, resulting in auxotrophic mutants, has been very successful in murine models of infection.

Looking to the future, vaccine prospects for humans are improving. Specifically, now the *T. gondii* genome is essentially fully sequenced, and all potential antigenic peptides are 'known' and available to study. This information combined with ever more sophisticated predicative algorithms capable of predicting T cell epitopes and their interaction with various MHC alleles may allow a return to synthetic peptide vaccines with modern potent vaccine adjuvants. The challenge will be to produce a vaccine that copes with the polymorphisms in human MHC molecules at a population level and polymorphisms evident in antigenic epitopes of the different strains of *T. gondii*.

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Functional foods aren't just growing in popularity with health-conscious people. Prebiotics may also prove to be beneficial to our pets, according to **Bob Rastall**.

Prebiotics for pets

Functional foods to improve human health are increasing in popularity with more and more products in the supermarkets. The science behind their development is also accumulating rapidly. One of the most important areas of application of functional foods in humans is gut health. Gut disorders are a very common cause of visits to the GP. The success of such products for human nutrition has inevitably led to them being considered for application in companion animals, most commonly in dogs, but with some developing interest in cats and fish.

Probiotics vs prebiotics

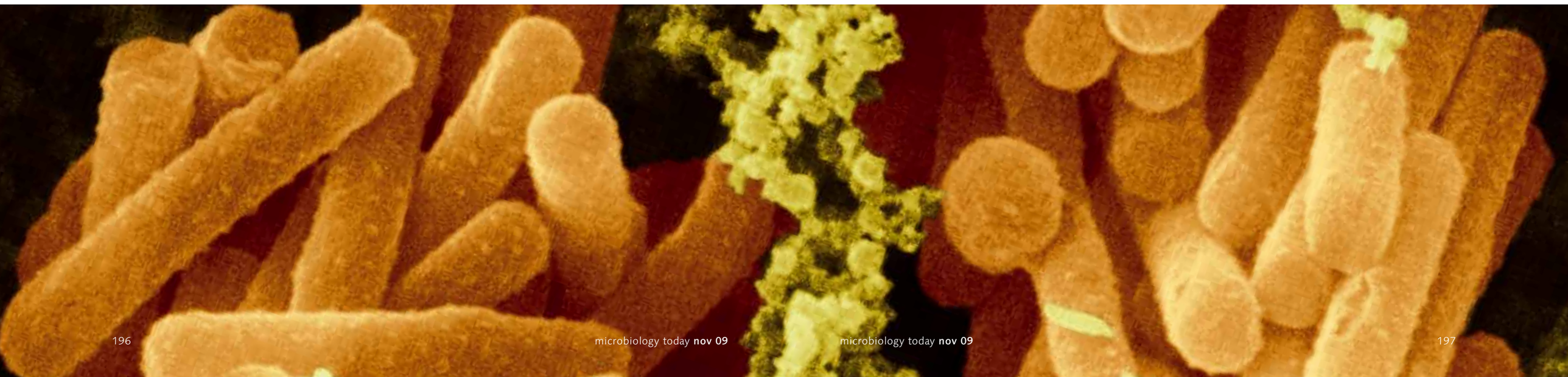
Traditionally, human functional foods for gut health have been based on the probiotic concept. Probiotics are live bacterial supplements or food ingredients which, when taken in sufficient numbers, confer health benefits to the host. There are very many well-designed studies showing positive effects with probiotics, although some have not shown an effect. Probiotics have also been applied to pets, and bacterial species from the lactobacilli, bifidobacteria and enterococci are finding their way into pet foods. One big disadvantage with probiotics, however, is the need to keep the organisms viable in order to produce the full range of potential benefits. This is overcome in the human food industry by the use of chilled, usually dairy, products as delivery vehicles, an approach that is not very practical for pet food.

Prebiotics are an alternative to the use of probiotics which is gaining currency at the moment. The concept of prebiotics was originally described in 1995, and they have recently been redefined by the International Scientific Association of Probiotics and Prebiotics as follows: '*A dietary prebiotic is a selectively fermented ingredient that results in specific changes, in the composition and/or activity of the gastrointestinal microbiota, thus conferring benefit(s) upon host health*'. The stress on the words dietary and gastrointestinal is to facilitate the use of the term, with a suitably modified wording for extra-intestinal application. To date, all known prebiotics are carbohydrates. They have the great advantage of being resistant to processing in cooked food products – a particular advantage to the pet food industry. The most common prebiotics are the inulin, derived from chicory, and fructo-oligosaccharides (FOS), derived from inulin by hydrolysis or from sucrose by synthesis. Galacto-oligosaccharides (GOS) made from lactose are also prebiotic and mainly used in formula infant foods.

The most important attribute of a prebiotic is that it is selectively fermented by certain members of the gastrointestinal microbiota which are regarded as having health-positive attributes. Most attention so far has been on increasing the population levels of bifidobacteria and lactobacilli, and on increasing the levels of short-chain fatty acids at the expense of phenolic toxins and genotoxic compounds and enzymes which may predispose towards development of gastrointestinal cancers. Inhibition of exogenous pathogens is a frequent target *in vitro*, but this is very difficult to demonstrate in humans or animals.

▶ *Where's my prebiotic snack? … Photos.com / Jupiter Images*

▼ *Lactobacillus bulgaricus* in yoghurt. *Scimat / Science Photo Library*



▲ Dry cat food. *Stockxpert / Jupiter Images*

▼ *… I've got it! Stockxpert / Jupiter Images*

Cats and dogs

Although giving prebiotics to companion animals such as dogs and cats is being proposed, there is some concern over the basis for applying the concept in non-human species. The problem is that we actually know very little of the functional ecology of the gut microbiota in companion animals. Are bifidobacteria and lactobacilli health-positive in the context of dogs and cats?

Most studies on the gut microbiota of such species have been carried out using traditional culture-based methods with selective media which are known to be inadequate for enumeration of bacteria from such complex ecosystems. Molecular microbiological methods are giving us a much more reliable picture of the gut microbiota of dogs and cats. Results of studies using techniques such as denaturing gradient gel electrophoresis (DGGE) and clone libraries have shown that the major taxonomic groups in the gut microbiota of canines are *Clostridiales*, *Fusobacteriales*, *Bacteroidales*, *Enterobacteriales* and *Lactobacillales*. In cats the major groups are *Clostridiales*, *Lactobacillales*, *Bacteroidales*, *Campylobacterales*, *Actinomycetales* and *Fusobacteriales*.

Whilst lactobacilli have been found in the guts of these companion animals, their function is unknown. There is a much bigger question over the status of bifidobacteria. These bacteria have been only inconsistently isolated from culture-based studies and inconsistently identified in molecular microbiological studies of canines. This suggests that, if they are indeed a normal member of the gut microbiota, they are present at or below the detection limits of the methods used.

The picture is even more inconsistent in felines. Many studies have failed to show bifidobacteria, but some have shown very high levels. Clearly, much more research is required to clarify the status of bifidobacteria in dogs and cats. These microbiota studies raise the question of what the target for prebiotic intervention should be in dogs and cats.

Studies on prebiotics in pets

Currently, most research and development utilizes prebiotics developed around the properties of the human colonic microbiota. The most widely studied prebiotic in pets is FOS. Many studies have shown that feeding FOS results in changes in the microbiota of dogs. The range of carbohydrates that are currently marketed as prebiotics for animal application includes some that are not considered to be prebiotics in humans. For example, manno-oligosaccharides (MOS), derived from yeast cell walls, are poorly supported as prebiotics by experimental data.

Many experiments on prebiotics in pets have looked at functional outcomes in terms of animal health and nutrition, such as immune function markers, nutrient digestibility, faecal and urinary nitrogen excretion, faecal short-chain fatty acid concentration (mainly acetate, propionate and butyrate) and elimination of pathogens. It has not been firmly established, however, that these effects are a result of prebiotic-induced modification of the gut microbiota, as in many cases these modifications were not characterized. However, the available data do support the effectiveness of FOS as a prebiotic in dogs with respect to outcomes of pathogen removal and immune status.

The few studies that have been carried out in cats have shown that FOS results in increases in bifidobacteria and lactobacilli with a decrease in clostridia, *Escherichia coli* and staphylococci. Faecal levels of putrefactive metabolites, such as phenol, indole and ammonia, decrease and short-chain fatty acids increase after prebiotic feeding. Studies have been rather small, involving few animals, and the health consequences of increasing saccharolytic bifidobacteria in a carnivorous animal is still open to question.

Whilst it is apparent that pet owners will pay for functional pet foods aimed at improving the gut health of their animals, there is a need for much more research on the health consequences and, perhaps, a rethink of what we mean by a prebiotic in companion animals.

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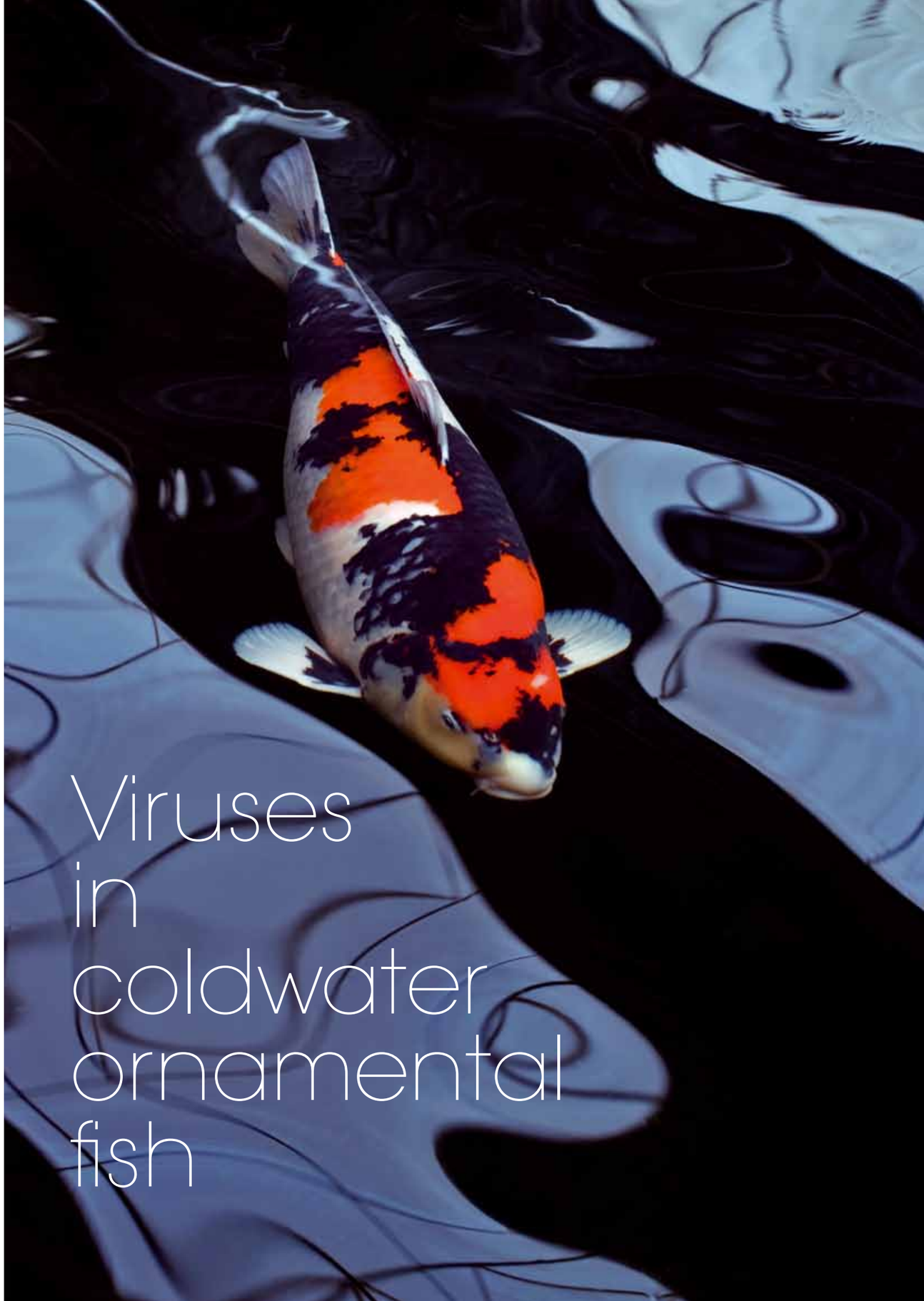
Viruses in coldwater ornamental fish

Keeping coldwater ornamental fish is very popular in the UK, but according to **Keith Way**, owners need to be aware of the wide range of virus diseases that can decimate their stock.

▲ Fig. 1. A carp displaying epidermal hyperplasia, typical of carp pox. *K. Way*



▶ An ornamental koi carp. *Stockxpert / Jupiter Images*

Coldwater and tropical ornamental fish are the third most popular pet in the UK after cats and dogs. The English Housing Survey in 2001 estimated that over 3 million homes owned ponds with the intent of attracting wildlife. The Ornamental Aquatic Trade Association (OATA) estimated in 2008 that 2.1 million households in the UK had a garden pond containing ornamental fish.

Koi carp (*Cyprinus carpio koi*) and goldfish (*Carassius auratus*) are the species most commonly kept in garden ponds and coldwater aquaria. Aquatic retail outlets sell and distribute a wide range of ornamental fish species, including many varieties of goldfish and ornamental varieties of carp, orfe (*Leuciscus idus*), tench (*Tinca tinca*) and grass carp (*Ctenopharygodon idella*).

Virus diseases

The first disease of fish to be described, later recognized to be caused by a virus, was carp pox. The existence of a pox affecting carp was documented by the famous medieval Swiss zoologist Konrad von Gessner as early as 1558. He named the condition 'Karpfenpocke' because the epidermal hyperplastic lesions bore some resemblance to smallpox, which was prevalent in the human population in Europe in the 16th century. The disease will be familiar to many hobbyists, which is seen as raised white or translucent patches on the skin of koi and common carp in winter and spring (Fig. 1). Carp pox, like chicken pox in humans, is caused by a herpesvirus. The presence of a virus was confirmed by electron microscopy in the 1960s, but was not isolated in cell culture until the 1980s.

With the discovery of non-filterable disease agents, or viruses, in the late 19th century there came a greater realization of the role that viruses may play in infectious diseases of fish. However, the breakthrough for fish virology came with the general developments in virological techniques that blossomed in the 1950s and 60s. In particular, visualization of viruses by electron microscopy, improvements in protein and nucleic acid analysis and, most significantly, the isolation of viruses on continuous (immortal) fish cell lines. At the same time, aquaculture around the world developed in the 1960s and 70s, and farming of fish and fish-keeping rapidly increased. With these developments and, more recently, the global increase in trade in ornamental fish there has been an increase in new diseases and the emergence of serious virus diseases.

Viruses that have caused serious but isolated disease outbreaks in cyprinid species and some ictalurid (catfish) species, and may affect coldwater ornamental fish, include aquareoviruses, coronaviruses, poxviruses and iridoviruses. More serious disease epidemics in ornamental species have been caused by rhabdoviruses and herpesviruses.

Fish rhabdoviruses

Viruses in the family *Rhabdoviridae*, genus *Vesiculovirus*, are bullet-shaped and enveloped, and contain single-stranded RNA. They affect a wide range of mainly freshwater fish species and cause an acute haemorrhagic disease.

There are two vesiculoviruses that are known to cause serious disease in cyprinids. Spring viraemia of carp (SVC; Fig. 2) in the past was known by several names including infectious ascites, infectious dropsy and rubella. The vesiculovirus causing the acute form of the disease (SVCV) was isolated in 1971, and the chronic form of the disease characterized by skin ulcers, caused primarily by the bacterium *Aeromonas salmonicida*, was renamed carp erythrodermatitis. Naturally occurring SVC infections have been reported from a number of cyprinid hosts, including common and koi carp, crucian carp (*Carassius carassius*), goldfish and grass carp.

