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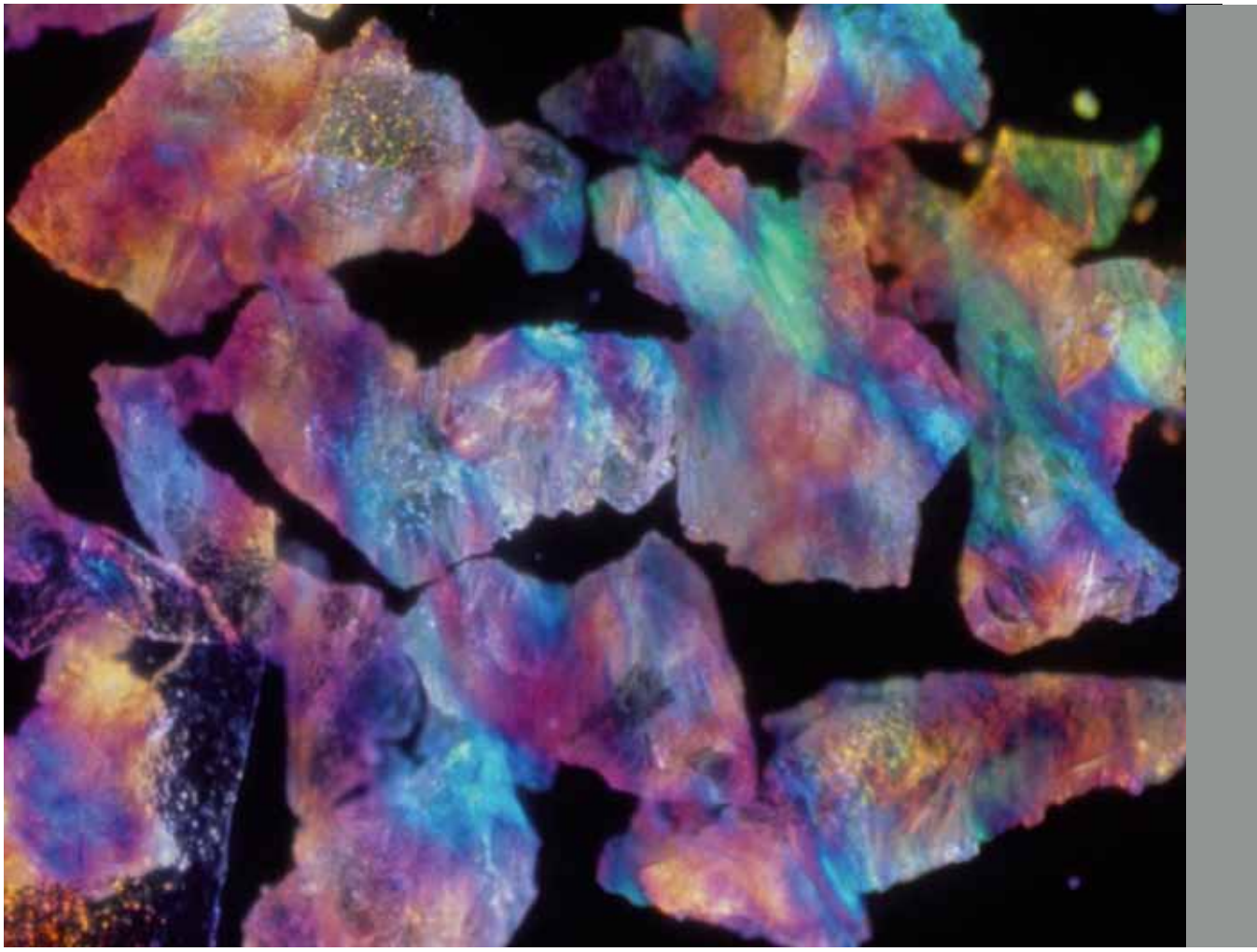

cytokines

interferon – the early days

cytokines, receptors and virus infection

treating fungal infections with interferon

protection against TB

interferon – where are we now?

contents

vol**34**(4)

regular features

other items

articles

Cover image Polarized light micrograph of crystals of human interferon. *Phillip A. Harrington, Peter Arnold Inc. / Science Photo Library*

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New category of membership for 2008

SGM is pleased to announce a new category of membership: **Associate Membership**. It embraces the former categories of Technician, Postgraduate Student and Retired Membership, but aims to support a whole range of other microbiologists.

Associate Membership is also open to microbiologists resident in the UK or Republic of Ireland employed in universities, research institutes, hospitals/HPA or commercial institutions, whose salaries are no higher than £25,000 p.a. gross. It is intended for graduate scientists, research assistants, postdoctoral fellows, biomedical scientists, clinical scientists, etc., as well as technicians.

Postgraduate Student Associate Membership is still available to anyone registered for a microbiology higher degree worldwide, subject to the £25k salary cap. Retired Associate Members will have the same benefits as before, such as special concessions and grants for attending SGM meetings.

The annual subscription for Associate Membership is only £25. All Associate Members will be eligible for special discounted registration fees to attend SGM meetings and receive *Microbiology Today*. Eligibility for grants remains the same as before – see **www.sgm.ac.uk/grants** to check out the schemes that apply to you.

Existing Technician, Postgraduate Student and Retired Members will be automatically converted to Associates, but if you are an Ordinary Member and are eligible to change to the Associate category, look out for the invoice to renew your subscription which will be arriving any time now. This contains full details of what to do.

Harrogate International Centre. *HIC Marketing*

All change for SGM meetings

As a result of requests to alter the structure of SGM meetings and observations of changes in the profile of subject areas within microbiology, Council held a full review of the entire meetings system earlier this year. It was carried out by a small working party made up of Council members, Group conveners and Marlborough House staff. The recommendations were considered and endorsed with very minor changes by conveners in May and approved at June Council.

The existing group structure is to be replaced by five divisions (Prokaryotic microbiology, Eukaryotic microbiology, Virology, Education and Irish). Each scientific division will be divided into four themes (Microbial diversity and evolution; Fundamental microbiology; Translational and applied microbiology; Infectious disease) to ensure that all areas of microbial science are covered. The programmes for SGM meetings will be devised through a matrix management system, starting with the 2009 spring meeting in Harrogate. Each division will be headed by a chair and chair-elect, who will sit on the Scientific Meetings Committee responsible for making decisions on policy and meetings content. The Scientific Meetings Officer will have a deputy under the new system. SGM members will also be able to propose sessions for consideration, via a form on the website.

There will still be two meetings a year, in spring and autumn, each lasting 3½ days, but the timetable of the meetings has been formalized. There will be up to four concurrent symposia each morning and flexible sessions in the afternoons. These can be workshops, training courses, debates, offered papers, mini-symposia, etc. Poster viewing will now take place in the early evenings, with drinks.

We look forward to implementing this exciting new system which aims to provide balanced programmes that reflect modern microbial science and meet the needs of the community. The flexible sessions will enable niche/minority topics to be included.

Population of the divisions is in progress and all current Group conveners have been invited to participate. Although division membership has been by invitation initially, the process will become democratic once the system is established. Chris Hewitt has agreed to be Scientific Meetings Officer Elect and the divisions will be headed up by Petra Oyston (Prokaryotes), Geoff Gadd (Eukaryotes), Stuart Siddell (Viruses), Jo Verran (Education) and Evelyn Doyle (Irish).

***Hilary Lappin-Scott**, Scientific Meetings Officer*

SGM Council June meeting

SGM strategy

Following up on earlier considerations of Strategy Group recommendations, Council discussed ways of networking with other societies and scientific organizations. It was noted that the BBSRC Director of Research has approached the society with a view to collaborating on setting up strategic networks, as recommended in the *Dorman Review of Microbial Science*. SGM has also been invited by Defra to carry out an independent review of their research into bovine TB in the UK.

Council review

The internal review of the composition of Council, its functions and workings as well as the responsibilities of members of Council and roles of SGM officers, chaired by Petra Oyston, is ongoing.

SGM membership

Council approved a new category of membership, termed 'Associate Membership'. This will include recent graduates, postgraduate students, early career postdoctoral fellows, clinical trainees, technicians, biomedical scientists and retired members (see p. 146 for details).

Review of scientific meetings and group structure

Hilary Lappin-Scott reported on the recommendations agreed by a Working Party earlier this year. Radical changes are planned, including a new organizational structure for delivering the science and a different timetable for meetings. See p. 146 for details. The new system will be phased in from September 2007 and take over in the spring of 2009. Council approved these proposals, thanked Hilary for chairing the review and welcomed her preparedness to serve for one more year beyond her term of office (until September 2009) to see the changes through.

SGM journals

The *Microbiology* editorial office has made significant progress in introducing the Bench>Press system for manuscript processing and journal production. It is hoped to complete the implementation of this system for all four SGM journals by the end of 2007.

Retiring members of Council

The President, Robin Weiss, thanked the retiring members of Council, Professors Lorna Casselton, Nick Mann and Tony Minson, for all they had contributed to Council and Society activities, Dr Geoffrey Schild for his work as Professional Affairs Officer and Professor Ian Poxton for his significant role as the first SGM Editor-in-Chief of *JMM*.

***Ulrich Desselberger**, General Secretary*

Experts wanted! SGM needs you!

SGM actively promotes microbiology to the media and helps journalists obtain accurate information. To do this we need scientists to answer their questions. With so many microbiological stories in the press these days, more experts are urgently required to join our existing database of contacts. Whether you have dealt with the media for years or never spoken to a journalist in your life, we want to hear from you. We can offer help with media training if necessary and we always check first that you are willing to deal with an enquiry.

Everyone's an expert in their own field of interest, so please help. A simple registration form is available at: www.sgm.ac.uk/noticeboard.cfm which takes only a couple of minutes to complete, or contact Lucy Goodchild for further information (l.goodchild@sgm.ac.uk).

That longest running experiment again

Imran Hayat really enjoyed reading Dr Jean Lindenmann's article in the February issue of the magazine which has stirred up some debate about the world's longest running experiment. He agrees with Richard Jackson that the field experiments at Rothamsted are the longest running biological experiments, but disagrees with Tim Mahony about the claim about the pitch drop experiment in the *Guinness Book of Records*!

'There are a number of much older experiments, my favourite being that of Lord Kelvin's artificial glacier experiment started in 1887 which can still be seen at the Hunterian Museum at Glasgow University. The world's longest running experiment is the Oxford Electric Bell or Clarendon Dry Pile* at the University of Oxford which has rung continuously since 1840. The experiment was set up to determine or test the theory of chemical actions. What do other readers think?' (imranhayatuk@yahoo.co.uk).