Tench rhabdovirus (TenRV) is closely genetically related to SVCV and has been isolated from a number of cyprinid hosts, including species that are often kept as ornamental fish, such as tench, orfe and rudd (*Scardinius erythrophthalmus*). Both SVC and TenRV exhibit similar symptoms where fish appear darker in colour and may display exophthalmia (pop-eye), haemorrhages on the skin and base of the fins, pale gills and abdominal distension or dropsy.

The geographical range of SVC and TenRV was for many years limited to European countries that experience low water temperatures in winter. However, since 1998, Brazil, the USA and Canada have reported SVC disease outbreaks and the virus has been detected in carp in China. Some of the viruses isolated during these outbreaks have been shown to be a new genetic strain distinct from the European strain of SVC.

Cyprinid herpesviruses

Viruses in the family *Herpesviridae* are large, complex viruses containing linear double-stranded DNA. Most animal species are hosts to at least one herpesvirus – humans host nine herpesviruses, including viruses causing cold sores and chicken pox. Herpesviruses are also found in a number of fish species, including pike, catfish, walleye, sturgeon, salmon and turbot. Ornamental cyprinid species, such as koi and goldfish, are hosts to at least three herpesviruses, including carp pox (cyprinid herpesvirus 1, CyHV-1).

Cyprinid herpesvirus 2 (CyHV-2) causes a disease known as herpesviral haematopoietic necrosis (HVHN). This disease was first reported as the cause of epizootics in juvenile goldfish in Japan in 1992 and 1993, and reports followed of isolated cases, with similar disease aetiology and high mortality (50–100%), in the USA, Taiwan, Australia and the UK. Although not associated with large disease epidemics, CyHV-2 appears to be globally distributed and present at a high prevalence in cultured goldfish populations. The disease occurs when fish are subjected to stress and held at water temperatures permissive for virus replication.

Cyprinid herpesvirus 3 (CyHV-3) is the cause of koi herpesvirus disease (KHVD), a contagious and acute viraemia first seen in common and koi carp, and affecting other varieties such as mirror and ghost carp (*Cyprinus carpio goi*). The first serious disease epidemics were seen in 1998 and over the next 5 years the virus devastated carp populations in countries around the world. It is thought that infected carp surviving at low temperatures may be reservoirs of the virus, and international trade in ornamental carp has facilitated the rapid global spread of the disease.

Similar to CyHV-2, the disease signs associated with CyHV-3 infection are seen at water temperatures between 16 and 25 °C. Fish suffering from these diseases display signs of lethargy, anorexia and pale patches on the skin and gills. During CyHV-3 infections, signs also include marked enophthalmia (sunken eyes) and pale discolouration or reddening of the skin, which often has a rough texture. However, the most consistent changes are seen in the gills (Fig. 3), which may be swollen, discoloured, necrotic and covered in excess mucus. Internally, the fish may show very few disease signs, but during CyHV-2 infections the goldfish may be anaemic, the kidney enlarged and the spleen may display distinctive white nodules (Fig. 4).

Avoiding disease problems

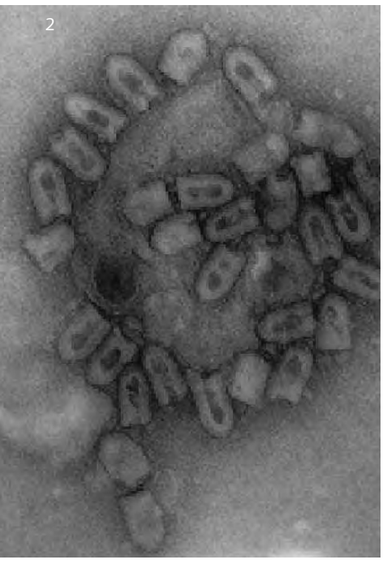
Disease outbreaks caused by aquatic viruses serve to remind the ornamental fish industry of the need for avoidance or prevention of disease through good hygiene and biosecurity practices. Poor fish transport conditions, rapid turnover of imported stock and lack of quarantine facilities all contribute to the spread of disease. No licensed antiviral vaccines are available for ornamental fish, and chemical and antibiotic treatments, used to treat bacterial, fungal and parasite infections, are ineffective. OATA advise hobbyists and retailers to adopt a biosecurity policy to reduce the risk of introducing and spreading disease. This includes buying fish from reliable sources with a known disease history, strict quarantine and hygiene measures, and effective water disinfection and sterilization.

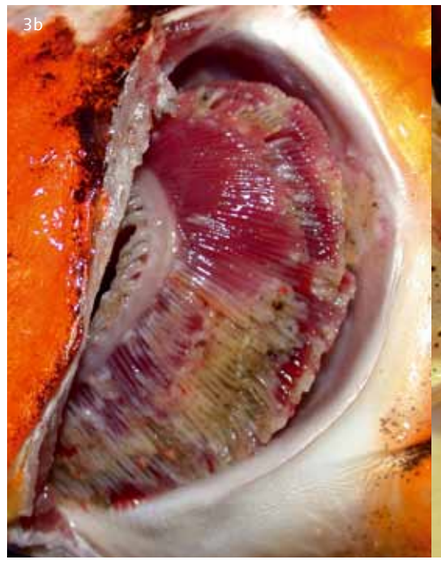
Healthy populations of ornamental fish are generally not threatened by virus diseases. The virus diseases described are mostly seen when environmental conditions change or other stress factors affect the fish. Outbreaks of viral disease are most often observed in fish recently introduced into a pond or retail facility and suffering from handling and transport stress. Fish under stress or at low water temperatures also experience suppression of their immune system. The poor physiological and immunological condition of fish undoubtedly contributes to the severity of disease outbreaks as has been shown in carp populations during SVC and KHV outbreaks.

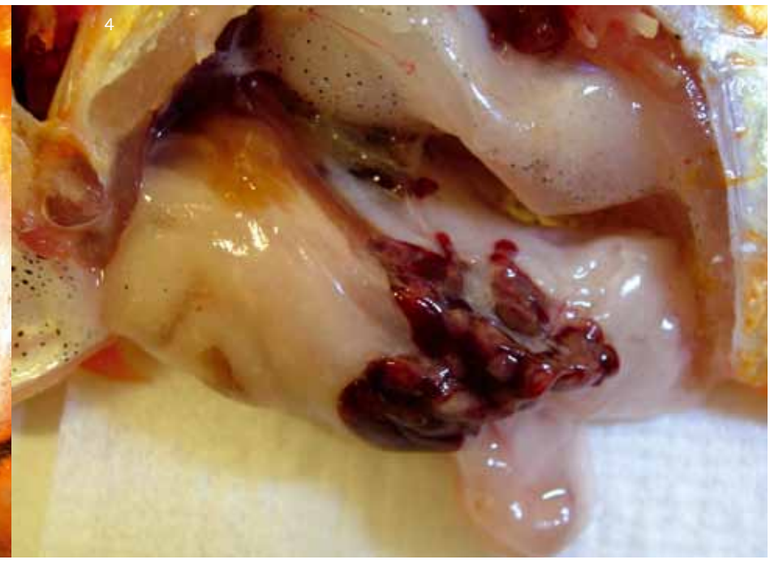
◀ Fig. 2. Electron micrograph of SVC rhabdovirus particles. *K. Way*

◀ Fig. 3. Gills of (a) a healthy koi carp, and (b) of a koi carp suffering from koi herpesvirus disease. *K. Way*

▼ Fig. 4. White nodules in the spleen of a goldfish suffering from herpesviral haematopoietic necrosis. *K. Way*







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Are our homes microbiologically safe for our pets?

We tend to think of domestic pets as potential sources of human infection, but **Charles Penn** asks if the animals are just as much at risk of disease from living with us.

◀ *Digital Vision / Jupiter Images*

Humans and their dog and cat companion animals have been closely associated for millennia, as the evidence for domestication of these species clearly shows. But how has the cost and benefit of this association worked out, not only for humans, but for the animals too? Microbiologically, we intuitively think of the animals with their irrational behaviour and sometimes outrageous habits of personal hygiene, as a potential hazard for the humans in their shared living environment. Sources of microbial hazards that can contaminate or enter the home through animal care and activity are many and varied. They include:

- the animal itself – excreta and other external secretions, respiratory and salivary (licking and washing the fur and skin, coprophagy and licking of perianal regions may significantly contaminate saliva)
- associated biota – internal parasites; associated arthropods such as fleas, and free-living insects like flies that may be attracted to the animal itself or to uncovered food
- the animal's food – often this is poorly controlled and may include table scraps or uneaten items which may or may not be fresh, spoiled food that has been stored too long to be attractive for human consumption, raw meat trimmings from food preparation, deliberately raw meat that may be thought 'more natural' for the animal, and dried 'chews' of, for example, unsterilized animal material carrying pathogens
- the external environment – muddy paws, perhaps from agricultural land with a liberal mix of faecal material from farm animals can quickly contaminate floors, furniture and surfaces
- contact with prey – for example, birds and rodents which may carry a wide range of pathogens potentially harmful to humans

Human infection from pets

Not surprisingly then, there is some level of public awareness (albeit not universally accepted!) of the risk of human infection in the home from companion animal sources. We are discouraged from allowing pets onto our soft furnishings and bedding, and especially onto surfaces where food is prepared. Indeed, there have been numerous studies investigating the role of pets as a possible source of infections in humans. Gastrointestinal infections are an obvious example, where household pets have been considered as possible sources of *Salmonella*, *Campylobacter* and pathogenic *Escherichia coli*, among others.

Less well known is that cold-blooded animal pets like snakes and turtles can carry pathogens, notably *Salmonellae*

of various kinds. One of the most bizarre mishaps has been a multi-state outbreak in the USA of *Salmonella enterica* Typhimurium arising from contaminated frozen vacuum-packed rodents supplied as feed for pet snakes! The reptiles, although not affected themselves by their carriage of the food poisoning pathogen, passed on the infection to their human handlers.

Are pets really a serious source of pathogens for people?

The underlying assumption in the great majority of these studies has been that the animal is the source of human infection, and if the same pathogen is found in both hosts the animal almost automatically gets the blame for passing it on to the human! But is this rational? Is it not possible that pet animals might equally be infected with pathogens emanating from ourselves, or acquired as a result of our uninformed practices in 'caring' for our pets?

Taking a step back, several issues have to be explored before these questions can be answered. Are healthy dogs and cats routinely carriers and sources of the zoonotic pathogens we fear? Or do they get sick as we do when infected, and perhaps cease to carry or shed these organisms when they recover? Can these pathogens be transiently excreted by pets after exposure to food or environmental or other sources?

The scientific literature on these topics is surprisingly sparse, and like any investigation of complex and variable phenomena in populations, different studies can give different answers and may be difficult to reconcile. Most authors agree that diarrhoeal disease in these animals attributable to organisms like *Salmonella* or *Campylobacter* is rare. This may be because they rarely have these organisms in their digestive tracts, or because they are generally not susceptible to disease when these organisms are present. First then, how commonly are these key pathogens present in cats and dogs? A simplistic generalization from the literature is that yes, a substantial number of pathogens can indeed be isolated from some cats and dogs when large numbers of animals are tested. However, this doesn't mean they are universally present, or that these pet animals represent an unacceptable hazard in the home.

A search of recent scientific literature suggests that at least in some circumstances, the presence of *Salmonella*, for example in dogs, is nowadays quite rare in a domestic setting. One large-scale study involved sampling faecal specimens every 2 months for a year. In dogs fed raw poultry meat, which is commonly contaminated with *Salmonella*, the isolation rate for the bacteria increased about eightfold, yet remained low at less than one isolation per dog per year of sampling.

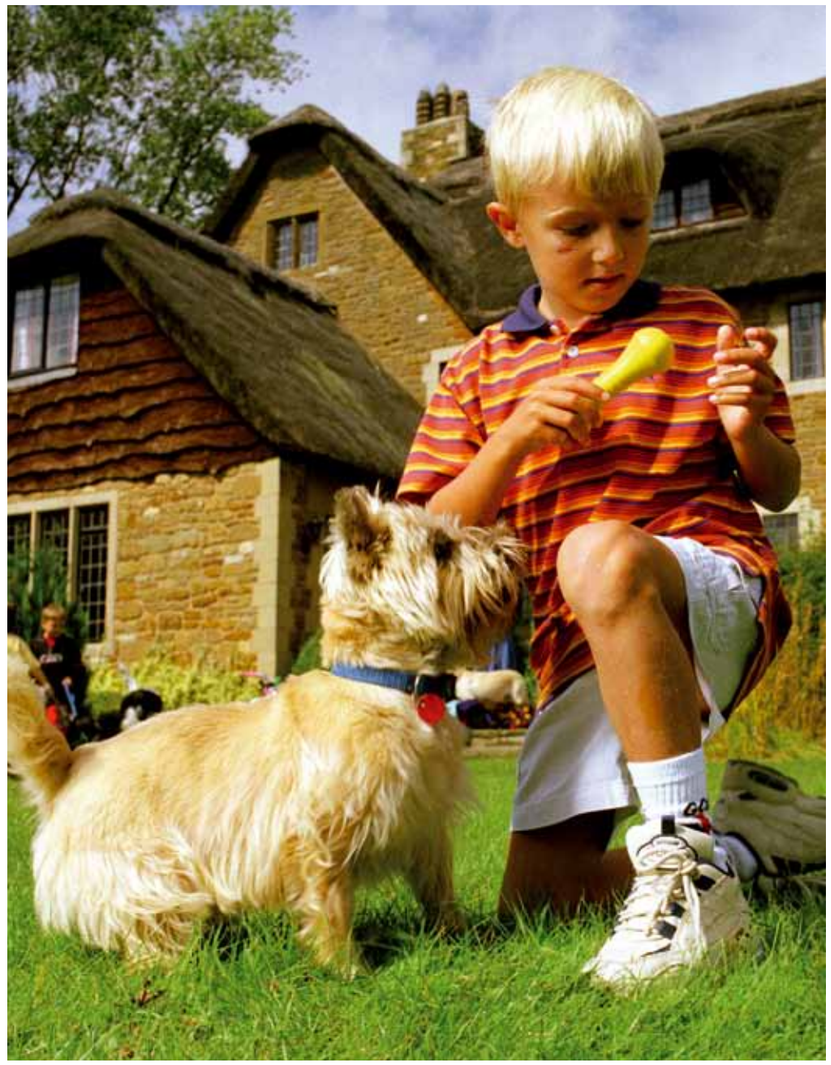
In soon-to-be published studies undertaken by Jenny Jennings at the WALTHAM Centre for Pet Nutrition in Leicestershire, faecal samples from substantial numbers of cats and dogs kept under semi-domestic conditions were tested for the presence of *Campylobacter jejuni*, the most frequent cause of bacterial diarrhoeal disease in the UK. Somewhat unexpectedly, this pathogenic species was rarely isolated, although a moderate number of animals did harbour the less pathogenic species *Campylobacter upsaliensis*, which is rarely associated with human disease.

The biter bitten?

A tentative conclusion then is that carriage of the more serious bacterial pathogens associated with intestinal disease in humans is uncommon in companion animals. Is there any evidence that these animals do acquire infections from their human hosts? Several studies do suggest that this is likely. While the available evidence suggests that intestinal carriage or on occasion intestinal disease in these animals is more likely to result from injudicious feeding than from direct human contact, the same conclusions cannot necessarily be drawn about, for example, respiratory infections. A recently described case of *Mycobacterium bovis* infection in both humans and a dog in the same household was highly suggestive of transmission from human to animal. So perhaps it is not unreasonable to keep an open mind about the direction of transmission of pathogens between humans and pet animals!

The key to future research

It is perhaps appropriate to end this article with a few words about an impending technical revolution in molecular biology which will open up new dimensions in knowledge of host-associated microbiota, particularly of the gastrointestinal tract. Until very recently, a comprehensive understanding of the complex microbial communities present in the nose, mouth, digestive tract, urogenital tract and body surfaces has been impossible, due to the immense technical difficulty of culturing, identifying and quantifying the micro-organisms present. Over the past couple of years, however, it has become possible to detect molecular 'signatures' from the DNA sequences of all the hundreds of species present, without the need to culture them individually. Furthermore, they can be quantified, over a range of abundances of many orders of magnitude, by simply counting the number of times a particular sequence is found when millions of sequence 'reads' are determined from samples of DNA derived and amplified from, for example, samples of faeces or dental plaque. This is made possible by the application of 'next generation' DNA sequencing technologies like pyrosequencing. As a result we can expect over the next few years to make huge leaps forward in dissecting the intricacies of not only pathogen detection and carriage, but the entire microbial ecosystem of host-associated microbiota.



▲ A pet female grey-banded kingsnake (*Lampropeltis alterna*). *Paul Hoskisson*

► Animals may pass infections on to us, but do we also pass our infections on to them? *WALTHAM Centre for Pet Nutrition*

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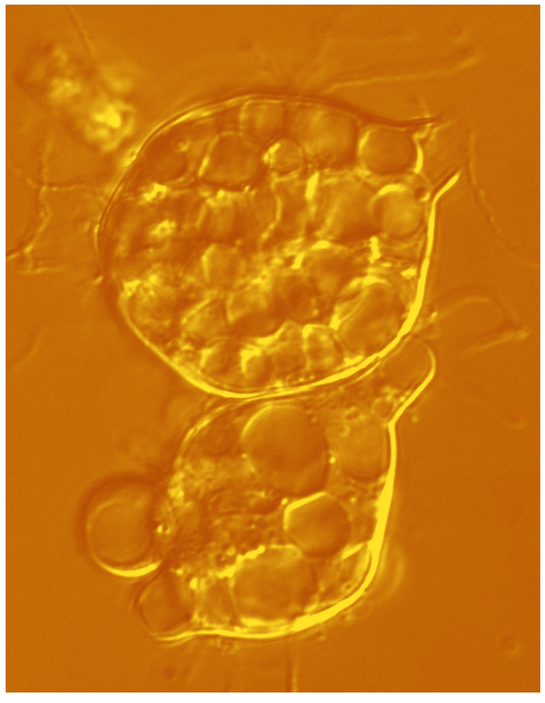
Amphibian species worldwide are being driven to extinction by an aquatic fungus. As **Matthew Fisher** explains, if control measures are not put in place, this pathogen could have a devastating effect on the biodiversity of amphibians.

▶ Top. A giant African bullfrog (*Pyxicephalus adspersus*). *M. Fisher*
▶ Bottom. The chytrid *Batrachochytrium dendrobatidis*. *Louise Walker/Neil Gow*

Disease-driven declines in global amphibian biodiversity



Amphibians became the most ancient class of land-dwelling vertebrates when, 360 million years ago, *Ichthyostega* first hauled itself onto what was then Greenland. Since then, the amphibia have diversified into over 6,300 species that not only settled all continents except Antarctica, but also survived the catastrophic extinction events that overwhelmed their sister group, the dinosaurs. However, longevity of species is no guarantee of their future success; modern-day amphibians are suffering rates of extinction that far exceed those of any other class of vertebrates, including mammals and birds. Nearly one-third of amphibian species are threatened.

The question of why amphibians are becoming extinct at these accelerated rates has puzzled scientists for three decades. While it is now clear that we are heading for a new anthropocene mass-extinction event as a consequence of human-driven planetary degradation, it has not been clear why this should be affecting amphibians more than other taxa. Further, many amphibian declines and extinctions were observed to occur in pristine environments that are relatively untouched by humans, such as rainforests and montane systems.

A clue to the mystery came about when scientists working in Central America noted that the declines in amphibian biodiversity appeared to be occurring in a wave-like manner, with the initial losses being observed in Costa Rica, then spreading southwards towards the Panama Canal at rates of up to 43 km per year. These patterns of decline were suggestive of an epidemic, spreading pathogen, and in 1997 an international team of scientists discovered a new organism that appeared to be associated with many previously 'enigmatic' amphibian extinctions in two regions: Central America and north-eastern Australia. In 1999, the mycologist Joyce Longcore formally described this organism as new species of aquatic fungus and named it *Batrachochytrium dendrobatidis* – a name that is usually abbreviated to *Bd* for obvious reasons!

So what is *Bd*?

We are most familiar with the fruiting fungi (the Basidiomycetes, such as the common mushroom *Agaricus*) and the moulds (the Ascomycetes like *Penicillium*). However, *Bd* is neither of these. This fungus belongs the chytrids – these are an ancient, basal lineage of fungi that tend to be aquatic with a motile, flagellate aquatic zoospore stage in their life-cycle. It is this zoospore that seeks, then infects amphibians by penetrating their skin and forming a zoosporangium. However, despite a decade of research on *Bd*, much of its biology remains a mystery and key questions still exist. When and where did *Bd* arise? How is *Bd* spreading across the world? How does the chytrid infect over 350 species of amphibians and why do only some manifest the disease, chytridiomycosis? What is the genetic basis underlying virulence in *Bd*? To answer such questions, researchers need to be able to 'discipline-hop' in order to draw together strands of information from disparate fields such as montane ecology through to 'omics

◀ Left. Testing a Mallorcan midwife toad (*Alytes muletensis*) for infection by *Bd*. *M. Fisher*

◀ Centre. A midwife toad (*Alytes obstetricans*). *Jaime Bosch*

◀ Right. Fieldworkers at an infected lake in the Pyrenees. *M. Fisher*

▼ Chytridiomycosis mortality in the Pyrenees. *M. Fisher*

and invasive-species biology in order to identify the major factors that are causing this emerging pathogen to drive collapses in amphibian biodiversity.

Bd genetics point to a single and recent origin of a panzootic lineage

Recently, the Joint Genome Institute and the Broad Institute have sequenced genomes of *Bd* from isolates recovered from two species of amphibian: *Phyllomedusa lemur* in Panama and *Rana muscosa* in California. These genomes have provided a scaffold upon which patterns of genetic diversity from isolates of *Bd* that have been recovered from infected amphibian populations across the globe can be aligned. Studies on these patterns of genetic diversity have provided a striking answer: *Bd* appears to have evolved once as the product of a single mating event between two closely related but non-identical parental strains. This lineage then appears to have become rapidly globalized into naïve amphibian communities, with the consequence that all isolates of *Bd* are extremely closely related, and show little phylogeographic relationship between patterns of genetic diversity and the regions from where isolates were recovered.

Does *Bd* come from 'Out of Africa'?

Several studies have focused on histopathological screens of museum collections of preserved amphibians in an effort to identify the original source of the infection. Currently, the earliest published record of *Bd* is from a specimen of an African clawed frog, *Xenopus laevis*, collected in 1938 from the Western Cape lowlands of South Africa. Other studies of historical collections of African amphibians have uncovered similarly early occurrences of *Bd*-infected amphibians from the 1920s and 1930s, showing that the pathogen had a widespread African distribution in the early half of the 20th century. Around this time, *Xenopus* was exported around the world in large numbers from South Africa for use in an early version of a human pregnancy test. This trade in clawed frogs would have potentially spread *Bd* widely as most clawed frogs in South Africa are infected by *Bd* (but do not die from the infection). As infected *Xenopus* release zoospores into their tank water, these zoospores could potentially transmit infection once the tank water is emptied into water supplies.

Overall, studies of archived amphibians have found the following continental sequence of detections: Africa (1938), North America (1961), Australia (1978), South America (Ecuador 1980), Central America (Mexico 1983), Europe (Spain 1997), Oceania (1999), and South-east Asia (2007). These broad-scale data, while suggestive of a globalization of *Bd* from an African origin, are not conclusive: museum collections tend to be very patchy in their sampling and many regions of the world remain unscreened, especially for the early years of the last century. Also, isolates of *Bd* from South Africa would be expected to harbour higher levels of genetic diversity than are seen in other parts of the world. This signature is not seen in the genetic data so, unfortunately, we still do not know where *Bd* originally emerged from!

Where is *Bd* going?

It is clear that *Bd* has the capability for inter-continental travel via the human trade in infected amphibians and, once introduced, has the potential to spread rapidly. This has been clearly demonstrated in Central America, where David Attenborough's BBC team filmed the extinction of the Panamanian golden frog in their series '*Life in Cold Blood*' following the arrival of *Bd* in the region. Introduced North American bullfrogs have vectored the infection into the UK, and the disease has 'jumped' into local populations of toads and newts in Kent. Ongoing projects with the Institute of Zoology, Imperial College and Natural England are attempting to determine whether the infection is spreading further in the UK, and what effect it may have on indigenous species of amphibians.

However, despite the global occurrence of Bd, the infection has not spread everywhere yet. With over 465 species, the island of Madagascar is the most amphibian-rich place on earth. Surveys have shown that *Bd* does not occur on the island, and the potential for *Bd* to extirpate this unique community has led to international calls for a high degree of biosecurity to be implemented to prevent the fungus from being accidentally introduced to the island.

Worldwide, teams of experts have formed to map the presence, and absence, of *Bd* in amphibian communities. This global mapping project for the disease can be viewed at **www.spatialepidemiology.net/bd-maps**

What can be done to stem this panzootic?

Once it was realized that the global amphibian trade was the most likely culprit for the spread of Bd worldwide, changes to international policy were sought to limit the spread of infection. The Aquatic Code has been developed by the World Organization for Animal Health (the WOAH; also known as the OIE) and lists infections that need to be tested for in animal imports. In 2008, *Bd* was listed by the WOAH, meaning that amphibians imported from a country known to have *Bd* must be certified free of infection.

However, while this legislation has the potential to limit the further spread of *Bd*, it does nothing to mitigate the infection in natural populations. This, much more difficult task, is currently a hot topic for scientists working on *Bd*. One solution is being tested on the Balearic island of Mallorca, where *Bd* has been introduced and infects populations of the highly endangered Mallorcan midwife toad, *Alytes muletensis*. Teams of researchers have been catching and treating all the tadpoles in infected populations, using the antifungal drug itraconazole, in an attempt to clear infection. If successful, this approach could be used to clear infection in small, isolated infected populations of amphibians.

Other approaches that are proving promising are the use of 'probiotic' bacteria that exist on the skin of some amphibians and secrete antifungal metabolites. These bacteria could potentially be introduced into infected communities in an effort to combat infection. However, many species of amphibians are declining at rates that preclude such approaches. For these species, *ex situ* captive-breeding programmes are the only option. Such 'Amphibian Arks' (www.amphibianark.org/) are likely to be the only places where much of the world's amphibian biodiversity is able to reside in the future until scientists can develop an effective method for clearing the infection from nature.

Matthew C. Fisher
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Further reading

Fisher, M.C., Garner, T.W.J. & Walker, S.F. (2009). The global emergence of *Batrachochytrium dendrobatidis* and amphibian chytridiomycosis in space, time and host. *Annu Rev Microbiol* **63**, 291–310.

The significance of zoonotic transmission of viruses in human disease

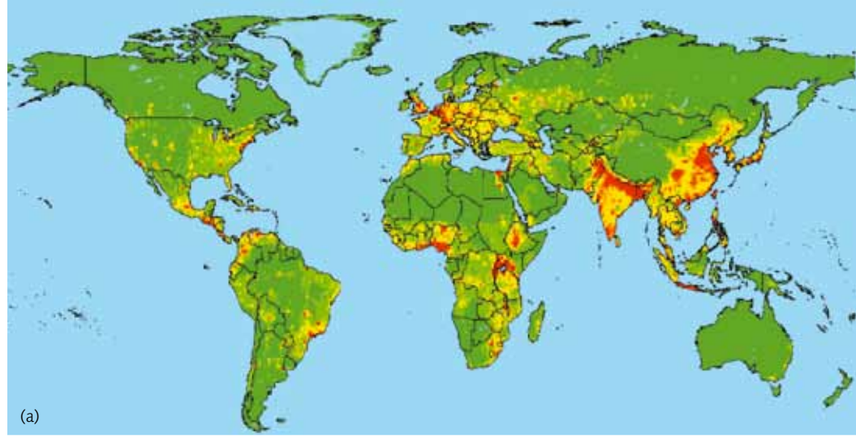
Most of the viral human infections and diseases which have emerged over the past 25 years have zoonotic transmissions as their origin (Table 1). Almost three-quarters of zoonotic transmissions are caused by pathogens of wildlife origin, mainly in the areas of sub-Saharan Africa, India and China, and to a lesser extent in North America and Europe (Fig. 1), and viruses comprise approximately 20% of all emerging infections. Zoonotic transmission is favoured by close contact between humans and animals, and insect vectors may be involved (Table 1).

Influenza

Influenza viruses of several human pandemics have been recognized as reassortants containing several genes from animal influenza viruses or as complete animal viruses. The 1957 H2N2 influenza virus ('Asian 'flu') and the 1968 H3N2 influenza virus ('Hong Kong 'flu') have picked up the viral haemagglutinin (HA) and several other genes from avian influenza viruses. On the other hand, analysis of the recently reconstructed H1N1 influenza virus that caused the 1918 pandemic ('Spanish 'flu') strongly suggested that it was an avian influenza virus which had been transmitted directly to humans. Similarly, the H5N1 influenza viruses causing small 'flu outbreaks in humans in Asia and Europe since 1997 are also completely of avian origin, most likely affecting people who raise and sell domestic birds for a living (Figs 2, 3).

The 2009 swine origin influenza A H1N1 virus (S-OIV) is itself a triple reassortant, arising from decades of circulation in pigs. Starting in Mexico, this virus spread to the US and Canada, then to Europe and elsewhere in 2009, and has now been declared the cause of a new pandemic by the World Health Organization (WHO).

Since the early days of modern virology animals have been recognized as real or potential reservoirs of viruses which can be transmitted to humans, as **Ulrich Desselberger** describes.



▲ Fig. 1. Global distribution of relative risk of an emerging infectious disease event caused by (a) zoonotic pathogens from wildlife, (b) zoonotic pathogens from non-wildlife. The linear scale ranges from green (lowest risk) via yellow to red (highest risk). *Adapted with permission of Macmillan Publishing Ltd from Jones, K.E.* et al., Nature *(2008),* ***451****, 990–994.*

▶ Fig. 2. Health authority workers attempting to prevent the spread of an avian 'flu outbreak in China. *Mike Clarke, AFP / Getty Images*

◀ Fig. 3. Poultry markets in China. *Peter Parks, AFP / Getty Images (left); China Photos / Getty Images (right)*

Table 1. Confirmed or probable zoonotic transmissions of viruses to humans

Year	Virus	Disease	Species	Transmission pathway	References
1918	Influenza A virus	Spanish 'flu	Birds?	Direct transmission of an avian influenza virus	Stevens *et al.*, *Science* 2004, **303**, 1866–1870
1957	Influenza A virus	Asian 'flu	Birds	Reassortment with avian influenza virus	Scholtissek *et al.*, *Virology* 1978, **87**, 13–20
1968	Influenza A virus	Hong Kong 'flu	Birds	Reassortment with avian influenza virus	Scholtissek *et al.*, *Virology* 1978, **87**, 13–20
1997	Influenza A virus	Avian 'flu	Goose?	Close contact in Hong Kong	Claas *et al.*, *Lancet* 1998, **351**, 472–477
2009	Influenza A virus	Swine 'flu	Swine	Close contact with animals in Mexico?	Shinde *et al.*, *N Engl J Med* 2009, **360**, 2616–2625; Zimmer & Burke, *N Engl J Med* 2009, **361**, 279–285
1931?	HIV-1	AIDS	Chimpanzee	Close contact, use as food	Gao *et al.*, *Nature* 1999, **397**, 436–441
1940?	HIV-2	AIDS	Sooty mangabey	Close contact	Chen *et al.*, *J Virol* 1997, **71**, 3953–3960
1976*ff*	Hantavirus a.o.	Haemorrhagic fever with renal syndrome (HFRS)	Rodents	Close contact with rodent excretions (aerosols)	Lee & van der Groen, *Prog Med Virol* 1989, **36**, 62–102
1993	Sin nombre virus (Bunyavirus)	Hantavirus pulmonary syndrome	Rodents	Close contact with rodent excretions (aerosols)	Nichol *et al.*, *Science* 1993, **262**, 914–917
1993*ff*	Rotavirus group A	Acute gastroenteritis	Cats, piglets, calves, rabbits	Close contact with animals	Das *et al.*, *Virology* 1993, **194**, 374–379; Matthijnssens *et al.*, *J Virol* 2006, **80**, 3801–3810; Steyer *et al.*, *J Gen Virol* 2008, **89**, 1690–1698
1994	Hendra virus (Paramyxovirus)	Acute respiratory distress syndrome; encephalitis	Fruit bats, horses	Close contact with horses	Murray *et al.*, *Science* 1995, **268**, 94–97
1999	Nipah virus (Paramyxovirus)	Severe respiratory disease; encephalitis	Fruit bats, pigs	Close contact with pigs	Chua *et al.*, *Lancet* 1999, **354**, 1257–1259
1999	West Nile Virus (Flavivirus)	Fever; encephalitis	Crows, horses	Close contact with animals; transmission by mosquitoes	Lanciotti *et al.*, *Science* 1999; **286**, 2333–2337
2002	SARS coronavirus	Severe acute respiratory distress syndrome	Palm civets?	Originating in China Close contact with animals?	Ksiazek *et al.*, *N Engl J Med* 2003, **348**, 1953–1966; Drosten *et al.*, *N Engl J Med* 2003, **348**, 1967–1976; Peiris *et al.*, *Lancet* 2003, **361**, 1319–1325; Kan *et al.*, *J Virol* 2005, **79**, 11892–11900

HIV

HIV-1 and HIV-2 (human immunodeficiency virus), members of the subfamily *Lentivirinae* of the *Retroviridae*, and the causative agents of AIDS, have been recognized as having originated from African monkeys: HIV-1 is closely related to the simian immunodeficiency virus of chimpanzees (SIVcpz), and HIV-2 to the SIV of sooty mangabeys (SIVsm).