**Editor's Note*: the *Guinness Book of Records* has this as the 'world's most durable battery'.

New Council officers

Professor Charles Penn

Professor Charles W. Penn began his 5-year term as Editor-in-Chief of *Journal of Medical Microbiology* on 4 September 2007.

Charles' research career has embraced the molecular biology of pathogens ranging from *Neisseria* and *Treponema* to *Helicobacter*, *Campylobacter* and *E. coli*. At the reductionist end of the spectrum he has a particular interest in bacterial flagella and on a more holistic front, in bacterial genomics and whole-genome analysis of transcription and its control. He is currently committed at the University of Birmingham to develop and exploit microarray technology for applications in *E. coli* research. Charles brings to the editorship extensive editorial experience on *FEMS Letters*, *Microbiology* and *JMM*, as well as knowledge of the workings of the Society as former General Secretary.

Professor Richard Elliott

With effect from 1 January 2008, Professor Richard M. Elliott (University of St Andrews) will commence his 5-year term as Editor-in-Chief of *Journal of General Virology*.

A profile of Professor Elliott will appear in the next issue of *Microbiology Today*.

New elected members of Council

The following will serve on Council for 4 years from 4 September 2007:

Dr David J. Blackbourn

Following my PhD in microbial genetics with Colin Harwood, I spent 9 years in the US, first as a postdoc and then as a staff scientist, where I became a virology convert. I worked on SIV at Davis and then moved to San Francisco to work with Jay Levy on HIV. Here I became interested in Kaposi's sarcoma, the most common cancer of untreated AIDS patients. Following the discovery of KSHV by Chang & Moore in 1994, I worked increasingly on this virus. I returned to the UK in 1999 to a lectureship at the Institute of Virology in Glasgow to establish my own group, which continues to work on KSHV immune modulation and pathogenesis. In 2005 I moved to my present position as Reader at the Cancer Research UK Institute for Cancer Studies, University of Birmingham. I was a member of the SGM Virus Group committee 2003–2006 and look forward to serving on Council.

Professor Kim R. Hardie

Following a Biology degree at Leicester, I completed my PhD studying the activation of the HlyA in Cambridge. After postdocs looking at iron acquisition (Nottingham), secretion of the aerolysin (Victoria, Canada) and Type II secretion (Institut Pasteur, Paris), I obtained an EMBO Fellowship. Then at Nottingham I investigated quorum sensing, and with a Fellowship from the British Society of Antimicrobial Chemotherapy, started my own research group characterizing *H. pylori* secretion. Aside from a sabbatical at the CNRS (Marseille), I have remained in Nottingham, moving into the School of Molecular Medicine where I currently hold the post of Associate Professor. With a broad interest in microbial pathogenicity, I focus on bacterial protein secretion machineries and deciphering the relative contribution that LuxS makes to quorum sensing and cell fitness by combining molecular microbiology with metabolomics. I am looking forward to serving on the CCS group committee alongside the Council.

Dr Paul A. Hoskisson

I was recently appointed as a Lecturer in Microbiology at the University of Strathclyde. My first degree is in Applied Microbiology from Liverpool John Moores University and I continued in the same department to do my PhD on antibiotic production in *Micromonospora echinospora* with Glyn Hobbs and George Sharples. I then moved to Mark Buttner's lab at the John Innes Centre, to study sporulation in *S. coelicolor*. Following that I moved to Maggie Smith's lab at Aberdeen to continue to work on *Streptomyces*, but this time on bacteriophage resistance, before moving to Glasgow. My principal research interests are the developmental biology of actinomycetes, particularly using *S. coelicolor* as a model organism. I have previously served on the SGM FB Group committee and look forward to contributing to the work of Council.

People

Congratulations to ...

Dr David J. Adams on his appointment as Director of the Higher Education Academy Centre for Bioscience, based at Leeds University.

Professor Jeff Errington (University of Newcastle) on being elected to Fellowship of the Academy of Medical Sciences and the American Academy of Microbiology.

Dr Olivier Sparagano (University of Newcastle) on becoming President of the Society for Tropical Veterinary Medicine. He would be delighted hear from SGM members working in the same area.

Deaths

The Society notes with regret the deaths of **Dr S. H. Black**, College of Medicine, Texas A & M University, USA (member since 1959) and **Mr Bryan O. Underwood**, Worplesdon, Surrey, (member since 1973).

Professor Sir John M. Burnett (member since 1953) has died in Oxford. Sir John was a distinguished mycologist, academic and university administrator, being Principal and Vice-Chancellor of Edinburgh University 1979–87. He was president of the British Mycological Society 1982–83 and in latter years much concerned with championing biodiversity issues.

Former SGM Treasurer, **Professor Douglas H. Watson** died in early September. A full obituary appears on p. 198.

Dr Muriel Rhodes-Roberts died in August after a long and brave battle with cancer. She enthused generations of microbiology students at the University of Wales Aberystwyth and was also a great supporter of the promotion of microbiology in schools, serving on MiSAC for many years.

Dr David Pitcher (member since 1977) died in September. David became an Editor of *IJSEM* in 2000, but retired in 2005 due to ill health. At the time he was working at the Respiratory and Systemic Infection Laboratory of the HPA. Before that he worked at the National Collection of Type Cultures and at the Institute of Dermatology, St John's Hospital, London. He was an ex officio member of the ICSP Subcommittee on Taxonomy of Mollicutes and described several new species of *Mycoplasma*, *Corynebacterium*, *Brevibacterium* and *Propionibacterium*.

Professor Terry Beveridge (member since 1991) from the University of Guelph, Canada, died on 10 September. Terry was an Associate Editor of *Microbiology* from 1997 to 2004.

SGM Staff

Congratulations to **Nicolas Fanget** on his marriage in June to Amina Al-Mossawi. The happy event took place in Edinburgh on 24 June 2007.

Welcome to **Gemma Sims**, who has joined us as Educational Resources Developer. She will be producing materials to support the microbiology content of the new A level courses that are coming on stream in schools in September 2008. Gemma is an experienced secondary school science teacher who has recently been working in Italy. Her first degree, gained at Durham University, was in Cell Biology and she has nearly completed the Open University MSc in Science.

New corporate members

Envirogene Ltd

EnviroGene specializes in the development and application of quantitative molecular methodologies to the environmental sector. The business is currently focusing on water quality problems due to microbial and chemical contamination and is undertaking projects in both the UK and US. For further information contact Sarah Parker (t 08452 584366; f 01443 819052; e sarah.parker@envirogene.co.uk; w www.envirogene.co.uk).

Lab M Ltd

Lab M is a manufacturer and distributor of microbiological culture media and supplies. For further information contact Lisa Baldwin (t 0161 765 2512; f 0161 762 9322; e info@labm.com; w www.labm.com).

New Group conveners

Food & Beverages Group

Cath Rees

I am currently Senior Lecturer in Microbiology in the Food Microbiology group at the University of Nottingham, but my youth was spent studying biochemistry at Oxford followed by a PhD in plasmid biology at Leicester. I joined Gordon Stewart's group in Nottingham and used my training in bacterial genetics to develop *lux* phage for detection of *L. monocytogenes*. After being appointed as a Lecturer at Nottingham, I continued to work on a variety of projects involving phage, from detecting *M. paratuberculosis* in milk to removing *Campylobacter* from poultry. However, I still hang on to my roots in bacterial genetics by studying gene expression of *Listeria* in food processing environments. Being a geneticist who works in food science, I'm familiar with the challenge of discipline bridging! As convener of the Food & Beverages Group I will try to find areas that will interest both communities.

Welcome also to **Professor Maggie Smith** (University of Aberdeen), new convener of the Physiology, Biochemistry & Molecular Genetics Group, and **Professor Stuart Siddell** (University of Bristol) who will head up the Virus Group.

A boost from the taxman?

If you are involved in a UK company carrying out innovative work in science then it could be eligible for tax credits, or, in certain circumstances, receive a cash payment.

HM Revenue & Customs (HMRC)'s Research and Development tax credits are open to businesses of all sizes, including SMEs.

To find out more go to **www.hmrc.gov.uk/randd/index.htm**

Groups

New committee members, elected by postal ballot for the Clinical Virology, Microbial Infection, Physiology, Biochemistry & Molecular Genetics and Systematics & Evolution Groups or elected unopposed (all other Groups) to serve from 4 September 2007 are as follows:

Cells & Cell Surfaces

K.R. Hardie *University of Nottingham*
C.W. Penn *University of Birmingham*

Clinical Microbiology

C. Jenkins *Royal Free Hospital, London*
G. Ramage *Glasgow Dental School*
J.R. Wain *Wellcome Trust Sanger Institute, Cambridge*

Clinical Virology

K.J.M. Jeffery *John Radcliffe Hospital, Oxford*

Education & Training

R.E. Grady *University of Manchester*

Environmental Microbiology

E.J. Shaw *University of Reading*
K. Tait *Plymouth Marine Laboratory*

Eukaryotic Microbiology

P. Dyer *University of Nottingham*
M.L. Ginger *University of Oxford*

Fermentation & Bioprocessing

I. Nakouti *Eden Biodesign*
G.M. Stevens *University of Manchester*
C.E. Thompson *Liverpool John Moores University*

Food & Beverages

K. Mellits *University of Nottingham*
J. Gray *Health Protection Agency, London*

Microbial Infection

P.W. Andrew *University of Leicester*
J.S. Cavet *University of Manchester*
M.J. Horsbrugh *University of Liverpool*

Physiology, Biochemistry & Molecular Genetics

M. Camara *University of Nottingham*
G.M. Fraser *University of Cambridge*
N.R. Stanley-Wall *University of Dundee*

Systematics & Evolution

H.N. Shah *Health Protection Agency, London*
B.J. Tindall *Deutsche Sammlung von Mikroorganismen und Zellkulturen, Braunschweig*

Virus

W.P. Duprex *Queen's University of Belfast*
S.E.Y. Goodbourn *St George's Hospital Medical School, London*
J.W. McCauley *NIMR, London*
A. Whitehouse *University of Leeds*

Grants

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: **20 March** and **26 September 2008**.