Other viruses

Since 1976, Hantaviruses (of the family *Bunyaviridae*) have been recognized as being causally associated with outbreaks of haemorrhagic fever with renal syndrome (HFRS), a disease particularly prevalent among military personnel since the First World War. These viruses are endemic in rodents and voles, and are mainly transmitted by aerosols of rodent excreta.

In 1993, a severe pulmonary syndrome occurred in several south-western states of the US ('four border disease'), caused by zoonotic transmission of another Bunyavirus, Sin nombre virus, which is endemic in rodents and co-evolves with them.

During the late 1990s, Hendra and Nipah viruses, both viruses of the *Paramyxoviridae* family, were transmitted from fruit bats to horses, pigs and humans. The SARS coronavirus, producing severe respiratory disease in humans in 2003, is likely to have been transmitted from palm civets and spread from south-east Asia to Canada and Europe.

West Nile virus, affecting crows and horses, was transmitted by insect vectors to humans and caused outbreaks of febrile encephalitis in the USA since 1999. In 1999, an outbreak of human encephalitis occurred in the eastern USA which was also due to infection with West Nile virus, transmitted by mosquitoes from *Corvus* (crow) species where it circulates naturally.

Group A rotaviruses of animal origin have been recognized in rotaviruses isolated from children with acute gastroenteritis as donors of individual genome segments after reassortment events, or as whole animal viruses transmitted to humans.

Surveillance

The above are only the most prominent examples of transmission of whole animal viruses or of parts of their genomes to humans. Many other cases of such transmission events have been reported in the literature. The issue is big enough to expand the epidemiological surveillance of human viral pathogens to that of animal viruses which have been proven or have the potential to be transmitted to humans. Indeed, such surveillance programmes are increasingly recognized as being worth the effort, and have been established for major pathogens like retroviruses and influenza viruses (for example: **www.defra.gov.uk/animalh/diseases/notifiable/ai/wildbirds/survey.htm** and **www.defra.gov.uk/animalh/diseases/notifiable/ai/keptbirds/index.htm**).

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References

Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. & Daszak, P. (2008). Global trends in emerging infectious diseases. *Nature* **451**, 990–993.

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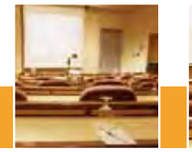
Wolfe, N.D., Dunavan, C.P. & Diamond, J. (2007). Origins of major human infectious diseases. *Nature* **447**, 279–283.

A full list of references is available upon request from the author.

conferences



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29 March–1 April 2010 www.sgmeicc2010.org.uk

Systems, Mechanisms and Micro-organisms

Top international speakers will consider current challenges and developments in a wide range of sessions related to the theme – and beyond.

PLUS – Virology: a packed programme of symposia, workshops and posters at this premier meeting of virologists in the UK.

Who should attend?

Anyone who wants to keep up to date with modern microbial science, no matter what their field or stage of their career. The conference will also provide a great opportunity for networking.

Where is it?

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Deadlines

Abstract submission 22 January 2010
Earlybird registration 26 February 2010

Systems & cells
- Signalling and systems biology
- Environmentally-induced morphogenesis
- Applications of 'omics
- Regulatory networks
- Small regulatory RNAs
- Gene function analysis

Clinical & Medical Microbiology
- Parasites and pathogens: how to hijack the host and evade the immune response
- STIs: now!
- Workshop for infection trainees: MRC Path and beyond
- Gut microbes and health: from molecular to metabolic impact
- Virus workshops: Epidemiology and modelling | Global challenges of virus infection

Environment
- Microbiology of oceans

Industry
- Renewables (*joint with Biological & Environmental Systems Group*)

Virology
- The 'omics revolution: elucidating the pathways of virus infection
- The global challenges of virus infection
- Workshops: Positive-stranded RNA viruses | Negative-stranded RNA viruses | DNA viruses | RNA viruses | Retroviruses | Epidemiology and modelling | Global challenges of virus infection
- Posters

SGM Prize Medal

Sir Paul Nurse, FRS: Prize Medal Symposium: *Controlling the Cell Cycle*

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Innovations in Microbiology Learning & Teaching (*joint event with HEA Centre for Bioscience*)
Infection trainees' workshop
Workshop for early career microbiologists: *Effective presentation skills*

Other highlights

- Prize Lectures
- Gala Dinner at the Dynamic Earth
- Poster sessions with drinks
- Trade exhibition

Autumn**10** | University of Nottingham

6–9 September 2010
www.sgmnottingham2010.org.uk

Metals and Microbes

Other**Events**

Regional Meeting jointly sponsored by SGM and SfAM

University of Birmingham, 7–8 January 2010
Genetics, Biochemistry and Molecular Biology of Archaea
Contact p.a.lund@bham.ac.uk

Irish**Division**

15–16 April 2010

National University of Ireland, Galway
New insights into molecular microbiology through the manipulation of protein structure and function
Organizer Gerard Wall (e gerard.wall@nuigalway.ie)

2–3 September 2010

University of Maynooth, Ireland
Insect-mediated microbial diseases of humans and animals: current problems and future threats
Organizer Kevin Kavanagh (e kevin.kavanagh@nuim.ie)

Spring 2011

Queen's University Belfast
Phages

Autumn 2011

University of Cork
Marine biotechnology

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

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Suggestions for topics for future symposia are always welcome.

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Abstracts

Titles and abstracts for all presentations must be submitted through the SGM website by the advertised deadlines. For further information contact the Administrator.

www.sgm.ac.uk/meetings

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Projecting microbiology

The SGM funds 10 Science Bursaries each year organized by the Nuffield Foundation. Students work alongside practising scientists to take part in microbiology-based projects, lasting 4–6 weeks, in universities, industry or research institutions during the summer holidays. **Rosy Halfyard**, a recipient of SGM support, found that her bursary opened up many doors.

Rosy Halfyard from the Cavendish School in Hertfordshire spent four weeks in Summer 2008 working at Bio Products Laboratory (BPL) in Elstree. She studied Biology, Chemistry and History for her A-levels and has gone on to do medicine at university. She presented her project as a finalist in the BA CREST awards at the Big Bang Fair in London and received the Intel ISEF prize, which involved travelling to Reno, USA, to attend the world's largest pre-university science competition, bringing together students from around the globe. Rosy was pleased to answer some questions about her experience.

Q How did you get involved with the Nuffield Bursary Scheme?

The leaflet was shown at my school, and I really liked the idea of having the opportunity to work in a real science setting. I was the first person at my school to have ever done a bursary so I was a little unsure as to what would be expected. I have always enjoyed science and wanted to see what working in a science setting would be like.

Q What were the aims of your project, and how did you go about achieving these?

I worked at Bio Products Laboratory (BPL) – a company that produces a wide range of medicinal products derived from blood plasma. All products are injected into the human body and therefore need to be of high sterile quality. I worked in the microbiology department on a project to determine a method for testing the disinfectants used in the production areas of BPL. The purpose of the project was to ensure BPL's use of disinfectants is both necessary and effective. If ineffective, it can be assumed that various classes of micro-organism would be found within production areas. I had to find a way to neutralize the disinfectants so that microbial growth could be obtained. I went about this by doing research on the disinfectants and micro-organisms being tested, and having meetings with my mentor to discuss my findings.

Q What did you learn most from your bursary experience?

I learnt so much from my bursary experience. It really opened my eyes to the processes and variety of jobs that are required in order for a medicinal product to be available in a hospital. My scientific knowledge and practical skills improved greatly, and I also got to experience life in a real scientific workplace.

Q How have you shared your bursary experience with others at school?

I've put up a display about my work and have also encouraged more students from my school to get involved with the scheme.

Q How did your bursary experience affect your future plans?

The Nuffield bursary determined that I want to work in science. Although I enjoyed the laboratory work, it showed me that I would prefer a job that was really people-based. However, I definitely want to be involved in research at some point in my career.

Q How does it feel to have won the Intel ISEF award at the Big Bang Fair?

I still cannot believe it! I really enjoyed explaining my work to the judges and public at the fair. I think winning was just a huge bonus! And I'm glad that the judges saw the importance of my project as well as the effort I had put into it. I'm really looking forward to going to Reno and being able to meet lots of new people, and to share my experience at BPL.

Since winning the Intel ISEF award, Rosy has received a letter of congratulations from her local MP.

The Nuffield Foundation are always looking for project supervisors and welcome enquiries from scientists willing to host a student in their laboratory.

Thanks to the Nuffield Foundation for permission to reproduce the content of this article.

Further information

www.nuffieldfoundation.org/go/grants/nsbsc/page_394.html

◀ *Image of Rosy courtesy Nuffield Foundation*

SGM at *Evolution East Midlands*

24 June saw Dariel Burdass and Janet Hurst of the External Relations Office in Nottingham, at the invitation of SGM member Gina Manning, running a workshop on hand hygiene for a group of enthusiastic post-16 school students. The event was part of the *Evolution East Midlands* conference, a day of lectures, workshops and poster displays aimed at promoting bioscience to pupils from nearly 20 schools from the local area. Sir Alec Jefferies, the inventor of DNA fingerprinting, was the keynote speaker, with Ben Valsler of *Naked Scientist* fame one of the supporting lecturers. Our workshop, which stressed the importance of good hand hygiene in preventing the spread of infections such as swine 'flu, proved popular, and we also gave away leaflets and posters during the lunch break. *Evolution East Midlands* took place at Biocity Nottingham, a bio-incubator founded by Nottingham Trent University (NTU), the University of Nottingham and East Midlands Development Agency which houses 60 companies in this fast-moving field.

Thanks to Gina Manning and her colleagues of NTU for inviting us to participate in a very enjoyable and worthwhile day.

▼ School students at the *Evolution East Midlands* workshop with Janet (2nd from left) and Dariel (2nd from right). *Integra Communications*

Review

The Good, the Bad & the Ugly: Microbes

Published by SGM 2009
68 pp. and CD
ISBN: 978-0-9536838-5-7

Far from a sterile read!

This is an absolutely tremendous book, which introduces the wonderful world of the very small but with beautiful big colour photographs. In this respect, *The Good, The Bad and The Ugly* is worlds apart from the majority of microbiology texts, which, for generations of editions, have failed dismally to make this subject compelling, either for specialists or for younger people who have yet to do their first Gram stain! The trap many competing books fall into is that they are either achingly over-detailed – and lose readers in a mire of microbial taxonomy – or, ironically, they're so sterile in the way they're written that readers' minds fall victim to the cognitive equivalent of a saprophyte that recycles interest elsewhere! That, or the content is so over-simplified that the reader is still left wondering what the difference is between a virus and a bacterium.

The presentation of *The Good, The Bad and The Ugly*, however, is captivating. The page size is large – A4 – and so is the text, which is succinct and clear. The book itself is short and condenses the microbial world into five punchy chapters. It opens by setting the microbiological stage with an introduction to the organisms that fall under the umbrella term 'microbe' and how we name and classify them. Then it's down the nearest human throat to find out how the body works both with and against the different elements of the microbial world before presenting some tantalizing morsels on the roles of microbes in food production and, less appetizing, food poisoning. The next chapter ventures into the great outdoors to explore how bacteria contribute to the carbon and nitrogen cycles, how they help to clean up sewage and the basics of bioremediation. The closing chapter is devoted to climate change and, true the title of the book, looks at how the microbial world can help and hinder in this process.

What I especially liked about this book was the nice smattering of history charting the key milestones and contributions of some of the big names, like Pasteur and Fleming, together with the use of additional 'factlet' boxes to emphasize the importance of some aspect of what was being presented. The whole thing is exceedingly well written and the use of images contrives to make the content into, quite literally, an infectious and engaging read. Some of the images are more decorative than factual, but if it stimulates a young person to keep reading that's hardly a problem.

Which brings me to the question of, at whom is this book aimed? Without doubt the target market is school children and the accompanying CD contains a host of materials that could be used in class to bolster the educational experience. But the overall level of the content is quite high and would certainly satisfy a GCSE and (these days) probably an A-level syllabus.

Slightly disappointing was the fact that the book under-emphasized the world of viruses which, whilst strictly not 'microbes', cause enough confusion amongst the general public to warrant more attention than they received. There are also some other points in the book that probably deserve more explicit coverage than they have been afforded. The section on antibiotic resistance is a bit weak, given its importance, and the issue of hospital superbugs is quite superficially covered, confining itself solely to MRSA. Likewise, the question of how life on Earth began received less than half a page.

But these relatively trivial points do not tarnish what is otherwise a sparkling book, which will definitely appeal to its target market and beyond. I'm a clinical lecturer in virology and I thoroughly enjoyed it (and learned a few things too!).

***Dr Chris Smith**, The Naked Scientists, Cambridge University (www.thenakedscientists.com)*

In brief

Measuring microbial growth

Advanced practical microbiology course for teachers and technicians
15 January 2010, University of Cardiff

Bookings are now being taken for this course. The cost is £75 per person to include lunch, refreshments and all course materials, but there is a discount of £15 per head for school members of the SGM. Contact Yvonne Taylor for details (e education@sgm.ac.uk)

MiSAC Competition 2010

Food Safety and Barbecues is the theme of this year's schools competition. Pupils are asked to produce a storyboard for a television advertisement describing how food poisoning can be prevented at barbecues through sufficient cooking and good hygiene.

The closing date is **19 February 2010**. Good cash prizes, sponsored by SfAM are up for grabs. Contact **education@sgm.ac.uk** to receive a flier and entry form.

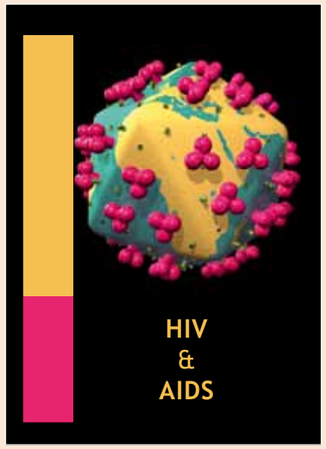
Influenza: a seasonal disease

This is the latest factfile to be compiled in the SGM education office. In eight brightly illustrated pages it covers the importance of the disease, the causal virus, how it is transmitted, how it replicates, symptoms of the infection, treatment and prevention (vaccines). Epidemics and pandemics, including swine 'flu, receive a two-page spread. Single copies are free (e education@sgm.ac.uk).