SGM has a wide range of schemes to support microbiology. See **www.sgm.ac.uk/grants**

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

Student Schemes

GRADSchool Grants

Postgraduate Student Associate Members registered for a PhD in a UK university can apply for funding to support the full cost of course fees for a national GRADschool. Students funded by Wellcome Trust, BBSRC, NERC, MRC or EPSRC are entitled to a free place on a GRADSchool course and should not apply to this scheme. Applications, on the appropriate form, are considered throughout the year but must be made before booking a place on a course.

Postgraduate Student Meetings Grants

Grants cover travel and accommodation expenses for attendance at one SGM meeting each year. Applicants must be Postgraduate Student Associate Members resident and registered for PhD in an EU country. Closing date for the Edinburgh Meeting: **29 March 2008**.

Elective Grants

Funding for medical/dental/veterinary students to work on microbiological projects in their elective periods. The closing dates for applications in 2008 are **20 March** and **26 September**.

Vacation Studentships

The 2008 scheme is now open for applications. As described on p. 184 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 **15 February 2008**.

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 Understanding of 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.

Calling all Birmingham biochemical engineers

The Biochemical Engineering laboratories and the MSc course in Biochemical Engineering at the University of Birmingham will celebrate their 50th anniversary in 2008.

To mark the event, there will be a day's Symposium at the University on 25 April 2008, followed by a dinner in the evening.

If you studied, worked or were associated with Biochemical Engineering in Birmingham, we'd like to see you there. For more information, please contact Joe Biddlestone or Alvin Nienow (A.J.Biddlestone@bham.ac.uk *or* A.W.Nienow@bham.ac.uk).

Lister Institute Research Prizes 2008

Applications are now invited from young clinicians and scientists for the 2008 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, and therefore provide unfettered research funding. Prizes will be allocated on the basis of the applicant's research proposal and track record. Applications may be in any area of biomedical science or related areas. Further information and application forms are available from the Lister's web site: www.lister-institute.org.uk or directly from the Institute's Administrator (secretary@lister-institute.org.uk).

SGM membership subscriptions 2008

The following rates were agreed at the AGM of the Society on 4 September 2007.

Membership category		Annual subscription		Additional subscriptions for publications (print only)							
				Microbiology		*JGV*		*IJSEM*		*JMM*	
		£	US$	£	US$	£	US$	£	US$	£	US$
Ordinary		52	100	102	195	102	195	102	195	54	105
Associate *Postgraduate Student* *Retired* *Microbiologist with annual salary <£25k*		25	50	46	86	46	86	46	86	46	86
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 £18/US$32 to subscription.

Members are reminded that their 2008 subscriptions are due for payment by **1 December 2007**.

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.

New 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 2007, you should have amended your subscription notice and returned it to the membership office by **9 November 2007**. 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 payment online.

Subscriptions waived for unemployed members

As in previous years, subscriptions may be waived at the discretion of the Society for unemployed members under the age of 35 who are resident in the UK. If you are eligible and wish to benefit in this way in 2008 you should send a signed statement that you are currently unemployed to the Membership Office before **30 November 2007** (Please note that no increase in journal requirements will be permitted).

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 Inland Revenue as qualifying for income tax relief. Any member who would like further information or has difficulty in obtaining this relief should contact the Executive Secretary.

microshorts

Lucy Goodchild takes a look at some stories that have hit the headlines recently.

Typhoid fever reveals its slowly evolving secret weapon

New research carried out at the Max Planck Institute for Infection Biology, the Wellcome Trust Sanger Institute and the Major Overseas Programme in Vietnam has revealed two distinct pools of *Salmonella typhi* infection, which could explain its global spread and persistence. In 1896 there was an epidemic of typhoid fever in Folkestone, UK. The medical authorities discovered that it was being spread by local milk, but it wasn't until 1902, after Robert Koch put forward the idea of an asymptomatic carrier, that 'Mr N the Milker' was blamed for the outbreak. He was soon ruled out as he did not have the disease but then re-examined in 1909 and shown to be a carrier. Researchers today suggest that this original strain of *S. typhi* still persists as a slowly evolving carrier strain, alongside a more rapidly evolving type that causes epidemics. Scientists believe, therefore, that treatment of the acute disease may not be sufficient to eradicate typhoid fever.

Wellcome Science, 6 July 2007, p. 40

Wonder of synthetic phages

Synthetic biology could soon be exploited in cleaning products and veterinary medicines, since researchers have developed one of its first potential applications. Biofilms are a problem in a variety of environments, from teeth and catheters to food processing machines, and cause many infections. Scientists at Massachusetts Institute of Technology and Boston University have engineered a bacteriophage to attack *E. coli* biofilms. In order for a treatment to eradicate a biofilm, it must be able to degrade the extracellular matrix (slime layer) as well as destroying the bacteria underneath. Several bacteriophages present in sewage have this ability but, as the team were not keen on 'digging through sewage', they decided to engineer a phage to carry a suitable enzyme. T7, an *E. coli*-specific phage, was modified to carry the gene encoding dispersin B, an enzyme that can cut through the extracellular matrix of a biofilm. Researchers cultivated *E. coli* biofilms on plastic pegs and found that their synthetic phage eliminated 99.997% of the bacterial biofilm cells, making it two orders of magnitude more effective than its 'natural' counterpart. The scientists were also able to control the timing of gene expression, so that the enzyme was produced during infection. It may even be possible to create a phage library containing viruses capable of dealing with a range of bacterial problems, including biofilms. Although the use of bacteriophages to treat human infections has not yet been approved, the US Food and Drug Administration has approved a 'phage cocktail' to prevent the growth of *Listeria monocytogenes* on lunch meat. In the future, synthetic phages could be used to clean pipes and even to support or replace antibiotics in livestock.

http://web.mit.edu/newsoffice/2007/biofilm-0706.htm

Eco-friendly batteries

Traditional methods used in the production of items such as batteries and solar cells are wasteful and involve toxic chemicals. In a bid to make electronics more environmentally friendly, researchers at Massachusetts Institute of Technology have harnessed the rapid replication abilities of viruses, making them grow and assemble nanomaterials into working electrical devices. By combining viruses with semiconductors and electronic materials, items such as transistors, batteries and even electrical materials used to diagnose cancer can be made faster, cheaper and greener. This method produces little waste, which is biodegradable. It is inexpensive and can be carried out at room temperature.

www.nanotechproject.org/131/7907-tomorrows-green-nanofactories-podcast

Toxoplasma infected rodents drawn to cats

Researchers at Stanford University, USA have shown that the protozoan parasite *Toxoplasma gondii* alters a very specific behaviour of rodents: it removes their fear of cats. *Toxoplasma* can only reproduce inside the feline gut. By making its rodent host attracted to the scent of cat urine, the parasite is effectively increasing its chance of ending up inside a cat. Although behaviour-altering parasites are relatively common, the effect *Toxoplasma* has on rodents is unusually specific. Areas of the rodent brain controlling different fear induced reactions overlap, but scientists have found that parasite-infected rodents are only drawn to cat urine, while they remain fearful of dog odour.

National Geographic News, 3 April 2007

'Flatulence cards' to reduce methane emissions

Many fingers have pointed at cows as major contributors to greenhouse gas emissions, but now pets and even humans are being asked to offset their flatulence. Gases, including carbon dioxide and methane, are produced by bacteria in the large intestine, and are released into the atmosphere. Australian company Easy Being Green has decided to reduce the effect of flatulence on climate change by selling 'flatulence cards', carbon credits to offset the gases produced by people and their pets. For a mere US$27 a dog's emissions, including trips to the vet and unpleasant smells, can be offset. To do the same for human flatulence would cost US$16 and US$6 for a cat. The company claims to offset carbon emissions by installing energy saving devices, such as fluorescent light bulbs and water-saving shower heads, in New South Wales homes. 'Flatulence cards', the company says, are a way of targeting the individual to make green choices.

http://news.nationalgeographic.com/news/2007/03/070306-warming-credits.html

◀ Milk. *Liquidlibrary / Jupiter Images*

◀ Cat and mouse. *YLLA / Science Photo Library*

▲ A cartoon of Joseph Pujol (1857–1945), the French entertainer known as 'Le Petomane' (The Fartiste), performing his stage act. Pujol achieved fame for his flatulence, which he used to do impressions, play a flute and extinguish gas lamps. *Jean-Loup Charmet / Science Photo Library*

▶ Oyster mushrooms (*Pleurotus ostreatus*) growing on a tree trunk. *John Wright / Science Photo Library*

Mycelial mat makes good insulation

Recent US graduates Eben Bayer, 21, and Gavin McIntyre, 22, have developed an eco-friendly alternative to traditional insulation – using mushrooms. Greensulate is cheap, sustainable and even fire-retardant. By adding starch to a mixture of water, perlite (mineral particles found in potting soil) and flour, the fungus *Pleurotus ostreatus*, or oyster mushroom, is able to grow into a dense mycelial mat, shaped in a square mould. The addition of hydrogen peroxide prevents contaminants from growing, and the mat is dried out after 2 weeks of growth to avoid it triggering allergic reactions. The developers, whose research started at the Rensselaer Polytechnic Institute, have been growing the insulation under their beds and stress that the product is at least a year away from the market. The next step is to make larger, brick-like pieces and test them against the elements, with potential to build a wall.

International Herald Tribune, June 2007

1918 influenza: the virus that survived 75 years

In the late 1990s scientists sequenced the entire genome of the 1918 strain of influenza, which had caused the most devastating pandemic in living memory. Researchers from the National Institutes of Allergy and Infectious Diseases describe how this was possible in the journal *Antiviral Therapy*. In a remote Inuit village near the town of Brevig Mission, Alaska, the body of a large woman lay under more than 6 feet of ice and dirt for over 75 years. In the new report, researchers explain how a combination of the ideal conditions in the permafrost and the ample fat reserves in the woman kept the virus so well preserved in the lungs that scientists were able to sequence its genetic code. The information they were able to gather is vital to our understanding of the influenza virus, and in our fight against 'flu.

Antiviral Therapy (2007). 12, 581–591

Interferon: the early days

A fortunate job offer as a young man led **Derek C. Burke** to work at the NIMR during the exciting period in the late 1950s when interferon was just being discovered.

Fifty years ago I was lucky enough to be a young scientist working with Alick Isaacs, the discoverer of interferon. I first met Alick in November 1955, and he immediately impressed me as an extremely intelligent and very lively person. Little did I know that those next few years working with him were going to set the course of my whole career. I had just come back from the US, after spending 2 years as a postdoc at Yale, where I'd been working with some novel nucleosides from a Caribbean sponge, containing arabinose not ribose. I had a first degree in chemistry and a PhD for work on steroids, but the time at Yale was the start of my life-long fascination with the biological sciences. I had gone to the US in September 1953, and on the boat was a young man named Jim Watson, who had just published with Francis Crick that famous letter in *Nature*. I returned in 1955 on the *Mauretania*, newly married to a Yale PhD, liable for military service in the British army and without a job. So I was grateful to be offered two jobs in Britain – one working on rocket fuel development, and the other on the biochemistry of viruses at the National Institute for Medical Research in North London, which I gladly accepted. This was a 3-year appointment in the Chemistry Division, *not* the Virology Division, since Sir Christopher Andrewes, Head of Virology, allowed only medics into his division!

Interferon is discovered

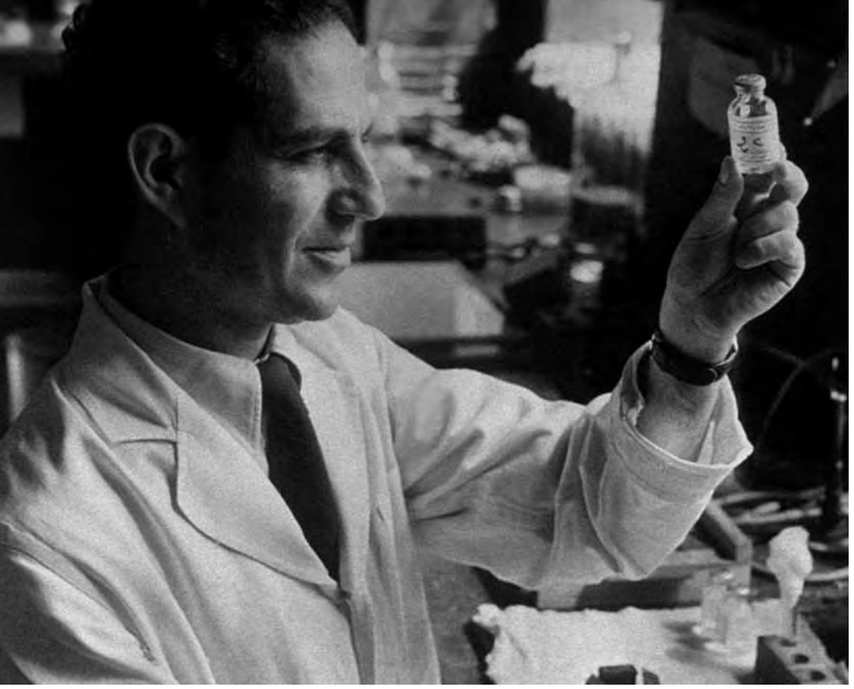
My first project was to determine the nucleic acid content of influenza virus, known to be an RNA virus, but how much RNA? Near its end, Alick suggested that I should help him 'with something interesting that we are doing on interference'. 'We' was Jean Lindenmann and himself, it was March 1957, and interferon was only a few weeks old. The name was new – Alick once explained that it was 'time that biologists had a fundamental particle, for the physicists have so many: electron, neutron, proton, etc.' That did not stop Lord Hailsham, then Chairman of the MRC, objecting to such a nasty hybrid word – with both Latin and Greek roots! By then, though, the name had stuck.

Interferon had been discovered when testing quite another hypothesis. It was the steam age of virology (as Sir Christopher would say, referring rather disparagingly to the dream age that would follow – molecular biology and all that!), and no one really knew how animal viruses worked – indeed it was suggested that the viral coat was left outside the cell, like phage. Alick and Jean tested this by seeing whether any viral property – and they chose interference – was still associated with the outer membrane of the cells of the chick chorio-allantoic membrane, and could be washed off. What they found, of course, was not the viral coat outside the cell, but the interferon newly made inside the cell.

The system was crude. The virus used to stimulate interferon, heat-inactivated influenza virus, was not very potent. Interferon was estimated by challenging treated chick cells with infectious influenza virus and then measuring virus growth by haemagglutination titration. We tested, in sextuplicate, at least three twofold dilutions of the interferon sample; the amount of virus produced was measured by diluting it in serial twofold steps in plastic plates, and adding chicken red blood cells. The endpoint of the titration was the well with partial agglutination, and the reciprocal of the interferon dilution, the interferon titre. The experiments took hours to titrate,

◄ The entrance to the NIMR, Mill Hill, London, where the author worked with Alick Isaacs on interferon in the late 1950s. *James King-Holmes / Science Photo Library*

► A young Derek Burke cutting up fertile hens' eggs for interferon assays, with the assistance of Valerie Carver. *Derek Burke*



◀ Alick Isaacs (left) photographed in 1957, the year in which he and his Swiss colleague Jean Lindenmann (right, photographed in London in 1956) discovered interferon. Alick Isaacs was Head of the Laboratory for Research on Interferon at the National Institute for Medical Research from 1964 and was elected an FRS in 1966, shortly before his untimely death at the age of 45 in 1967. *Jean Lindenmann, Zürich, Switzerland*

involving little more than purely mechanical operations, and this left time to talk. Alick was the leader in conversation, and ideas for new experiments, political discussion or identification of snatches of opera that he would sing made the time pass quickly.

Characterizing the compound

Two papers had already been written for the *Proceedings of the Royal Society*, but there was still much to do. So we worked quickly and published the results in a series of papers in the *British Journal of Experimental Pathology*. I still have my laboratory notebooks, and my first experiment, dated 4 March 1957, was headed 'Dialysis of interferon' – we did not even know whether interferon would pass through a dialysis membrane! The second experiment, started the same day, was to test whether interferon activity was destroyed by shaking a crude preparation with ether. It was; another hint that interferon was a macromolecule. Next we tested the stability of interferon at different pHs and then a series of experiments to see if it behaved like a macromolecule, either a polysaccharide or a protein. It was precipitated with ammonium sulfate, degraded by treatment with the proteolytic enzymes trypsin and pepsin, inactivated by shaking with butanol, but not inactivated with periodate – all suggesting it was protein rather than polysaccharide, and if a protein, then presumably it could be purified, possibly relatively easily. The first of these conclusions was true, but the second took a long time and was much more difficult. The first paper in the series 'Studies on the production, mode of action and properties of interferon' was submitted as early as 23 July 1957. Alick wrote papers very quickly, taking the laboratory notebooks home and producing a first draft by the next morning.

The next paper, submitted on 7 November, described the use of ultraviolet-inactivated (UV) virus to induce interferon. We found that the time of irradiation was important, short periods producing high yields, while longer periods led to a complete loss of effectiveness. These observations are now most readily interpreted as a measure of the capacity of the virus to form double-stranded RNA, the actual inducer.

How did it work?

The next paper was immodestly called 'Mode of action of interferon'. It seems incredible now that we could have thought that the problem was that simply solved. This short, rather complicated paper, showed that pretreatment of cells with interferon, followed by inactivated virus, led to an increased yield of interferon, a phenomenon called 'priming'. This has now been explained by the induction of otherwise rate-limiting transcription factors required to produce interferon messenger RNA. At the time, the best explanation we could produce, though ingenious, was very complicated, and the conclusion of that paper was remarkably dense and strikingly void of any molecular interpretation. It is a comment on how descriptive our understanding of cellular processes was then. In the event, all this was overtaken when others showed that interferon production was inhibited by treatment of virus-infected cells with actinomycin, an inhibitor of DNA-directed RNA synthesis. Since the virus used to induce was resistant to actinomycin, cellular DNA must be involved. That explained the cell specificity of interferon and provided the essential molecular framework for much of the work that followed in the early sixties.

Antiviral drug potential

Virus interference, which we now believed was mediated by interferon, was not virus-specific, so that one virus could interfere with the growth of a number of unrelated viruses. Could interferon be developed as an antiviral antibiotic? The next paper showed that interferon was active against three pox-viruses, vaccinia, cowpox and ectromelia, although herpes simplex appeared to be more resistant. So it really did look as if interferon could be developed as an antiviral antibiotic.

Interest in interferon was growing. Alick and I wrote an article titled 'Interferon: a possible check to virus infections' for the *New Scientist* in June 1958. We were invited to present our results at a Conversazione for the Fellows of the Royal Society in May 1958. We were all dressed up, in dinner jackets, and when we were asked to present our demonstration a second time at an event to which only the 'great and good' were invited, we had to wear white tie and tails, which I had to hire. I vividly remember dressing up in our very modest little North London flat, and sitting down with my wife to eat in my splendour, and she complimented me by putting on an evening dress, as we sat at the kitchen table, before I went off to the great event. It was a heady time; I was only 28.

Alick suggested that I should help 'with something interesting that we are doing on interference'. It was March 1957, and interferon was only a few weeks old.

Trials and tribulations

However, problems were beginning to surface. We were puzzled that we got protection against the growth of vaccinia virus in rabbit skin using chick interferon, for David Tyrrell had found that interferon was species-specific and that chick interferon was not active in rabbit cells. So was our result due to traces of UV virus in the interferon? If so, how many other results were due to traces of UV virus? This troubled us, and coincided with criticism from the US, where interferon was being called 'misinterpreton' and several eminent virologists were dismissing the effects as due to traces of virus. Alick was very depressed by this reaction; the first sign of a series of depressive setbacks which dogged him over the next few years. He was off work for a month or two and I spent that time repeating all the initial experiments with interferon which had been treated at pH 2 to destroy any UV virus, so as to be quite sure that the effects we had been observing, and publishing, were due to interferon and not to traces of contaminating virus. To our relief, all the early experiments held up.

Two lines of inquiry dominated our time for the next few years. The first was to see whether interferon could really be developed as an effective antiviral agent in the UK. In the late fifties the penicillin story still grated in Britain; the perception was that a British discovery had been 'handed over' to the Americans during the war and developed by them into an industrial production process which had been patented, on which we were now paying royalties. So the MRC was under pressure to determine if interferon could be developed as an effective antiviral agent in the UK. This resulted in a novel collaboration between the MRC and three major pharmaceutical companies: Glaxo Laboratories, ICI Pharmaceuticals and Burroughs Wellcome, (later the Wellcome Foundation). Set up about 1958, it had the specific aim of making enough interferon to do a clinical trial. I was a member of that committee, and Alick was chairman. The collaboration had its ups and downs, but it did achieve a trial against a vaccinia virus challenge in the upper arm of unvaccinated volunteers in the spring and summer of 1962. The outcome was two-edged: on the one hand, the collaboration had shown that interferon could be used in humans against a virus challenge, but on the other hand, it was not practical to prepare either enough interferon, or to deliver it early enough to be a useful therapeutic. The clinical development of interferon was put on hold for some years, for we could not make enough of it – a problem not solved until the development of large-scale production in human cells by Cantell in Helsinki and by Finter in the UK, and finally by means of gene cloning in the early eighties.