News for SGM School Corporate Members

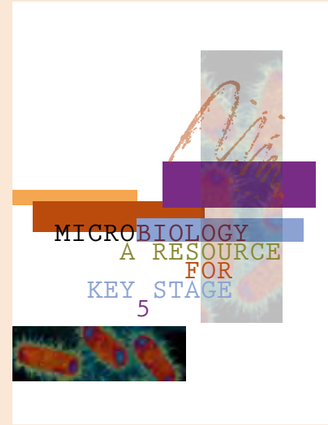
Free with this issue: HIV & AIDS resource

To mark World AIDS Day on 1 December 2009, a copy of this new 12-page full-colour resource is being distributed to all School Members of the SGM. It has been compiled by education office staff and takes a broad-ranging look at this devastating disease.



The resource clarifies the difference between HIV and AIDS, describes the virus, how it replicates and how it causes the disease. The stages of the infection are charted and transmission of HIV is explained, together with sections covering tests, treatments and work on developing an effective vaccine. The booklet also explores the origins of HIV.

New to this resource are some datasets for 2008 supplied by the United Nations that will enable students to consider the real facts about the global distribution of people living with HIV and the incidence of the disease.



Coming soon…

A factfile on *Superbugs*.

Renew your School Membership for 2010, to make sure that you don't miss out on this fascinating new resource.

The Annual Subscription for schools is still only a bargain £10.

Also in the pipeline: *Microbiology – A resource for Key Stage 5*

Sue (left) and Jo (right) at a meeting in Bergen, Norway. *Sue Assinder*

You say goodbye and I say hello

Two big players in SGM educational activities are swapping places. **Jo Verran** is taking over as Education and Public Affairs Officer on Council from **Sue Assinder**, who is assuming Jo's former job as Chair of the Education Division.

Sue Assinder writes:

One Monday morning 6 years ago, I had a telephone call from the then SGM President, Sir David Hopwood. It had been suggested to him by SGM Council that I might be an appropriate person to become the new Education Officer – would I be interested? My first reaction was that I already had enough challenges in my 'day job' given that I was just on the point of taking over as Head of School, so I delayed giving an answer until I'd sought advice from the current Head as to whether he thought I would have time. His view was very clear – *no, you won't have time, but don't let that stop you!* I took his advice and have not regretted it for one moment.

A few particular highlights come to mind. My involvement in the Microbiology Awareness Campaign led to me speaking at unexpected venues, including both Houses of Parliament. When I signed up for the role, I had certainly not expected to be educating peers of the realm about the properties of body glitter gel (as a model for rhinovirus in mucus, not for personal adornment). I have had enormous fun at public science events, seeing the fascination of young children when shown bioluminescent bacteria and their delight upon being presented with one of the famous SGM glo-bugs. I have been fortunate to go to several meetings of the American Society for Microbiology and to witness the international impact of the SGM in microbiology education. And underpinning all of these activities has been the pleasure of working with Janet Hurst and her staff to plan resources and events.

There have been many occasions in the past 6 years when working for the SGM has been an island of sanity in a sea of academic madness. It has been a period during which many microbiology departments have been restructured, microbiology degrees have become an endangered species and microbiology lecturers have struggled to maintain teaching quality in the face of RAE-itis. Throughout, SGM has maintained a commitment to promoting microbiology education at all levels, and it has been a privilege to be part of that endeavour. I hand over to Jo with sadness that my time is over, but with confidence that the role will be in safe hands.

Turning to the future, I look forward to taking over Jo's role as Chair of the Education & Training Division at a time when the SGM is aiming to embed education within its scientific meetings, rather than it being a bolt-on activity. The key will be to deliver an education programme that will be attractive both to members whose professional roles focus on teaching and also to those whose primary interests are in research.

Jo Verran gives her perspective:

I was elected to be Convener of the SGM Education & Training Group at the Norwich meeting in 2001. I was thrilled to be so actively involved with microbiology education. The Education Group hosted a symposium at every SGM meeting, with the committee members (many thanks to all!) enthusiastically running with their interests, or being nobbled, to develop and organize events on a range of topics as workshops, demonstrations, debates or in lectures.

The first meeting I organized was for over 200 postgraduates at Edinburgh; the last comprised a series of introductory talks on *Biofilm basics* in Dublin, which preceded the plenary. It was the largest audience an education event had ever had, and it was really exciting to wave the flag for microbiology education to almost all the conference delegates!

We have often run joint meetings with other SGM groups, providing updating and training in bioinformatics, microscopy and medical/dental student training, but have also hosted more overtly 'educational' events, showcasing innovative and successful approaches to learning (e.g. laboratory classes in virology, and e-learning).

It is hard to pinpoint particular highlights, but *Communicating microbiology* (Edinburgh 2008) attracted some really charismatic presenters, and the biofilm event was a bonus for me, since it linked both my research and teaching interests. The provision of a new annual award by Yakult for early career outreach work gave more evidence of the achievements of our group.

I've worked closely with Janet and the staff at Marlborough house, and am really grateful for their friendship, ideas and help. This relationship has enabled SGM to be involved in education events beyond the UK, particularly via FEMS, but also through ASMCUE (Conference on Undergraduate Education) meetings, and a joint conference with the Norwegian Microbiology societies in Bergen. Through my role, I have also had opportunities to impact on and contribute to microbiology education at national level, as a member of the team who produced the National Subject profile for higher education programmes in microbiology (2008) – Sue produced the final report.

It has been a privilege and a joy to have been involved with microbiology education via SGM, and I think there have been many beneficiaries of the work of the Education and Training Group – and now the Education Division. I am delighted to be able to pass on my role to Sue Assinder, and assume a new role as Education and Public Affairs Officer on Council.

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 **Jane Westwell** (e j.westwell@sgm.ac.uk).

Getting the most out of your SGM membership

SGM works hard to support early-career microbiologists by delivering a range of activities such as career development workshops and provision of careers information. Also, for eligible members registered for a PhD or working in the EU, there are generous grants to support travel to conferences and short research visits. **Jane Westwell** recently caught up with three SGM members who have made the most of their membership by successfully applying for grants.

Cate Reynolds, a PhD student at Imperial College London, was the first recipient of the Hayes–Burnet Travel Award which is a joint venture with the Australian Society for Microbiology (ASM). She was awarded £3,000 to fund travel and attendance at the ASM's annual conference followed by a 3-week research visit. She describes her experience.

The possibility of travelling to Australia in the name of microbiology caught my eye in one of the SGM's regular emails for two main reasons: the opportunity to travel to the other side of the world seemed like a fun idea, and I had very recently met Professor Julian Rood who works at Monash University in Melbourne on clostridial genetics. His laboratory's recent work on *Clostridium difficile* toxins, employing pioneering gene knock-out technology, had just been published in *Nature*, and the ability to make such targeted gene knock-outs would be very useful for my PhD research into surface proteins from *C. difficile*.

The grant asked for proposals for a laboratory-based project of 1–3 three weeks where techniques could be learned and collaboration fostered. The relationship between my home laboratory of Professor Neil Fairweather at Imperial College London and the Rood laboratory in Australia was probably typical of an Anglo–Australian link. Having both worked on clostridia for a large part of their careers, the two lab heads had met on numerous occasions at conferences and sometimes shared ideas via email and reagents via airmail, but there had been no direct collaboration and little in the way of personal contact between postdocs or PhD students in the two labs. This is primarily due to the geographical distance between the two countries, which makes meetings between the more junior scientists unlikely.

The Rood laboratory is one of the leading labs worldwide in the nascent field of genetic manipulation of *C. difficile*. Success is still technically very challenging, but is key to pushing forward our understanding of the molecular mechanisms underpinning the virulence of this pathogen. I therefore wrote a proposal to travel to Melbourne to see how *C. difficile* genes are knocked out down-under and to try to knock-out a gene of interest for my PhD.

I was delighted to receive the Hayes–Burnet Travel Award, and I travelled to Perth, Western Australia, for the ASM Annual Conference at the beginning of July 2009. Here I presented my work to a large audience as part of a plenary session, which was rather daunting but a great experience. I also enjoyed listening to many stimulating presentations from both Australian and international delegates.

After the conference I flew over two time zones to Melbourne where I spent 3 weeks at the Rood laboratory. The welcome was very warm both in the laboratory and in Melbourne itself. In the lab I gained a thorough insight into the challenges of creating *C. difficile* gene knock-outs and feel much better equipped to overcome them now that I am back in the UK. I was also stimulated to think about my PhD project from different angles. I feel that my visit created a link between our two laboratories that will greatly facilitate our ability to collaborate in the future.

Fortunately I didn't spend all my time in the lab though and made some great friends who I hope to keep in touch with both scientifically and personally. Being hosted by the locals meant that I could explore Melbourne with the very valuable addition of local knowledge! Overall the experience was amazing, I both had a great time in Australia and learned a lot. I would like to thank the SGM and the Australian Society for Microbiology for supporting my visit, as well as everyone at Monash University who made my visit so enjoyable. I wholeheartedly encourage PhD students to apply for the award in 2010 (*closing date: 12 February 2010*).

Heiko Ziebell completed a PhD in plant virology at the University of Cambridge where he also held a postdoctoral research fellowship. Heiko's research focused on the mechanisms underlying cross-protection of cucumber mosaic virus strains – a form of biological control. During his time at Cambridge, Heiko obtained funding twice from the (old and new) President's Fund and also a grant to attend an SGM conference.

I chose my PhD project because I found it fascinating. I was dealing with applied plant protection on the one hand, but also investigating the molecular mechanisms behind this control mechanism. I enjoyed both parts of science, the fundamental research and its practical application for growers. Afterwards, I was very lucky to be awarded a Research Fellowship at Trinity Hall in Cambridge. This enabled me to build on my PhD research and investigate a few more questions that had previously arisen.

The President's Fund awards made a substantial contribution to the success of my research. With the help of the first award, I visited Prof. Jim Berry at SUNY Buffalo in the USA to learn *in situ* hybridization of plant tissue. It is a very complex method and quite difficult to achieve with certain plant tissues. It took me many months to optimize the method for our particular situation, but the results were eventually published in the *Journal of General Virology*.

The second award contributed to a longer research visit (3 months) in Prof. Perry's lab at Cornell University in Ithaca, NY. I was investigating whether or not the cucumber mosaic virus mutant that I used for my cross-protection experiments was aphid-transmissible (aphids are the most important vector of this virus). Prof. Perry is a leading expert on aphid transmission, so I learned quite a few skills during my visit. He subsequently offered me a position as postdoctoral researcher in his lab starting in October this year. Therefore, the research visit was a great success! I also met fantastic people, with whom I still am in contact. It is always very interesting to explore a different country/culture and meet new people. You also learn different ways of doing your day-to-day research, and look outside your own little box! Everyone was very hospitable, and I never felt lonely. And I very much enjoyed the Buffalo wings at the Brew Pub in Buffalo and harvesting maple sap for boiling in Ithaca!

For both trips, my accommodation at university residences was organized by the collaborators, which was very helpful. Apart from that, I booked all flights and worked out the cheapest/quickest schedule myself. It can be quite a challenge to make all the arrangements for an overseas trip, including getting someone to look after your plants (I usually have a lot at home and on my allotment!) and pets (leopard geckos).

I think it was also very important to be able to present my research at conferences and I am very grateful to my PhD supervisor, who encouraged all of us to do this. The collaboration for my second USA visit started when I met Prof. Perry at the meeting of the American Society for Virology last year.

I am very grateful to the SGM for their funding schemes for early-career microbiologists, and I would advise others to attend conferences and present their work. Conferences are an excellent opportunity to meet fellow researchers, both on a graduate and professional level, and exchange ideas. I found the SGM meetings always very exciting as all UK plant virologists get to meet each other. We are a very friendly group and it is always nice to see everyone again at those meetings. And for me, going to an overseas conference led to some fantastic times in the USA and even a new professional position.

Meghna (Meg) Dharod is a PhD Associate at University of Westminster working on foot infections in diabetics – one of the most important complications of type 2 diabetes mellitus.

To find my PhD project I looked on the internet for researchers interested in clinical microbiology and I found my supervisor who is very passionate about research. Diabetes is increasing and it's one condition that cannot be cured, so I decided to focus on this area.

I am very grateful to SGM for the President Fund, as the cohort study I carried out in India helped me to understand the different risk factors of the diabetic foot, the huge variation in the treatment given to the patients and the reasons for so many amputations. I have collected statistically significant data and I am currently writing up my findings for publication. I have managed to network with many leading diabetologists and consultants in India, who have shown interest in future collaborations and discussed postdoctoral projects with me.

Like many scientists, I have research ideas, but lack the funds to explore them. I applied for grants thinking that if my ideas were good enough to help patients, I would surely secure some funding to organize my trip. I also occasionally used my savings to support my work, but I am grateful to SGM for funding my attendance at conferences throughout my PhD along with the grant to support my research visit. Before travelling, I used the internet to collect information on the country I was visiting and researched the conference presenters so I could acknowledge their work and network well.

During my research visit, time was a significant constraint since I only had 3 months. Some days I worked very long hours and found myself juggling to complete my research as well as networking with other researchers. However, after working hard and keeping within the time frame, it was satisfying to gain so much knowledge and equip myself with endless information on diabetic foot infections.

I have attended several conferences and have been very pleased that all my posters and oral presentations were accepted. Most importantly, the feedback I received and the guidance from other scientists has been invaluable. I feel even more encouraged after receiving the Young Investigators Award at the 26th International Congress of Chemotherapy and Infections. All the conferences had a common message – to wipe out diseases – but at each I met different people with varied experience.

SGM grants

Full details of all schemes and deadlines can be found on the grants pages at www.sgm.ac.uk/grants/default.cfm

Don't go on a vacation – go to work!

The SGM vacation studentship scheme has run successfully for many years. In 2008 we funded a bumper crop of 65 undergraduate students carrying out microbiology research projects of 6–8 weeks in the summer before their final year. To further enhance their research experience, all vacation students were encouraged to submit an abstract for presentation at the SGM Spring Conference in 2009. Students who presented a poster were able to apply for funding to attend the conference. **Jane Westwell** talked to three of the students at Harrogate who were standing by their posters and ably parrying questions from delegates. All three shared their experiences and thoughts on the scheme.

Alberta Davis obtained an Upper Second Class BSc (Hons) in Biomedical Science this summer from University of Westminster. Her vacation studentship project in 2007 *Antimicrobial susceptibilities and molecular epidemiology of* Neisseria meningitidis *invasive isolates from the Gambia from 1995 to 2007* was supervised by Dr Pamela Greenwell.

After completing my O levels I began working for the UK Medical Research Council (MRC) in the Gambia as a trainee laboratory assistant. I found the techniques involved in identifying pathogens and diagnosing many disease conditions in the microbiology and haematology laboratories amazingly interesting!

This encouraged me to apply for the Diploma in Biomedical Science offered to lab assistants then, via distance learning at the University of Westminster. I really enjoyed the first couple of modules I took and when an opportunity came up to pursue the subject at BSc level, I knew it was the right choice for me.

I had never worked on a research project on my own, so my BSc supervisor and I believed the SGM Vacation Studentship would be a good opportunity to gain hands-on experience, managing financial and laboratory aspects of carrying one out. This also helped me when I started work on my final year project.

I spent some of the project time in the Gambia. It was not easy waking up early to get to the lab, but having previously worked full-time at the MRC made the transition smoother. I made weekly plans of the various methods I needed to carry out and tried as much as possible to follow through with them. Whenever I defaulted, I'd work during the evenings and some weekends too! Nonetheless, I always found time to socialize and have some fun whilst in the Gambia.