The other line, which was my responsibility, and filled my time until the early sixties was the purification of interferon, but that is quite another story!

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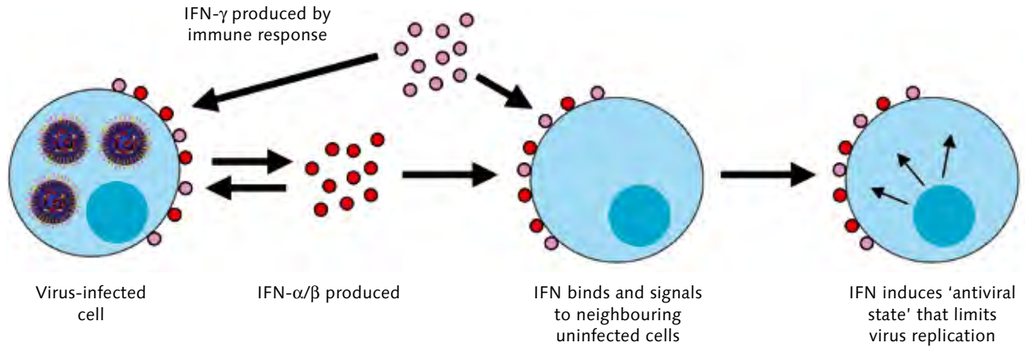
Viruses and interferon – 50 years on

Since its discovery in 1957 a huge amount has been learned about interferon and its importance in controlling virus infections. **Rick Randall** and **Steve Goodbourn** explain what's known now and what we still need to find out.



▲ Fig. 1. Antiviral action of IFN. *Rick Randall*

◀ A glass vial of IFN. Here, the crystal form of IFN is seen; it is made soluble when used as an injection. *James King-Holmes / Science Photo Library*

Although prior to 1957 scientists were studying the phenomenon of interference among animal viruses, it was 50 years ago that Isaacs and Lindenmann (working on influenza virus infection of chick chorio-allantoic membranes) first showed that virus-infected cells can release a substance, which they termed 'the interferon' (IFN), that when added to uninfected cells somehow interfered with subsequent virus infection (see Derek Burke's account on pp. 156–159).

Since then an enormous amount has been learnt about IFN and its importance in controlling virus infections. Indeed, when working correctly (which it rarely does due to virus countermeasures – see below), the IFN response is capable of controlling most virus infections, even in the absence of an adaptive immune response. We now know that IFN works by inducing what is termed an 'antiviral state' in cells and does so by up-regulating the expression of a large number of cellular genes (IFN-responsive genes), many of which have direct or indirect antiviral action (Fig. 1).

Examples of cellular genes upregulated by IFN with indirect antiviral activity include procaspases, which sensitize cells to undergo suicide (apoptosis) upon viral infection, and MHC molecules, that increase the chances of virus-infected cells being killed by the adaptive immune response (cytotoxic T cells); examples of proteins with direct antiviral activity include PKR and 2′,5′-oligoadenylate synthetase (both of which inhibit virus protein synthesis) and Mx proteins (that have a number of antiviral activities). However, there are still many cellular proteins that are upregulated by IFN whose exact antiviral function is not yet known. Much has also been learnt about how IFN is induced and how it signals to upregulate the expression of these cellular genes. Indeed, the mechanisms of IFN induction and signalling have been paradigms of cellular gene expression.

There are two types of IFN, namely IFN-α/β (a group of IFNs sometimes referred to as type I IFNs) that are released by virus-infected cells and specialist immune cells (including plasmacytoid dendritic cells), and IFN-γ (type II IFN) that is released by subsets of lymphocytes during an immune response. Cells which secrete IFN-α/β have a variety of receptors that recognize patterns of molecules (termed PAMPs), such as double-stranded RNA (dsRNA), which are characteristic of pathogens as they are not normally present in the absence of infection. These PAMP receptors, once stimulated by their appropriate ligands, activate intracellular signalling cascades that lead to the induction of genes that encode IFN-α/β. Once released, IFN-α/β binds to the IFN-α/β receptor on neighbouring uninfected cells (as well as on the initial infected cell) and activates an intracellular signalling cascade, known as the JAK/STAT pathway, leading to the upregulation of IFN-α/β-responsive genes. IFN-γ binds to a different receptor and activates a slightly different signalling pathway that leads to the upregulation of IFN-γ-responsive genes (there is some, but not complete, overlap between the sets of genes upregulated by IFN-α/β and IFN-γ).

Viruses counteract the interferon response

The recognition that IFN could inhibit the replication of many viruses soon led to the hope that it could be used as a general treatment for virus infections as an early 1960s 'Flash Gordon' cartoon illustrates (Fig. 2). However, we now know that one reason why IFN treatment of virus infections has not lived up to its early promise, and why in nature IFN is not always

▲ Fig. 2. Flash Gordon cartoon depicting the 'first' human use of interferon (1960). *Reproduced with permission of King Features Syndicate Inc.*

effective in controlling virus infections, is because viruses all have strategies for circumventing the IFN response. Usually this involves viruses making products that specifically prevent the IFN response from working correctly. Indeed, the general importance and potential power of the IFN response in controlling virus infections can be judged from the fact that even simple RNA viruses, with limited genetic capacity, nevertheless produce proteins that specifically antagonize the IFN response. Interestingly, the way in which viruses circumvent the IFN response varies and these different modes of action must be one of the major factors influencing the type of disease a particular virus causes.

Some viruses (e.g. poliovirus and some strains causing influenza) have a blunderbuss approach in which they globally block host cell gene expression/and or protein synthesis, thus preventing the cell from either producing or responding to IFN. Whilst extremely effective, such an approach has the major disadvantage that the infected cell will die fairly rapidly, thereby limiting the time in which the virus can complete its replication cycle. In addition, with such a strategy it may not be possible for viruses to manipulate cells to their own advantage, e.g. by inducing the cell cycle so that enzymes are produced that might be required for virus replication. Furthermore, these viruses will not be able to establish latent or persistent infections in cells in which cellular protein expression has been blocked.

As a result, many viruses have more subtle ways of circumventing the IFN response that include: specifically interfering with the cellular pathways that lead to the induction of IFN (e.g. hepatitis C virus, rotaviruses, herpesviruses), blocking the ability of IFN to signal in virus-infected cells (e.g. poxviruses, paramyxoviruses, rabies, dengue), inhibiting the activity of IFN-induced enzymes which have antiviral activity (e.g. influenza viruses, herpesviruses, poxviruses) or having a replication strategy which is largely insensitive to the actions of IFN (e.g. retroviruses). However, it is important to note that many viruses employ more than one of these mechanisms to circumvent the IFN response and, within these categories, different viruses achieve the same general outcomes using different molecular means.

Vaccines, antiviral drugs and oncolytic viruses

Although viruses encode products that block different arms of the IFN response, and whilst in general IFN has not been the hoped for 'wonder drug' in treating virus infections, nevertheless it has been successful in treating certain chronic/persistent infections, such as hepatitis C (although even here the success rate is only ~50–70 %).

By understanding at the molecular level how viruses counteract the IFN response, new medicines and new ways of combating infections may be developed.

Nevertheless, by understanding at the molecular level how viruses counteract the IFN response, new medicines and new ways of combating infections may be developed. For example, it is clear that if a virus fails to circumvent the IFN response it will be attenuated *in vivo*. Consequently, attenuated virus vaccines may be developed by specifically isolating viruses that are unable to circumvent the IFN response. This may be achieved either by genetically engineering viruses to knock-out their IFN antagonists, or by selecting mutants that are sensitive to IFN. The fact that most viruses encode specific IFN antagonists also raises the possibility that novel antiviral drugs may be developed which block the activity of the viral antagonists.

There is also a great deal of interest in using oncolytic viruses, which may be defective in terms of their ability to circumvent the IFN response, for cancer therapy. Such an approach may be useful in treating cancers in which the tumour cells are in some way deficient in their IFN response as IFN-sensitive viruses may be able to replicate and kill tumour cells, but not normal cells with an intact IFN response. Furthermore, the study of viral interactions with the IFN response has led to a deep understanding of the mechanistic details of IFNs and their actions. Since it now appears that IFNs play additional roles in the control of certain cellular/immune functions in the absence of virus infections, new cellular targets are being identified for drugs to control cell functions in a variety of conditions.

The future

Although a great deal has been learnt about how viruses interact with the IFN response in the last 50 years, the story is not over. The molecular events involved in IFN induction and signalling are not yet completely understood, much has still to be learnt about how many viruses block the IFN response and about the consequences that particular molecular methods employed by given viruses have for both the virus and host, and there are many opportunities of using the knowledge gained from such studies to improve human and animal health.

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Chemokines, receptors and virus infection

A mosquito (*Anopheles stephensi*) feeding on human blood. This mosquito is well known for transmitting malaria. *Sinclair Stammers / Science Photo Library*

A delicate balance exists between host chemokines, receptors and infections. **Edward Wright** discusses how these interactions show that host genetic factors play an important role in susceptibility to infections.

Since the discovery of interferon there has been a rapid increase in the number of cytokines identified. This extensive group of secreted proteins has been shown to regulate many different cellular processes. Some of these signalling molecules are constitutively expressed, being involved in homeostatic and cell migration functions, while others are expressed to high concentrations at sites of infection or tissue damage. The burst of cytokines, released in response to the presence of foreign pathogens and injury, results in the production of a cytokine gradient that is primarily established by a select group comprising nearly 50 *chemo*tactic cyto*kines*, or chemokines. This 'chemokine trail' enables the migration of immune cells to the required site where they release further inflammatory chemokines that in turn stimulate both innate and acquired immune responses, guide more immune cells to combat the infection and promote wound healing. While the major role of chemokines is to direct the movement of immune cells to sites of infection, some also have a role in immune surveillance, ensuring there is a constant presence of circulating lymphocytes in the blood. Both inflammatory and homeostatic chemokines are produced and secreted by many different cell types, including immune and muscle cells, and are closely linked to other cytokines having very similar functions.

Signalling

To elicit their effect on target cells, chemokines bind specific receptors on the cell surface. Attachment is a two-step process with the initial recognition and binding causing a conformational change in the chemokine before the final binding process can occur. As highlighted later, this two-step mechanism has been mimicked by some pathogens in order to hijack chemokine receptors as a point of cellular entry. While chemokines bind to different receptors, these are all anchored within the lipid bilayer and have seven transmembrane domains. As a result, four regions of the receptor are exposed to the extracellular environment that act in concert to bind the chemokine ligand. Once bound this stimulates a conformational change in the receptor, which itself causes the activation of a G-protein coupled to the intracellular domain of the receptor and a consequent signalling cascade ensues.

Similar chemokines have been identified in vertebrates such as fish, birds and amphibians, suggesting that chemokine signalling occurs by the same mechanism as that observed in mammals (described above). However, of the 24 mammalian chemokine receptors isolated, three, CCBP2/D6, Duffy Antigen Receptor for Chemokines (DARC) and CCX-CKR, are unable to induce downstream signalling as they lack an associated intracellular G-protein. Instead they target the chemokine for endosomal destruction by

internalizing it once bound to the receptor (hence they are termed 'interceptors'). These receptors are therefore thought to be more important in the control of circulating concentrations of chemokines than immune signalling.

Interfering with infection

It is not only chemokines that are able to bind chemokine receptors. Through co-evolution with their hosts, foreign pathogens have adapted to exploit these receptors in order to unlock cells and initiate infection. The first example of such an interaction was presented in the mid-1970s; it is well known that *vivax* malaria is endemic in most tropical and subtropical areas of the world; however, it was noted that more than 95 % of the population in West Africa is completely resistant to infection by the malarial parasite. Further investigation revealed that the malaria parasite *Plasmodium vivax*, along with its respective simian and murine relatives, *P. knowlesi* and *P. yoelii*, use DARC for attachment and infection of erythrocytes, and that protection from malarial infection correlates with the absence of DARC on red cells. It has since been shown that the lack of DARC expression on the surface of erythrocytes is due to a single nucleotide polymorphism that is differentially distributed across populations, but is at particularly high prevalence in West Africans.

HIV and AIDS

Since then, with the ever-expanding number of emerging infections and newly identified chemokine receptors, the number of pathogens that have been found to modulate the chemokine network has increased markedly. Six years after the DARC–malaria interaction was resolved, the first cases of possibly the best known infectious agent to use chemokine receptor entry was identified, human immunodeficiency virus (HIV). In 1984, within one year of HIV being confirmed as the aetiological agent causing acquired immunodeficiency syndrome (AIDS), its primary receptor, CD4, had been identified. However, it was quickly determined that another, unknown receptor was required for HIV to infect its target cells. Twelve years later this receptor was identified as a chemokine receptor and HIV is now known to be able to use more than 15 chemokine receptors in conjunction with CD4. Of these, two are used by the majority of circulating strains, CC receptor 5 (CCR5) and CXC receptor 4 (CXCR4), so named due to the arrangement of two cysteine residues in the chemokines they bind. As is the case when a chemokine binds its native, cellular receptor, the envelope of HIV must undergo a conformational change to bind CCR5 or CXCR4, but this is primarily seen as an immune evasion strategy since it keeps the major viral epitopes hidden from immune surveillance until the final moments.

HIV does not have it all its own way; genetic polymorphisms in chemokine receptors result in the inability of HIV to attach and subsequently cause infection. One of the most prevalent is the CCR5 Δ32 deletion, thought to have been selected due to the protection it conferred against smallpox and Black Death pandemics that swept across Europe until Medieval times. The deletion of 32 bp in the CCR5 gene causes the protein to remain cytosolic and to not be expressed on the cell surface. Without CCR5, HIV is unable to infect the cells and because strains that use CCR5 are transmitted at a much higher frequency than those that use CXCR4, individuals with this mutation are highly resistant to infection. This deletion is found only in Caucasian populations and at highest frequencies amongst Scandinavians (~15 % of the population) due to smallpox and Black Death infections persisting in that area longer than any other. However, it is not only chemokine receptor polymorphisms that affect HIV disease. Increased levels of CCR5 and CXCR4 ligands, known as anti-HIV chemokines, can also result in decreased risk of infection and longer survival. Higher circulating concentrations of these proteins will lead to less receptor without bound ligand and therefore fewer targets for HIV to bind. Whilst many stimuli can cause fluctuations in chemokine production, differences in the number of copies of genes encoding these chemokines (brought about by selective, segmental duplications in the human genome that enriches for immune genes) is known to be especially important in controlling HIV infection. Similar to the two genetic polymorphisms described above, the number of genes expressing anti-HIV chemokines is also distributed differently between populations. On average Africans have between five and six copies of a potent CCR5 agonist, macrophage inflammatory protein-1αP (MIP-1αP). However, Africans with more than six copies are less likely to become infected and progress more slowly to AIDS. The converse is seen in Africans with less than five copies of the MIP-1αP gene. In light of this and with resistance to current HIV drugs increasing, the possibility of complete saturation of CCR5 and CXCR4 has long been thought of as a novel target for an anti-HIV drug. Earlier this year Maraviroc, the first CCR5 small molecule antagonist, was licensed for use in Europe and America, having been shown to reduce HIV viral loads in clinical trials.

Other viruses

Other viruses known to use chemokine receptors to productively infect cells include respiratory syncytial virus and the poxvirus myxoma virus. However, a handful of pathogens have either captured host genes or evolved genes that allow them to express chemokines and receptor homologues, so called 'virokines' and 'viroceptors'. The majority of these are encoded by herpes- and poxviruses, which may be expected, given their genomes are amongst the largest of known viruses, encoding 100–250 genes. These virally encoded foreign proteins are used primarily for immune evasion and to establish the ideal replication environment for the pathogen. While the chemokine homologues only share 35–70 % identity with their host counterparts, they are still able to stimulate the same functions. Human herpesvirus-8 encodes several vMIPs that can promote cell maturation and other homeostatic processes, while human cytomegalovirus vCXC1 protein is able to initiate the migration of cells. A chemokine homologue has more recently even been isolated from a bacterium able to attract cells of the myeloid linage.

I have highlighted some examples that demonstrate the delicate balance that exists between host chemokines, receptors and infections. It is noteworthy that these interactions demonstrate that host genetic factors play an important role in susceptibility to infections and subsequent clinical outcomes. Taken together with the fact that malaria influences the spread of HIV infection, it becomes apparent that the interplay between host and pathogen, and different pathogens themselves can greatly alter chemokine responses and thereby significantly affect morbidity and mortality.

The interplay between host and pathogen can greatly alter chemokine responses and thereby significantly affect morbidity and mortality.

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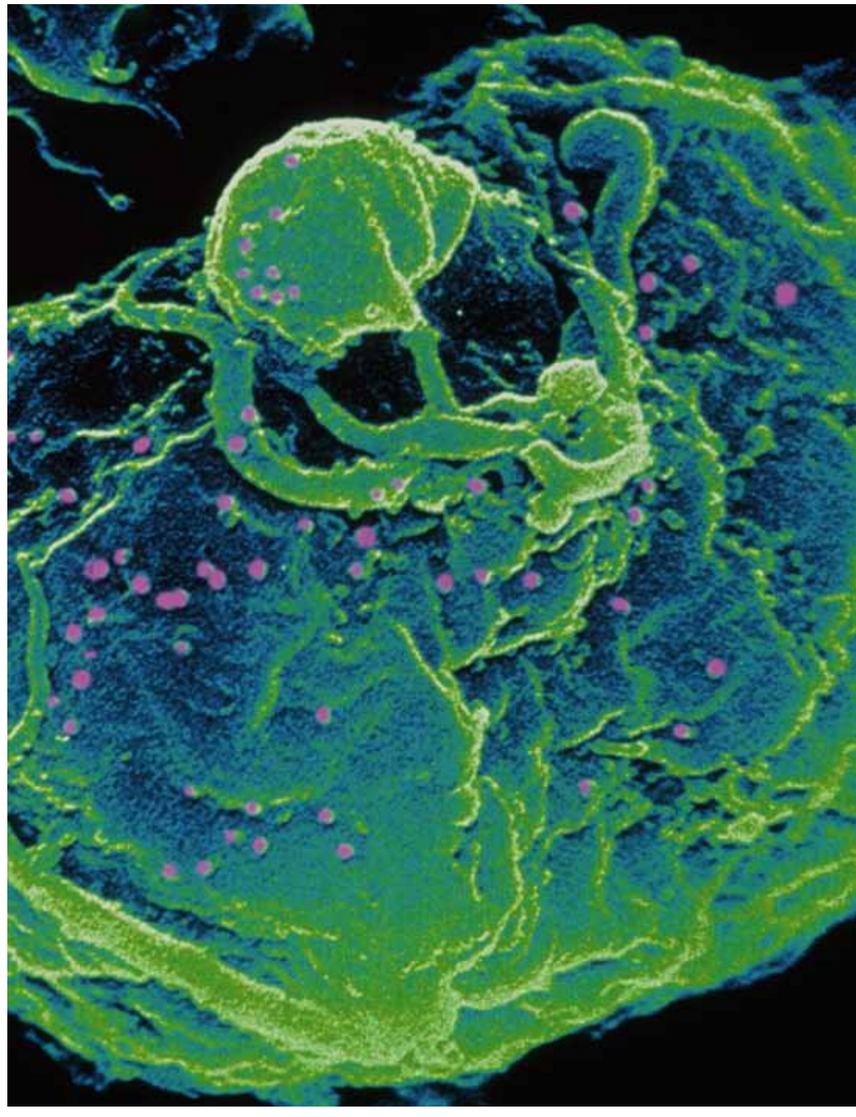


► False-coloured SEM of a T cell (green) infected with HIV (pink particles). HIV uses chemokine receptors expressed on the surface of immune cells to achieve attachment and infection. *Scott Camazine / CDC / Science Photo Library*

Gamma interferon and fungal infections

Available chemotherapies are not entirely successful in treating fungal infections, particularly in the immunocompromised, but **Javier Capilla**, **Karl Clemons** and **David Stevens** believe that cytokines can provide a useful adjunct to conventional antifungal drugs.