It was very rewarding to obtain good and meaningful results after, for example, carrying out a 2-day-long procedure, knowing that I understood the concept behind it and being able to present the data accurately in my own words. However, I was using many different techniques – such as DNA sequencing, molecular typing and antimicrobial susceptibility testing – so managing my time became exceedingly challenging, in addition to troubleshooting the various experiments.

When I was at the Harrogate conference, presenting my undergraduate project work to such a large gathering of microbiologists from all over the world, I found it absolutely amazing! I enjoyed talking to scientists and other students about the work I did in the Gambia and how the data generated are useful for epidemiological surveillance and treatment in a country affected by meningococcal meningitis. It also boosted my confidence to speak in public and enhanced my presentation skills.

I now work as a trainee scientific officer at the MRC in the Gambia, working in the diagnostic TB lab (Category 3 containment) where I'm gaining a lot of experience. I hope to begin a postgraduate degree – either an MSc or a PhD – next year.

I would advise future SGM vacation students to make good use of this opportunity to learn different techniques (especially molecular ones) as this may come in handy in your final year projects. Manage your time well, troubleshoot and always ask your supervisors if you don't understand something as this will prevent unnecessary repetition of procedures which may have financial implications. Above all, enjoy what you are doing!

Serenia Horgan graduated from Waterford Institute of Technology with a BSc (Hons) in Applied Biology and Quality Management. Her vacation project, supervised by Dr Catherine O'Reilly, was *characterization of a number of novel TCN utilizing bacterial isolates*.

During my secondary school education I had a wonderful science teacher who inspired me to pursue a career in the science industry, so I opted for the degree course at Waterford. I was considering whether or not postgraduate study was right for me, so I hoped that the vacation

studentship would help me master new skills and gain more confidence in the laboratory.

When I started the project, I was familiar with the laboratory and the staff, so I was able to 'hit the ground running'. There were three other people working on different aspects of the project, so there was always someone to help if any question arose. I really enjoyed doing the project; the only aspect that took some time to adjust to was time management as the day passed so quickly. The lab experience was invaluable for my final year.

The Harrogate conference was amazing – the sheer variety of topics and speakers. Alongside the educational aspect of the conference, the social side is just as important. During the meeting I made friends who are currently undertaking postgraduate studies in England, New Zealand and America.

After the studentship I decided to pursue postgraduate study, as full-time research is extremely rewarding. I plan to do a molecular ecology-based study, but this will incorporate many of the molecular techniques used in my project.

My advice to future vacation students is to ask as many questions as you can. Also there may be other research groups working in close proximity so take notice of what they are working on too – and ask questions!

Emma James is studying for a BSc (Hons) in Applied Microbiology at the University of West of England. She carried out an ad hoc funded project: *Hurdles and helping hands – how can universities help schools in the delivery of the microbiology content of the national curriculum?* supervised by Dr Lynne Lawrance.

At the start of my course, I was interested in all aspects of biology, but I found microbiology most interesting which led me to specialize in that area. I chose this project because I have always been interested in science education. Also because my enthusiasm for microbiology began only at university, I wondered why there was so little emphasis on the subject during SATS and GCSE.

An interesting aspect of this project was interviewing the head teachers. It was great that many people were interested enough in the subject to reply to questionnaires. The most challenging thing was contacting people to be involved. Luckily the SGM helped by sending out the questionnaires which meant that we could concentrate on finding people to interview. It was rewarding to see the project recognized at a conference and it was good experience to discuss the poster with people interested in this area. I also enjoyed the diverse content of the SGM conference.

I have now returned to finish my degree having just completed my placement year at Oxoid Ltd. I would ideally like to combine microbiology and education in a future career.

I would advise future SGM vacation students to take the opportunity to complete an independent piece of research. It is a good experience to analyse data you have collected and present it as a report. It is also a good opportunity to work with university staff in a different situation.

Application forms for 2010 vacation studentships are on the grants pages of the SGM website and the deadline is 19 February.

Going for it in Gothenburg

3rd FEMS Congress of European Microbiologists June 2009

Gothenburg. *Stockxpert / Jupiter Images*

Jane Westwell of the SGM organized a workshop for early-career microbiologists at the conference. Called *Making the Most of PhD and Postdoctoral Years* it focused on the essential areas of networking, getting published and effective presentation skills. The lecture theatre was packed, with over 300 postgrads and postdocs eager to learn how to enhance their future prospects.

The session was chaired by Dr Sara Burton, Teaching Fellow at Exeter University and vice-Chair of the Education & Training Division. In her introduction, Sara reminded delegates how much they can gain by exploiting the benefits of learned society membership. Opportunities she highlighted included travel grants, prizes, presenting work, career development and networking at conferences.

SGM President, Professor Hilary Lappin-Scott followed with an enlightening presentation on successful strategies for getting published – a subject of huge importance to any researcher. After a short break delegates returned to learn about presentation skills from Dr Lynne Lawrance, lecturer at University of West of England and, until recently, a member of the Education & Training Committee. Lynne's interactive talk entertained the audience whilst emphasizing the importance of developing good presentation skills. The workshop ended with a lively question and answer session.

After many years of delivering career development workshops at SGM conferences, External Relations Office staff were delighted to see that their activities translated successfully to a larger international audience.

addresses

council 09–10

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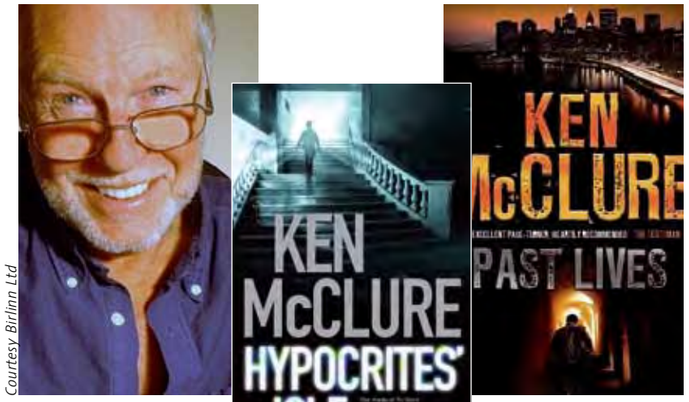
SGM aims to promote microbiology to a wide range of audiences and to encourage members to do the same. In this issue we explore some new avenues for science communication, including animated film and novels, as well as covering some more conventional outreach activities.



Courtesy Birlinn Ltd

From facts to fiction

How does a microbiologist turn into a successful thriller writer? **Ken McClure** tells us how he did it.

It is now over 40 years since I first walked through the doors of the bacteriology laboratory at the Edinburgh City Hospital for Infectious Diseases to begin a lifelong association with microbiology.

Since leaving school, I'd had a brief flirtation with the idea of becoming an engineering officer in the navy followed by some time as a professional guitarist before settling down to a 'proper job' – I became a student medical lab technician. Unlike the large, anonymous hospitals of today where the pressures of meeting targets and ticking boxes take precedence over all else, the 'City' was a pleasant, relaxed place to work where patients were people rather than numbers. The handling of high-risk pathogens in the open lab, however, would have horrified present day Health and Safety inspectors, perhaps causing them to suspect we were operating a process of natural selection for those who could handle dangerous organisms.

I followed the in-service and night-school training of the time for the minimum 7 years it took to become a Fellow of the Institute of Medical Laboratory Sciences (Bacteriology and Virology) before moving onto pastures new and becoming a research assistant in a new MRC unit being set up at Edinburgh University to study the genetics of bacteria. Happily, the job allowed me to continue study: I became a Member of the Institute of Biology and finally did a PhD in molecular genetics.

As time went by and the reputation of our group studying cell division and led by Professor Willie Donachie grew, we became involved in extensive international collaboration, something that led to me personally travelling to labs all over the world as a visiting researcher. It was after one of these trips – an adventure-strewn visit to Tel Aviv University – that I discovered a new passion in life – writing. I sat down and wrote an adventure story set in Israel and involving medical science, the first of some 20 'medical thrillers' I've now written since the mid-1980s.

People wonder if doing research and writing fiction might be incompatible, but I've always found that the demands of science for truth and accuracy and its insistence for references to back up any claims made can be beautifully offset by fiction writing where I can make the whole lot up!

I managed to combine both careers (at only the cost of an entire social life) for nearly 15 years before the MRC decided to end funding for our group at Edinburgh. If I'd wanted to stay in research, it would have meant a move to Cambridge or London – something I had little heart for – so I became a full-time writer in 2000. This, you will appreciate, was not an easy decision for a Scotsman to make, involving the giving up of a regular salary cheque. I can still feel the anxiety.

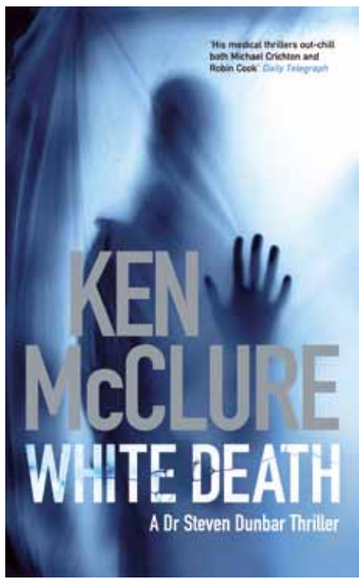
Some 9 years have passed, but I still read the scientific journals to keep up with what's going on and, of course, to look for new ideas. In the beginning the stories were pure flights of fancy, but as time has gone on, a pattern has developed. I come across some little known medical or scientific fact and use this as the factual basis for a fictional story. This leads to a mixture of fact and fiction in which I deliberately blur the edges, something that not only encourages the reader to believe that 'this could actually happen', but also enables me to pursue a hidden agenda. My prime intention is always to provide a thrilling read but I also do my very best to ensure that at the end of a Ken McClure book, the lay reader knows a little bit more about science than they did at the beginning.

When young people suggest that being a thriller writer must be exciting, I point out to them that it wasn't writing that took me to live and work in Paris and Madrid; it wasn't writing that took me to Tel Aviv and Kansas City; it wasn't writing that allowed me to see the Taj Mahal or watch the sun rise over Mount Fuji. It was microbiology.

White Death

Ken McClure's latest novel is one in a series featuring Dr Steven Dunbar, a qualified doctor and former soldier who now works as a Medical Investigator for a Home Office department called the Sci-Med Inspectorate. This hush-hush unit looks into crimes in areas where the police lack expertise. Our hero, a widower in his 30s with a teenage daughter, is called up to Scotland to investigate the apparent suicide of a GP in Edinburgh whose wife believes he was murdered …

A tale unfolds of children at a school outdoor centre who were vaccinated, allegedly to protect them against TB following exposure to an infected immigrant child, but who one after another develop a mystery skin disease which seems to lead eventually to death. Bioterrorism, underhand government activities, a rogue genomics company, the Russian mafia, guns and exploding cars all add up to a page-turning thriller spiced with lots of real microbial science. And along the way, romance awaits our hero.



White Death is not high literature, but it certainly makes an entertaining read. Microbiologists might well work out the dénouement before they reach the nail-biting conclusion. The general reader is unlikely to do so, but they will certainly have learnt some science en route.

***Janet Hurst**, SGM*

White Death by Ken McClure is published by Polygon (2009)

246 pp. ISBN 978-1-84697-125-9

See **www.birlinn.co.uk** for further information.

Ken has written 20 novels to date, six of which feature Dr Steven Dunbar.

The Bad Bugs Book Club

If you are interested in books, specifically novels, which have infectious disease as a key part of the story, then why not join the Bad Bugs Book Club? It's run by SGM Education and Public Affairs Officer Professor Jo Verran as part of her outreach activities. It's based in Manchester, but can be accessed on the web via Jo's site – **www.sci-eng.mmu.ac.uk/intheloop**

The first meeting took place in July, where the title under discussion was *Hot Zone* by Richard Preston. This describes, graphically, the outbreaks of Ebola that occurred in the 1980s. It is very much a thriller, with plenty of scientific detail. The book was compared with the film *Outbreak* which describes, rather less scientifically, similar incidents.

The second meeting was held in September and took the form of a trip to Eyam, the plague village, followed by a meeting to discuss *Year of Wonders* by Geraldine Brooks.

Reading guides for the books studied are being posted on the website, in the hope that the comments and suggestions are helpful to others. Online book club members are welcome!

Derek the Diatom and Doctorpus take on the terrestrials

Kelvin Boot shows how an important environmental issue is being publicized through the medium of cartoon film

Derek the Diatom, Britney Star and Doctorpus are just some of the cast of marine creatures starring in an animated film highlighting ocean acidification and the threats it poses to the marine environment. The film was made by students from Ridgeway School in Plymouth, after learning of the phenomenon from Plymouth Marine Laboratory scientist and SGM member Dr Carol Turley.

The chemistry of ocean acidification is quite simple: the ocean is a huge sink for atmospheric CO_2 and has been doing a great job for millions of years, playing its part in the global carbon cycle by maintaining the balance. Recently, however, its capacity has become stretched. Estimates vary but between 25 and 30% of additional CO_2, produced by humans from industrial processes such as cement manufacture and the burning of fossil fuels in vehicles and factories has been absorbed by the ocean. As CO_2 and seawater mix a weak acid is formed. Organisms living in the oceans have evolved in naturally alkaline seawater but as more CO_2 continues to be taken up, the seas have become 30% more acidic than before the industrial revolution. By the end of the century ocean acidity will increase by 100–150% if we keep on emitting CO_2 at the same rate. Experimental evidence shows that many calcifying organisms, such as corals, molluscs and even coralline seaweeds are negatively affected by this expected change in pH that restricts their ability to build the shells and skeletons that provide support and protection. Our seas have had a pretty constant pH for possibly as long as 20 million years. It is this extent of change over just a few centuries that is of most concern. It is predicted that many organisms may not have the capacity to adapt to the new ocean chemistry they face, or have the flexibility to move away from the threat or change their behaviour to combat it: the prognosis is not encouraging.

▲ Students in Plymouth working on *The Other CO_2 Problem*. *Plymouth Marine Laboratory*

◀ The group of students involved in making the film. *Plymouth Marine Laboratory*

Carol Turley, who spends much of her time advising policy makers about the potential consequences of ocean acidification is always looking for new ways to 'spread the word'. Recalling an award winning film about climate change that was made by Plymouth school students, she approached Karen Findlay, a teacher with an eye for an engaging educational opportunity. Karen contacted Sundog Media, a professional company, to help out with the technicalities of film-making, but it was the students who developed the ideas, invented the characters, wrote the script and provided the voice-overs. The result is a film that is short and to the point. The cast of characters bemoan the state of their oceans and look for evidence of the ocean's changing chemistry and how it may affect the food web from microbes upwards.

Already *The Other CO_2 Problem* has been featured on national and local TV news programmes, it has been translated into French and German and is being shown on TV in Brazil. It was premiered at the Copenhagen Climate Change Congress earlier this year and has been shown at the Royal Institution, and gathering of EPOCA (European Project on Ocean Acidification).

Original funding for producing DVDs of the film came from EPOCA, but such has been the response to the clear and strong message, that funding for further pressings of the DVD has been received from the Oak Foundation and the European Geological Union. It has been awarded the Royal Society of Chemistry Bill Bryson Award for Science Communication.

▲ Students working on the animation process. *Plymouth Marine Laboratory*

Merryn Hunt, one the students is convinced the film will have an impact: '*We were shocked; we hadn't heard of this* [ocean acidification] *before and we felt we had to do something. We had heard of climate change, but now there are two threats and we have a chance to make a difference.*' Carol Turley is thrilled with the result and the difference it has already made: '*We knew the film would be good and we hoped it would make an impact, but even we were surprised, it obviously strikes a chord with everyone who watches it. It makes people, people who make decisions, realize that the upcoming generation is concerned. The children have made it clear through this short film that they want something done. This year is going to be very important for new climate change negotiations and this little film is going to be crucial in bringing the other CO_2 problem to the forefront of the minds of policy makers.*'

The film *The Other CO_2 Problem* can be seen at:

www.pml.ac.uk

www.epoca-project.eu

www.youtube.com/watch?v=55D8TGRs14k

Kelvin Boot is a Science Communicator at Plymouth Marine Laboratory (e kelota@pml.ac.uk)

An exciting interactive event took place at the SGM autumn meeting. The public were invited to find out the latest facts on 'flu and the importance of hand hygiene in stopping the spread of infections.