Through the first half of the 20th century, fungal infections were thought of as exotic diseases. However, coinciding with the greater availability and aggressive use of antibiotics, immunosuppressive treatments, and AIDS, the frequency of severe fungal infections and the diversity of the causal agents has continued to increase until the present day. Most severe fungal infections are caused by saprophytic soil species. With the exception of infections due to dimorphic fungi such as *Coccidioides immitis* and *Histoplasma capsulatum*, which are primary pathogens, or by commensal species such as *Candida* spp., severe life-threatening infections by fungi are quite rare in healthy patients. In spite of advances in treatment over the last 25 years, currently available antifungal chemotherapies are not optimal, especially for diseases in immunocompromised patients. In addition, fungal resistance to the antifungal therapy, the spectrum of causative agents and the toxicity of prolonged treatments are major difficulties in successful treatment. One desirable treatment strategy consists of immunomodulation to stimulate an adequate host response by the use of a cytokine, as an adjunct to conventional antifungal therapy.

In vitro studies

In the 1980s, substantial experimental data were published that suggested gamma interferon (IFN-γ) might have potential use in the treatment of non-viral infections by enhancing host defences.

Neutrophils, macrophages and dendritic cells are the first effector cells contacting fungal cells. Neutrophils are rapidly recruited to the site of infection and play an essential role in fungal killing. The presence of fungal cells and host effector cells initiates a cascade of events through both non-specific and specific mechanisms of host response. Lymphocytes T helper 1 (Th_1), a CD4+ subset, are the predominant response to infections by invasive fungi, and cytokines associated with the Th_1 phenotype, including interleukin (IL)-12, IL-8 and IFN-γ, are critical to protective responses to the infection. Conversely the Th_2-phenotype cytokines IL-4 and IL-10 contribute to the progression of the infection. Effector mechanisms of IFN-γ and its role in modulating the host response against fungi include stimulation of macrophage and neutrophil killing of fungi by enhancement of both oxidative and non-oxidative mechanisms.

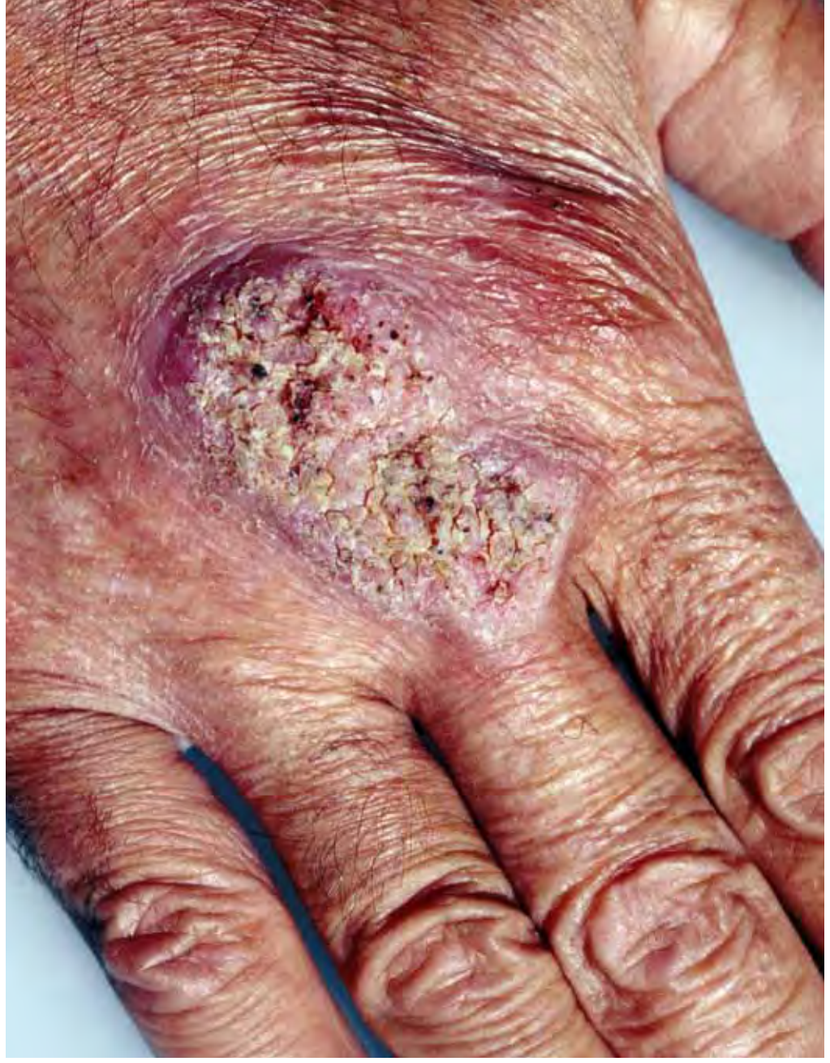
We have shown IFN-γ activity on host cells directed against intracellular and extracellular fungi, against the dimorphic fungi of the endemic mycoses and against fungal opportunists, with murine and human effector cells, with cells of the monocyte-macrophage lineage and with neutrophils, *in vitro*, *ex vivo*, and *in vivo*. *In vitro* studies using macrophages stimulated with recombinant IFN-γ showed an increase up to 44 % of the killing activity against *Candida albicans* (a phagocytable fungus) and 33 % against the non-phagocytable fungus *Blastomyces dermatitidis*. In addition, antibodies directed against IFN-γ neutralized the enhanced fungicidal activity of the macrophages or neutrophils.

In vivo studies

Animal models of cryptococcosis, paracoccidioidomycosis, coccidioidomycosis, blastomycosis, histoplasmosis, candidosis and aspergillosis have shown the beneficial effects of IFN-γ therapy in terms of survival and reduction of fungal burdens in infected organs. However, sole IFN-γ therapy has failed to induce complete clearance from infected tissues. In immunocompetent mice the administration of recombinant murine IFN-γ alone or in combination with amphotericin B, an antifungal agent, significantly improved the host's capacity to restrict the proliferation of *Cryptococcus* in tissues. IFN-γ was found to be more dramatic in its therapeutic effects in SCID mice infected with *Cryptococcus*. SCID mice are severely immunodeficient, mimicking the immune status of patients with AIDS that have severe fungal diseases. We

◀ Scanning electron micrograph of *Candida* and epithelial cells in the human vagina. *D. Phillips / Science Photo Library*

Data on the effects of IFN-γ therapy tell us that its activity enhances antifungal activity by activation of cell-mediated immune responses and that combining IFN-γ with an antifungal agent can result in powerful synergy.



◀ Lesion on the back of a patient's hand caused by blastomycosis, a fungal infection caused by *Blastomyces dermatitidis*. It usually affects the lungs after inhalation of fungal spores, but may become disseminated to the skin, or, in extreme cases to the bones, liver, spleen or central nervous system. *Scott Camazine / Science Photo Library*

demonstrated that intravenous administration of IFN-γ had an even greater beneficial effect than had been shown with the results obtained from immunocompetent mice. One possible explanation for this difference is related to the lower naturally occurring levels of IFN-γ in SCID mice due to T cell defects, and the phagocytic cells of those animals probably respond to a greater degree to exogenous administration of IFN-γ. These severely immunocompromised animals may also lack a variety of other defence mechanisms that might otherwise come into play in response to fungal infection. When IFN-γ was administered to *Cryptococcus*-infected SCID mice in combination with amphotericin B, the rate of cure achieved was significantly higher than using monotherapy, especially in central nervous system infection, demonstrating the synergistic effect of IFN-γ as an adjunct in severe impaired hosts. Similarly, IFN-γ in combination with conventional antifungal therapy was shown to be of benefit in models of systemic histoplasmosis.

However, others have reported IFN-γ to be of benefit or deleterious in murine models of candidosis. In a murine model of orogastrointestinal candidosis, a localized fungal infection, systemic administration of IFN-γ showed low or no beneficial effects – administration of IFN-γ was ineffective and its combination with suboptimal doses of fluconazole showed no synergism. Similar results have been reported in experimental pulmonary aspergillosis using intraperitoneal administration of IFN-γ, which had no benefit in prolonging survival of mice. Possible caveats to these findings are the importance of the route of administration of IFN-γ (e.g. intravenous IFN-γ, but not subcutaneous administration was beneficial in treating cryptococcal infection), frequency of dosing (e.g. daily dosing was deleterious, but dosing every other day was beneficial in murine cryptococcal disease) and the dosage used (i.e. too high a dose may be deleterious and too low a dose ineffective). Thus, thorough studies must be done before determining the utility of IFN-γ as an adjunctive therapy.

Turning to the importance of the compartmentalized response to IFN-γ, we explored the possibility of using gene therapy for delivering IFN-γ into the central nervous system to combat fungal meningitis by using an adenovirus vector carrying the murine IFN-γ gene under a cytomegalovirus promoter. Intracranial inoculation of the vector resulted in production of high concentrations of IFN-γ (>30,000 pg ml^{-1}) in the cerebrospinal fluid even 5 days after administration. Shao's group used a recombinant adenovirus vector containing murine IFN-γ cDNA (AdnIFN-γ) given intranasally in a murine model of pulmonary aspergillosis. They showed a 75 % reduction of fungal elements in lung and threefold higher survival than control animals or animals given IFN-γ intraperitoneally. Alveolar macrophages and lung leucocytes isolated from AdnIFN-γ-treated animals displayed enhanced killing of *Aspergillus* organisms *ex vivo*. Studies of this type suggest a potential clinical use for specific IFN-γ gene therapy in the future.

More recently, mice infected via the pulmonary route with a *Cryptococcus* sp. strain engineered to produce murine IFN-γ were able to resolve the primary infection and demonstrated complete protection against a secondary infection with a pathogenic strain, showing the importance of the stimulation of local cell-mediated immune responses and the development of protective host immunity. In contrast, a similar strategy against vaginal candidosis failed in protecting animals against experimental vaginitis.

Although IFN-γ appears to be a potential broad-spectrum antifungal agent, continued studies are needed to understand how better to modulate the regulation of the necessary part of the immune response during the course of the infection. The accumulated data on the effects of IFN-γ therapy tell us that its activity enhances the antifungal activity by activation of cell-mediated immune responses and that combining IFN-γ with an antifungal agent can result in powerful synergy.