'Flu and you

Swine 'flu is currently a disease of major concern worldwide and seasonal 'flu an ever-present infection each winter. What are the real facts about influenza? How can it be prevented? And what can we do to stop spreading it from person to person?

These questions were all answered by international expert Wendy Barclay, Professor of Influenza Virology at Imperial College London, in a fascinating talk delivered to an audience drawn from the general public, university staff and interested delegates to the conference. Wendy explained about the different strains of the virus, how they are constantly mutating, how the WHO tracks the different strains each year around the globe and why new vaccines are required annually. She stressed how important it is for at-risk people to have the injection and reassured the audience that it is impossible to catch 'flu from the jab. Wendy also described the effects of 'flu virus on the body and suggested ways of preventing its spread.

The last point was reinforced by a workshop on hand hygiene delivered by SGM Education Manager Dariel Burdass, who, helped by colleagues and a spray only visible under UV light to mimic the virus, showed how easily a bug is spread by aerosols, and by touching objects and other people. A member of the audience, Thomasina aged 8, 'sneezed' in a crowded bus made of a roll of paper. Passengers were marked by large paper circles. The sneeze was really a generous squirt of the UV spray. The lights were dimmed, the paper was held up and Dariel shined the UV lamp on to the 'passengers'. The droplets were seen to have spread a considerable distance along the 'bus'. In a real situation, quite a few people could have inhaled the 'flu virus and caught the infection, for mucus droplets from a sneeze travel at an amazing 100 miles an hour and spread up to 10 metres in a widening arc.

Several brave volunteers also had their hand-washing technique tested, by seeing how much they glowed before and after a scrub at the sink. The lesson clearly went home among some delegates, who were overheard talking about the importance of handwashing later in the week, something that microbiologists might be expected to know already!

Plans are in place to hold a public outreach event at future SGM conferences, to which, of course, delegates are invited. So watch this space for details.

Breaking the mould

A television play featuring microbiology is an unusual event, but 29 July saw a dramatized portrayal of the work of Howard Florey's group in wartime Oxford to develop penicillin as a life-saving treatment of infectious diseases. It starred Dominic West (better known for his role in *The Wire*) as Florey and the characters of Ernst Chain and Norman Heatley, other key players in the story, were faithfully reproduced. Certain SGM members were consulted about the script, to ensure that both the science and the language of the protagonists was appropriate for the time. The play, shown on BBC4, was well-received by critics and will no doubt be repeated for the benefit of those who missed it first time round.

hotoffthepress

Science writer **Meriel Jones** takes a look at some recent papers in SGM journals which highlight new and exciting developments in microbiological research.

Salmonella comes out of its shell

Van Meervenne, E., Botteldoorn, N., Lokietek, S., Vatlet, M., Cupa, A., Naranjo, M., Dierick, K. & Bertrand, S. (2009). Turtle-associated *Salmonella* septicaemia and meningitis in a 2-month-old baby. *J Med Microbiol* **58**, 1379–1381.

Salmonellosis is a worldwide public health problem. Its symptoms are stomach cramps, vomiting and diarrhoea that usually end after a few days of unpleasant illness. However, some people experience more severe symptoms that require hospital treatment, and occasionally have a fatal outcome. The illness is caused by inadvertently consuming *Salmonella* bacteria with food or water. A group of Belgian researchers have focused on exotic pets as a source of these bacteria. 'Exotic pets' encompasses a number of unusual animals, but the researchers were particularly interested in reptiles and other cold-blooded animals since, when tested, around 90% of reptiles harbour *Salmonella* and shed the bacteria into their faeces, even though the animals look perfectly healthy. Parents are usually well aware of the need for hygiene when dogs or cats and young children play together, but may be less alert to dangers from unusual cold-blooded pets.

Medical scientists have recorded more than 2,579 different serotypes of *Salmonella*, mostly from patients where their illness has been severe enough to seek medical attention. A further reason for concern is that an increasing number of uncommon serotypes associated with exotic pets are being recorded, particularly from infants with more serious invasive disease that leads to hospitalization.

Sophie Bertrand (Scientific Institute of Public Health in Brussels), with colleagues in the Belgian Health Inspectorate French Community and Hospital Ambroise Paré in Mons, has used one recent case to publicize the issue. This was a 2-month-old girl with meningitis and septicaemia that turned out to be caused by a strain of *Salmonella*, serotype Abony, which had only been identified in three other cases out of 35,021 in Belgium between 2003 and 2007. The infant fortunately recovered in a few weeks after receiving intravenous antibiotics, but when the paediatricians realized that there was a pet turtle in the house, they tested it and found multiple variants of two *Salmonella* serotypes in its faeces, serotypes Abony and Solna. Further tests showed that one of these serotypes was very similar to that of the bacteria that had infected the child. It was obviously the source of the infection.

It was likely that the baby was infected by indirect contact with the pet turtle. The researchers point out that reptile import restrictions and public information campaigns have been effective public health measures against reptile-associated salmonellosis in both Sweden and the USA, and advocate greater publicity of this health risk in Europe.

Brand X Pictures / Jupiter Images

Adult raccoon dog (*Nyctereutes procyonoides*). *US Air Force / Michael Dillon*

Did SARS come from raccoon dogs?

Xu, L., Zhang, Y., Liu, Y., Chen, Z., Deng, H., Ma, Z., Wang, H., Hu, Z. & Deng, F. (2009). Angiotensin-converting enzyme 2 (ACE2) from raccoon dog can serve as an efficient receptor for the spike protein of severe acute respiratory syndrome coronavirus. *J Gen Virol* **90**, 2695–2703.

Where do new diseases come from? That is an obvious question when serious new diseases suddenly appear, such as SARS (severe acute respiratory syndrome) in November 2002, which had a fatality rate of 10% over the first few months. Researchers quickly found out that it was caused by a type of virus, coronavirus, that had not previously caused any illness in people. This made its origin even more intriguing, and worrying. Over the following 7 years, researchers have inched towards an answer. They tracked the earliest SARS patients back to their work in live-animal markets in Guangdong Province in China. Among the animals for sale for the table were masked palm civets (*Paguma larvata*) and raccoon dogs (*Nyctereutes procyonoides*). Searching for a source of the SARS virus, researchers eventually found that some of these animals were infected with coronaviruses that were remarkably similar to SARS-CoV (SARS coronavirus). However, further studies made it very clear that although the masked palm civets were an important intermediary in the infection, the virus did not originate from them.

But what about the raccoon dogs? Fei Deng and colleagues at Wuhan Institute of Virology in China, in collaboration with researchers at Peking and Hong Kong Universities, have now found out more about how they fit into the story. This involves a key point in the SARS virus life cycle, namely the step at which it enters the cells of an animal and can start to cause an infection. The virus attaches to one particular protein on the mammalian cell, called ACE2 (angiotensin-converting enzyme 2), via a spike protein on the virus surface. The efficiency with which SARS-CoV infects human, rat or mouse cells is directly related to how well ACE2 supports virus replication.

The researchers compared the ease with which SARS-CoV from humans could use the ACE2 enzymes from humans, palm civets and raccoon dogs for entry into cells. Surprisingly, the raccoon dog enzyme was the best of the three, even better than the human enzyme. To work out why, the researchers compared the detailed structure of the ACE2 proteins. There were many small differences, and also large ones such as in the region most important for the interaction between SARS-CoV and ACE2. As a result, the researchers could not define a single reason, but the fact that the receptor from raccoon dogs had such a high affinity for the SARS-CoV that infects humans provides an important insight into the origin of this new disease. It has identified a second animal that is an important intermediary in the evolution of SARS.

All over the world – and beyond

Mancinelli, R.L., Landheim, R., Sánchez-Porro, C., Dornmayr-Pfaffenhuemer, M., Gruber, C., Legat, A., Ventosa, A., Radax, C., Ihara, K., White, M.R. & Stan-Lotter, H. (2009). *Halorubrum chaoviator* sp. nov., a haloarchaeon isolated from sea salt in Baja California, Mexico, Western Australia and Naxos, Greece. *Int J Syst Evol Microbiol* **59**, 1908–1913.

One intriguing question about bacteria is whether the same species is found all over the world. An international collaboration, led by Helga Stan-Lotter from the University of Salzburg in Austria, has recently isolated the same highly salt-tolerant species on an evaporitic salt crystal from an intertidal area in Baja California, Mexico, from natural salt pools on the Western Australian coast and in a salt lake on the island of Naxos in Greece. Indeed, it grew best in media containing 25% sodium chloride, indicating that it was not only salt-tolerant but halophilic, requiring high levels of salt in its environment. This, and other chemical and genetic characteristics, allowed the researchers to identify it as belonging to the domain *Archaea*, members of which are frequently exceptionally tolerant to environmental stress. The tests showed that it was a member of the genus *Halorubrum*, but distinct from the previously known 19 species of this genus.

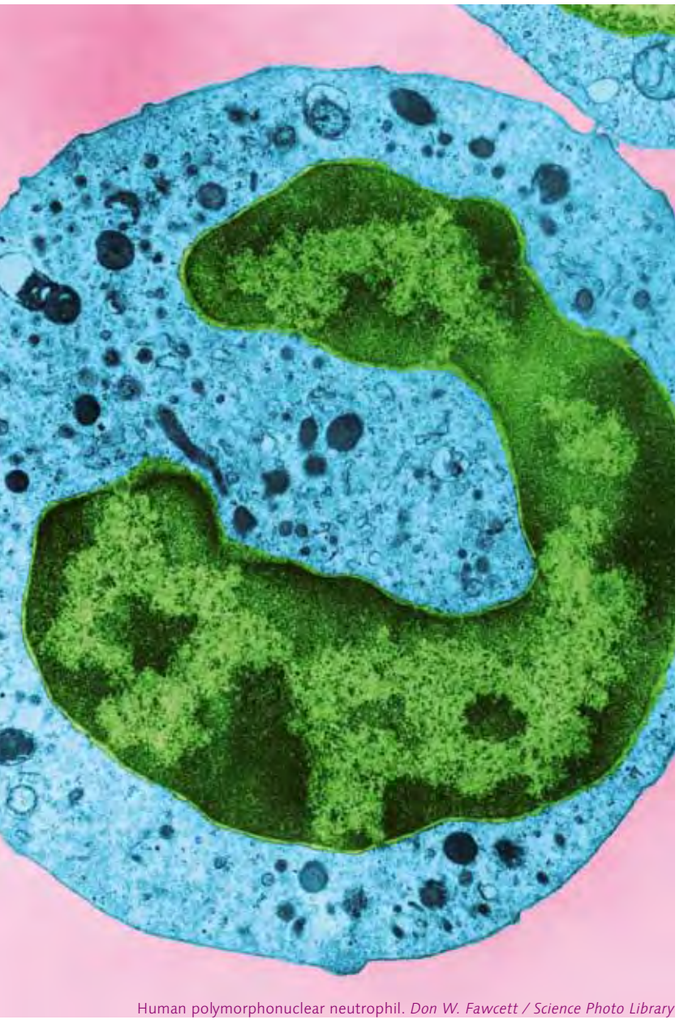
One further aspect of the stress tolerance of this bacterium comes from an experiment carried out with the Baja California isolate (initially called Halo-G*^{T}). This has survived being dried onto quartz discs and flown on the Biopan facility into low Earth orbit. The Biopan is designed for investigations in open space because it is mounted on the external surface of the Foton descent capsule owned by the European Space Agency. A motor-driven hinged lid opens in space to expose the contents to the harsh environment, and then closes to protect the samples from the heat of re-entry or contamination by other terrestrial micro-organisms. Impressively, strain Halo-G*^{T} survived the void of space. This gave the researchers inspiration to name the species *Halorubrum chaoviator*, after the Greek word *chaos*, meaning empty, void or space, and the Latin word *viator*, meaning traveller.

Sample holder portion of the Biopan facility. *European Space Agency*

Sense and respond

Alhede, M., Bjarnsholt, T., Jensen, P.Ø., Phipps, K.R., Moser, C., Christophersen, L., Christensen, L.D., van Gennip, M., Parsek, M., Høiby, N., Rasmussen, T.B. & Givskov, M. (2009). *Pseudomonas aeruginosa* recognizes and responds aggressively to the presence of polymorphonuclear leukocytes. *Microbiology* **155**, 3500–3508.

For any microbe to set up a successful infection, it must have a way to deal with the defences of its host. The bacterium *Pseudomonas aeruginosa* is an opportunist that usually sets up infections on top of a pre-existing illness. Patients with cystic fibrosis are particularly likely to suffer from damaging chronic lung infections caused by this species. It somehow manages to evade cells from the human immune system called polymorphonuclear neutrophilic leukocytes (PMNs), which are supposed to destroy invading bacteria, and persists within the lung. Researchers at the University of Copenhagen and Technical University of Denmark, along with other collaborators in Denmark and the USA, have been trying to work out how the bacteria do this and even manage to destroy the PMNs.



Human polymorphonuclear neutrophil. *Don W. Fawcett / Science Photo Library*

The bacteria form a biofilm that grows like slime over the surface of the lungs. Within this, their virulence stays at a minimum until there are enough bacterial cells to overwhelm the PMNs. They use chemical messengers and a system called quorum sensing to detect their numbers and decide when there are enough to launch an attack. One question, of course, is how they manage to evade the PMNs up to this time. The researchers' current project, led by Michael Givskov, has led them to a group of compounds called rhamnolipids that are necessary for the bacteria to do this.

Rhamnolipids are detergents synthesized by the bacteria that can make stable emulsions with fats and oils in water, giving the bacterial cells better access to these substances as food sources in the environment. Within the lungs of mice, *P. aeruginosa* that could synthesize rhamnolipids were both better able to set up infections and more efficient at killing PMNs. In contrast, mutant bacteria that lacked rhamnolipids were removed through the normal activity of the immune cells. The researchers' measurements showed that the rhamnolipid was concentrated in the bacterial biofilm, which matched with their observations of tissue samples taken from patients. In these, PMNs were present on the surface of biofilms, but never within them, which would be the case if the rhamnolipids were toxic to these mammalian cells.

The implication is that the biofilm can sense and respond to the presence of the PMNs by producing rhamnolipids. *P. aeruginosa* only synthesized the detergent for some of the time. The researchers showed that the activity of genes involved in rhamnolipid biosynthesis increased when the bacteria were exposed to PMNs. They speculated that the bacteria did not produce rhamnolipids constantly because they are toxic to all animal cells, inducing necrosis and death, and would produce unprofitable damage to the animal host.

These results are particularly interesting because rhamnolipids have been suggested as a comparatively non-toxic detergent with potential for environmental and food industry applications. One outcome of this work is to open up a route for discovering new antibacterial treatments via chemicals that block the quorum sensing system and also to show that the toxicity of a compound can depend on the environment in which it is present.

If you would like your name to be added to our database of book reviewers, please complete the book reviewer interests form at **www.sgm.ac.uk**. A classified compendium of reviews from 1996 to the present is also available on the website.

Encyclopedia of Virology 3rd edn

By B. Mahy
Published by Elsevier (2008)
£830.00 pp. 3,234
ISBN 978-0-12373-935-3

The third edition of the *Encyclopedia of Virology* has been prepared 9 years after the second edition and has been updated substantially, commensurate with the enormous amount of new data in all areas of virology, increasing the size of the work from 3 to 5 volumes. The *Encyclopedia* has the intention of being all-encompassing at a high level of quality. This is reflected in a large number of specialists (over 640; almost a *Who's Who* of virology), coordinated by the two Editors-in-Chief and 12 Associate Editors, who have all contributed in their areas of special expertise. It is amazing that viruses are found as obligate parasites in cells of practically all branches of the tree of life (*Eubacteria*, *Archaea* and *Eukarya*). The *Encyclopedia* presents an enormous body of knowledge in this respect in a very comprehensive way.

The chapters are alphabetically ordered, frequently according to the names of individual viruses or virus species, genera, families or orders, interspersed with articles on particular diseases or on general virology topics. Classification issues have received close attention, following the ICTV *8th Report on Virus Taxonomy* (2005). Glossaries preceding some of the chapters are useful in explaining terms of specific significance for the chapter. A list of the many abbreviations used would have been helpful.

With over 600 contributors, the quality of chapters can be expected to differ. Most chapters are excellent and contain references up to 2006/07. Only a few chapters do not fully review recent developments. The amount and richness of information provided does not permit comments to be made on individual contributions. Suffice it to say that for some viruses, a few almost unavoidable duplications are found in related chapters. One particular group of viruses is not reviewed in a single chapter, but in 12 different ones, making it difficult to see the large picture, although many of these chapters are individually very good. Chapters reviewing viruses affecting particular human organs or particular animals or plants are of interest to the generalist. This reviewer is concerned about how the wealth of knowledge provided in the *Encyclopedia* can be maximally used. An electronic version with a powerful search program should be considered for the next edition; such a system would also allow continuous updating.

In this reviewer's opinion, a special chapter on reverse genetics would have been of great interest, given the enormous progress which has been achieved by such systems in RNA virus research. Metagenomics would have been worth an entry, as much of the recent interest in this area has arisen from the discovery that traditional microbiological methods, relying on the culture of micro-organisms, have overlooked vast numbers of them. The issue of synthetic viral genomes is marginally mentioned, but would also have warranted a more detailed discussion.

This magnum opus represents a tremendous effort in providing a synopsis of present knowledge in all branches of virology. The *Encyclopedia* should be available in the libraries of universities, major research institutions, large schools and big laboratories in industry.

***Ulrich Desselberger**, Cambridge*

Living with Enza: The forgotten story of Britain and the Great Flu Pandemic of 1918

By M. Honigsbaum
Published by MacMillan (2009)
£16.99 pp. 237
ISBN: 0-23021-774-4

When Mark Honigsbaum was writing this book in 2008, bird 'flu was the threat on everyone's minds. By the time it was published earlier this year, a 'flu pandemic from an unexpected source was about to become reality. As I review this book, once again we are 'living with enza' but it is nothing like the Spanish 'flu pandemic of 1918–19 described by Honigsbaum. Taking place in the final year and aftermath of the Great War, the infection claimed at least 50 million lives worldwide and in Britain alone 228,000 died, many of them in the prime of life. Despite the devastating impact of the pandemic, little information about it has come down through the years by way of oral tradition. Honigsbaum, a journalist specializing in the history of disease, decided to redress the balance and tell the story through the voices of people who lived through the pandemic. He tracked down a collection of letters in the Imperial War Museum and used material gathered by researchers like virologist Professor John Oxford, together with contemporary official medical reports, papers published in medical journals and newspaper articles as his sources. The result is a fascinating chronicle of the Great 'Flu Pandemic, set in its historical and scientific context and extrapolated to the present. The government's approach to the crisis and the vagaries of the medical profession at the time are also explored.

The final chapters of the book speculate what might happen in the event of a 'flu

pandemic today. Being based around a bird 'flu strain that can be transmitted between humans, the domesday scenario predicted loses dramatic impact because it does not bear much similarity to the realities of the present swine 'flu outbreak. As ever, the bugs have sprung a surprise, and both the source of the current H1N1 strain and its impact on people have been unexpected. Also the scientists of today have done pretty well in dealing with the disease. Antiviral drugs are available to those who need them and supplies of vaccine are now reaching the most vulnerable members of society. If a second edition of *Living with Enza* is ever published, the author will have to include a new chapter!

Nevertheless, Honigsbaum paints a powerful picture in this book and it is well worth reading. Unfortunately, as seems usual in this type of publication, the illustrations are sparse and of poor quality. On the plus side, the work is fully referenced and has an excellent index.

***Janet Hurst**, SGM*

Aspergillus fumigatus and Aspergillosis

Edited by J.P. Latge & W.J. Steinbach
Published by American Society for Microbiology (2008)
US$169.95 pp. 598
ISBN 978-1-55581-438-0

The co-editors, Drs Jean-Paul Latge and William Steinbach, are both experienced in the basic sciences of the organism and disease manifestations caused by this fungus. The text is extremely timely given the emerging interest in the medical mycology and infectious disease community to treat and diagnose these infections. It is also important to focus upon *A. fumigatus* since by far it is the most common offending pathogen among the aspergilli. Aspergillosis is the most common infection caused by a filamentous fungus, and in the case of invasive aspergillosis (IA), a high mortality is associated with outcome. The text also goes beyond IA to examine allergic and bronchopulmonary manifestations, the non-invasive forms of these diseases, which in many instances are often forgotten among scientists and clinicians since the latter forms are not usually life-threatening. It is very clear that research into this organism has advanced at many levels, especially in biochemistry and molecular biology. Thus, the literature is rapidly expanding on subjects ranging from virulence to diagnostics, treatments, immune responses, with long-term goals of developing novel therapies and diagnostics to treat an otherwise very devastating disease (IA). The expansive subject matter has in part resulted in three international conferences on 'Advances Against Aspergillosis', with a 4th planned for February 2010. Thus, this text is perfect for all interested readers in that it centralizes all areas of studies.

There are 9 sections, each of which includes a variable number of chapters on: 1, the species; 2, growth and sensing; 3, immunity; 4, the spectrum of disease; 5, diagnosis; 6, therapy; 7, timing of anti-fungal therapy; 8, disease and patient populations; and 9, future directions of research. There are 41 chapters in all. The authors are to be cited for a good balance of material distributed among clinical and basic science chapters. One of the many outstanding features of the majority of chapters is the use of multiple authors. This of course is harder to co-ordinate, given the proclivities of scientists to develop their own theme, but, nevertheless, many chapters thus reflect each viewpoint. The text is quite comprehensive. It is therefore difficult to focus upon a critique of each chapter; however, chapters on comparative genomics (chapter 4), growth and biofilm formation (chapters 11 & 12), the cell wall as a dynamic structure (chapter 14), innate defenses (chapter 18), allergic bronchopulmonary aspergillosis (chapter 26), prophylaxis, and current consensus and controversies over IA (chapters 36, & 37) are especially relevant, but in no way is this comment meant to minimize the quality of the other contributed chapters.

A critical component of the text is, not surprisingly, the last chapter (chapter 41) on a perspective on *A. fumigatus* research for the next 10 years. The first 40 chapters tackle the state-of-the-art in regard to the many subjects mentioned above. Given all of this, what is next? It is clear that defining virulence factors of this organism remains difficult to accomplish, given the tried and true definitions of virulence. Thus, is auxotrophy a virulence determinant? The answer is a resounding 'no' and the authors are to be given credit for saying so. Are the current animal models representatives of these diseases? How does one begin to decipher virulence functions among genes that comprise large, redundant families? These questions not only complicate definitions of virulence, but point to the lack of defined virulence targets for the development of new antifungal drugs. Aspergillosis scientists, and really all of us, need to believe in the concept of avirulence therapies which have become quite fashionable among scientists that advocate this approach with bacterial pathogens. There is also discussion of the -omics approach to discovery, and both pros and cons are discussed. New therapies and diagnostics remain at the forefront of discovery. In regard to diagnostics, a theme that is developed is the identification of specific host responses, rather than features of the fungus, i.e. galactomannan antigenemia or PCR-based techniques. Perhaps a combination of host and fungal factor diagnostics is needed. The prophecy herein is that the development of new therapies is exciting but unrealistic, of which one could debate this point of view. Rather, emphasis is placed upon increasing the efficacy and reducing the toxicity of current drugs. Immune therapy and approaches are discussed.

I would conclude by saying that all of us who study these pathogens need to become stronger advocates of this science. Fungi continue to cause disease and death, and health care costs to patients and hospitals are staggering. Somehow we have not convinced the people who make decisions on funding research on fungal diseases (which is badly needed) to continue the cause of delivering better health care.

In summary, this text is a welcome addition to the library of basic and clinical scientists, graduate and medical students, and to those of us that teach graduate and medical students. Especially in regard to the upcoming generation of physicians, unless we tell them the significance of these infections, we will only remain hopeful with 'promising' approaches to improved health care. This text is important to spark interest in doing fungal research.

***Richard Calderone**, Georgetown University*

Acanthamoeba Biology and Pathogenesis

By N. Khan
Published by Caister Academic Press (2009)
£150.00 pp. 290
ISBN 978-1-90445-543-1

If you are interested in *Acanthamoeba* species, then this is the book to turn to. Kahn explores every aspect of this protozoan genus and, unlike many books on pathogens, he reminds us that *Acanthamoeba* is essentially an environmental organism that is also an opportunistic pathogen. The thoroughness of the book is complemented by its logical organization with discrete sections that provide information on the organism's biology, life cycle, infectious nature and mode of action, the host immune response that it provokes and the therapeutic strategies that are available to us. Furthermore, the 'Trojan Horse' idea is explored with respect to its 'endosymbionts', comprising viruses and numerous bacteria that not only evade digestion by this microbiological predator but carry on their life style with, in some cases, an enhancement of their pathogenicity. But before you rush out to get a copy, you need to consider the price (it is high), and consequently there would be an expectation of higher quality diagrams. Overall, a book well worth considering.

***Roger Pickup**, Lancaster University*

Animalcules: The Activities, Impacts, and Investigators of Microbes

By B. Dixon
Published by American Society for Microbiology (2009)
US$39.95 pp. 358
ISBN 978-1-55581-500-4

In 1973, the distinguished medical scientist Lewis Thomas published a collection of his essays from the *New England Journal of Medicine* as a very successful book, *The Lives of the Cell*. Bernard Dixon has now done the same with essays from the ASM publication *Microbe*. The vocabulary is more technical than that of Thomas, but this should not be a problem for microbiologists or their students. Dixon has a talent for spotting important developments for his interestingly written and scientifically sound essays. Most microbiologists will find much that is new to them, and students material that will help with their own essays and projects, as well as a lesson in lucid writing. The book will be a valuable addition to the libraries of individuals and universities.

***Michael Carlile**, Bridgwater*

Reviews on the web

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

The Dictionary of Virology, 4th edn

Living at Micro Scale: The Unexpected Physics of Being Small

Plant Pathology Techniques & Protocols

The ELISA Guidebook, 2nd edn

Prebiotics & Probiotics: Leatherhead Ingredients Handbook, 2nd edn

Microbial Toxins: Current Research and Future Trends

Biomeasurement: A Student's Guide to Biological Statistics, 2nd edn

Advanced Genetic Analysis: Genes, Genomes, and Networks in Eukaryotes

Candida albicans*: Methods & Protocols*

Essential Cell Biology, 3rd edn

The Immune System, 3rd edn

Detection of Highly Dangerous Pathogens: Microarray Methods for BSL3 and BSL4 Agents

Infectious Disease: Pathogenesis, Prevention, and Case Studies

Taxonomy, Phylogeny, and Ecology of Bark-inhabiting and Tree-pathogenic Fungi in the Cryphonectriaceae

Life in Space: Astrobiology for Everyone

Bacterial Polysaccharides: Current Innovations and Future Trends

Food-borne Microbes: Shaping the Host Ecosystem

Practical Guide to Diagnostic Parasitology, 2nd edn

Horizontal Gene Transfer: Genomes in Flux

Case Studies in Infectious Disease

Viral Applications of Green Fluorescent Protein: Methods and Protocols

Bioinformatics for DNA Sequence Analysis

Life Strategies of Microorganisms in the Environment and in Host Organisms

Escherichia coli – *Facets of a Versatile Pathogen*

Sequelae and Long-term Consequences of Infectious Diseases

Antiviral Research: Strategies in Antiviral Drug Discovery

Bacteriology of Humans: An Ecological Perspective

Illustrated Dictionary of Immunology, 3rd edn

Clinical Virology Manual, 4th edn

Gene Therapy of Cancer Methods and Protocols, 2nd edn

Bacterial Sensing and Signaling

Virus Diseases of Plants, 2-CD set

Principles and Practice of Clinical Virology, 6th edn

Essentials of Apoptosis: A Guide for Basic and Clinical Research

Defensive Mutualism in Microbial Symbiosis

Proteases and Cancer Methods and Protocols

Viral Genome Replication

comment

One piece of the 'one medicine agenda': redevelopment of the IAH

Keith Gull explains how the long-awaited redevelopment of the Institute for Animal Health (IAH) and a change in its strategy will provide a much-needed UK hub for the integration of studies in human and veterinary medical science.

The 'one medicine agenda' emphasizes the complex interrelationships between human and animal health and the importance of cooperation between human and veterinary medicine, building on a common pool of knowledge in microbiology, immunology, physiology, pathology and epidemiology (http://royalsociety.org/displaypagedoc.asp?id=32574). From an initial focus on zoonotic diseases, the agenda has spread to a wider emphasis on synergistic efforts leading to improved public health, and prevention and treatment of disease affecting humans and animals. These sectors have been separated for far too long and often are only brought together when major disease threats emerge.

Animal health research has been the poorer of the two sectors, both in research capacity, funding and infrastructure. Now, a major change in the animal health landscape has started with the recent announcement by the BBSRC that the IAH at Pirbright is to be redeveloped. Currently on two sites – Compton and Pirbright – IAH will consolidate onto a single site at Pirbright with the Government confirming £100m funding for a new CL3 and CL4 high-containment laboratory complex.

In September 2009, Professor Martin Shirley, Director of IAH, announced that there was to be a major change in strategy for the IAH. Henceforth, the Institute would focus exclusively on virus diseases. The new IAH will engage on fundamental immunology, pathogenesis, epidemiology, molecular virology, computational biology and bioinformatics, to be complemented by a synergistic and fully integrated international surveillance capability provided by the national and international virus reference laboratories already situated at Pirbright.

▲ Architect's impression of the new IAH facility at Pirbright. *IAH*

Specifically, the Institute will address four areas: large animal viral diseases, including those exotic to the UK; vector-borne and emerging viral diseases of livestock; avian viral diseases; and viral zoonoses from the livestock perspective. The Institute will be a national hub for this activity, providing a UK facility to attract strategic partnerships with the higher education sector, provide training opportunities for veterinary scientists, expand scientific links to developing countries and be part of the growing international network of world-class facilities.

How has this come about? Following the FMDV outbreak of 2001, BBSRC Council accepted the recommendations of my report that IAH Pirbright was badly in need of new buildings. Government accepted the advice to refurbish the Pirbright Laboratory, but inter-departmental issues in government produced delays; although some progress was made with new CL4 animal facilities being completed this year, and some ground work for the new laboratory complex started in 2007. The recent announcement of the funding under BBSRC's leadership should ensure efficient progress to completion of this critical national facility. We may not be able to say what the next major animal disease epidemic or human zoonotic episode may be, but we can say that environmental change and the changing patterns of human life in the world are conspiring to increase the rhythm of such outbreaks. UK capacity in this area will need continuing consolidation. The key development for the future is to produce a balanced, coordinated view of sort term basic research on infectious disease integrated with high-quality diagnostics, surveillance and long-term research. IAH's 20-year-long research and surveillance work on bluetongue disease meant that the UK was aware of the threat that this encroaching disease posed well before it 'landed' in the east of England.

Within 4 years the IAH will have a new, state-of-the-art, high-containment facility at Pirbright, with a comprehensive, multi-disciplinary focus on present and emerging viruses of animals, some of which are also zoonotic. It will be able to recruit the very best researchers from around the globe, and be part of an elite group of similar laboratories in strategic parts of the world. It is also one of the hubs that the UK needs to consolidate into a wider 'one medicine agenda' for integration of human and veterinary medical sciences.

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Further reading

Gull, K. (2002). *Review of the Institute for Animal Health – Pirbright Laboratory. A report for BBSRC Council*. www.bbsrc.ac.uk/organisation/policies/reviews/operational/0207_iah_pirbright.pdf

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