Clinical use of IFN-γ

A good deal is known about the safety and use of IFN-γ in humans. Patients with chronic granulomatous disease have an increased risk of developing pulmonary aspergillosis, and IFN-γ treatment is routinely used to increase their resistance to this infection, among others. Recombinant human IFN-γ-1b (rhIFN-γ-1b) has also been given safely to patients with invasive fungal infections, including those with severely impaired immune status. In a small clinical trial on cryptococcal meningitis, those given adjunctive IFN-γ cleared *Cryptococcus* from the CSF more rapidly than those not given IFN-γ. The adjunctive use of IFN-γ did not result in serious adverse effects. The measurable improvement of disease noted following rhIFN-γ-1b therapy indicates the need for large-scale trials. IFN-γ is currently regarded as salvage therapy for patients with refractory invasive fungal infections that fail conventional antifungal treatment. The recommended dose of rhIFN-γ-1b for adult patients is 50 μg m^{-2} of body surface area, given every other day until resolution of the infection is evident clinically. However, the study of adjunctive IFN-γ therapy should be considered early, especially for severely immunosuppressed patients.

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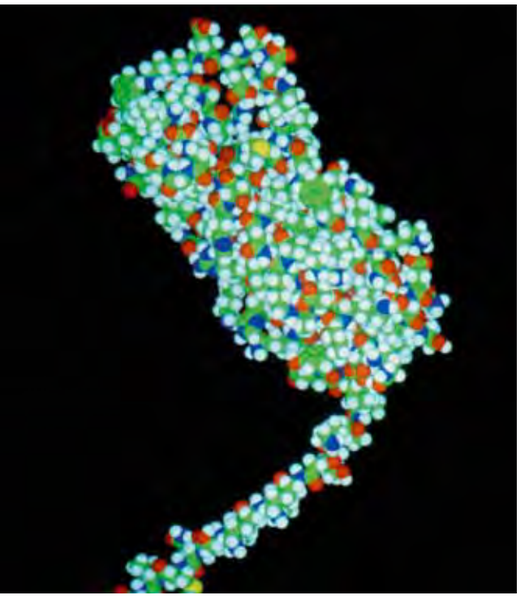
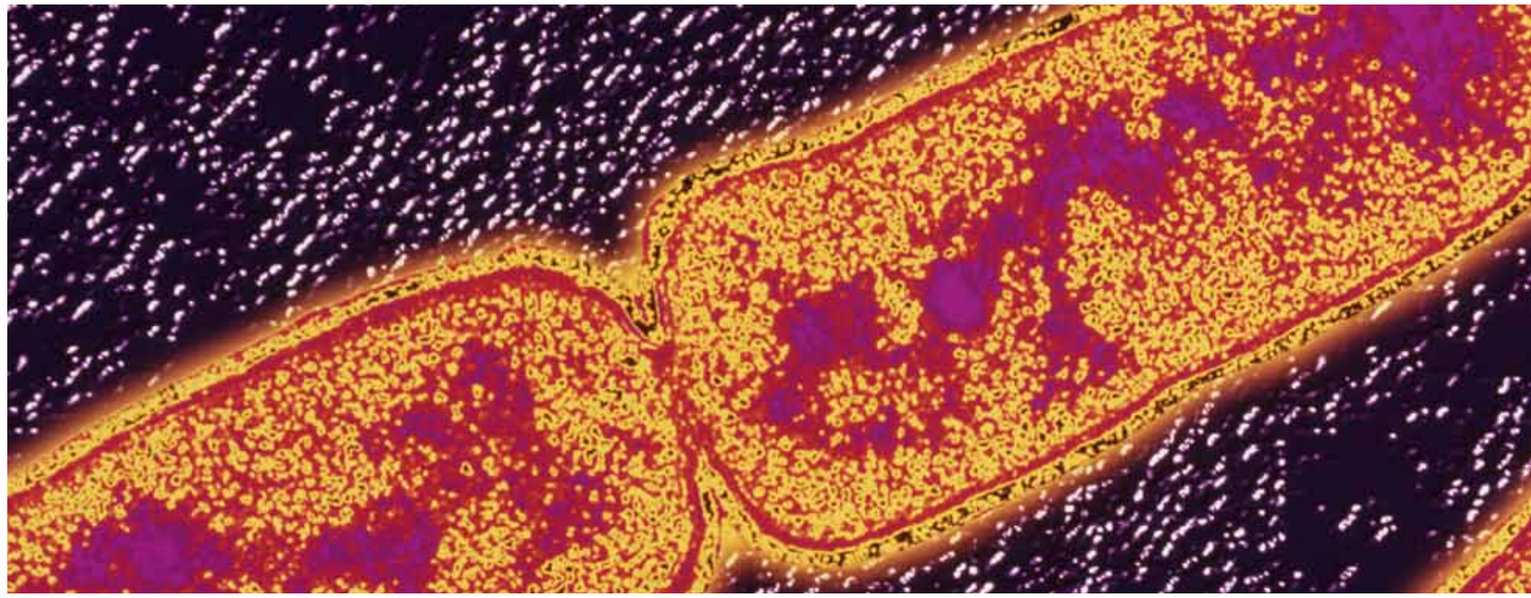


▲ Computer-generated model showing the proposed structure of gamma interferon. *J.C. Revy / MGH J. Novotny – Boston / Roussel Uclaf / Biosym. / Science Photo Library*



▶ Transmission electron micrograph (TEM) of *Mycobacterium tuberculosis* bacteria. *Alfred Pasieka / Science Photo Library*

Gamma interferon – key, but not sufficient for protection against TB?

M. tuberculosis is a classic intracellular pathogen – so macrophage activation by gamma interferon should be key to protection. But the picture may be more complicated, as **Hazel Dockrell** discusses.

Mycobacterium tuberculosis is an intracellular pathogen, choosing to live within macrophages, where it inhibits antibacterial processes such as phagosome–lysosome fusion. It also expresses haemolysin-like molecules that might, like *Listeria*, enable its escape into the cytoplasm, although confirmed evidence of this is still lacking. It induces granuloma formation within the lungs, which can progress to caseating necrosis, enabling its spread by coughing, and resulting in the destruction of lung tissue. The classic test for infection, the Mantoux skin test, measures recruitment and activation of antigen-specific T cells in a delayed-type hypersensitivity test. This focus on cell-mediated immunity has led to a major interest in the role of gamma interferon (IFN-γ).

Mice – and humans – that are unable to make or to respond to IFN-γ are highly susceptible to mycobacterial disease

Some of the earliest experiments in which cytokine genes were knocked out clearly showed that mice unable to make IFN-γ become highly susceptible to infection with *M. tuberculosis*. This susceptibility has been exploited to provide a model system in which the activity of anti-TB drugs can be tested in 8 days rather than the usual 1–1.5 months.

Mutations in the human IFN-γ receptor also result in susceptibility to mycobacterial disease. Although very rare, a number of individuals with mutations in the IFN-γR1 or IFN-γR2 chains of the IFN-γ receptor have been identified, and these individuals are more susceptible to infection with mycobacteria. Supporting the role of IFN-γ and its signalling pathways in immunity, similar Mendelian inheritance of Stat1, IL-12RB1 and IL-12p40 mutations have also been identified in susceptible individuals. More minor variations in the ability to make or respond to IFN-γ may also exist, as two variants in the IFN-γ promoter region, and a variant in the IFN-γR1 promoter have been shown to be associated with pulmonary tuberculosis in a West African population.

IFN-γ during active disease and following treatment

During active clinical tuberculosis, peripheral blood IFN-γ responses to mycobacterial antigens are present in cultures stimulated for 5–6 days, but are suppressed relative to those in healthy contacts. This depression is associated with the extent of disease, increasing from mild to moderate to advanced, and is particularly marked in patients with the disseminated miliary forms of disease. The ratio of IFN-γ to IL-10 can also be used as a marker of disease severity. With successful treatment, there is a recovery of the responses, one surprise being the rapidity with which such changes start after the initiation of treatment. A common interpretation of these depressed IFN-γ responses in active tuberculosis is that the cells capable of making IFN-γ are attracted to the site of disease in the lungs, and so are being missed in the assays normally performed on blood samples. The cells in bronchoalveolar lavage are able to produce better IFN-γ responses than those in the blood – and the presence of IFN-γ in pleural effusions can be used to help diagnose tuberculous pleurisy. However, recent findings that IFN-γ signalling processes are also

depressed in peripheral blood cells suggest that something more fundamental than just compartmentalization of antigen-specific cells is occurring and that *M. tuberculosis* may be actively inhibiting such beneficial T cell immunity.

If IFN-γ is key to protection, can it be used as an adjunct to treatment?

IFN-γ, given as an aerosol, has been used as a treatment for patients with refractory multidrug-resistant tuberculosis, or *M. avium/intracellulare* infection, with beneficial although temporary effects on bacterial loads. In mice, IFN-γ given intranasally extends the passive protection given by IgA antibody to the α-crystallin antigen.

Use of antigen-specific IFN-γ secretion as a marker of tuberculosis infection

Two commercial assays that measure IFN-γ production in response to stimulation with peptides from antigens called ESAT-6 and CFP10 (with an additional TB7.7 peptide in one case) are now available. These determine either the release of IFN-γ in a simple overnight whole-blood assay that uses a very sensitive ELISA (the QuantiFERON-Gold test) or the number of IFN-γ-producing cells in an overnight ELISPOT assay (T-SPOT.TB). Due to the relative specificity of the peptides used, BCG vaccination does not induce a false-positive result in these tests. These IFN-γ release assays were introduced to diagnose latent TB infection, but both latent and active tuberculosis infection can give positive results. Certainly, recent work has shown that latent tuberculosis is not a situation in which the bacilli are in a deep and silent sleep, but rather that during latency particular families of proteins are expressed, and that both maintenance of latency and the resuscitation of bacilli back into active growth are active processes. If an IFN-γ response is related to bacterial load, then such assays may also be able to monitor disease progression.

These overnight assays require the presence of cells that are capable of making IFN-γ quickly, and it is assumed that this reflects an ongoing immune response in the individual. Some studies, using an overnight ELISPOT assay, have shown that the numbers of IFN-γ-secreting T cells falls with a decline in bacterial load during treatment. However, in a group of household contacts in Uganda, IFN-γ production in a 5-day assay was greater in those that subsequently became Mantoux-test-positive than in those who remained test-negative. So the relationship between the shorter and longer term IFN-γ assays may not be as simple as 'short=ongoing immune response' and 'longer term=memory response resulting from prior exposure'.

IFN-γ as an indicator of immunogenicity in vaccine trials

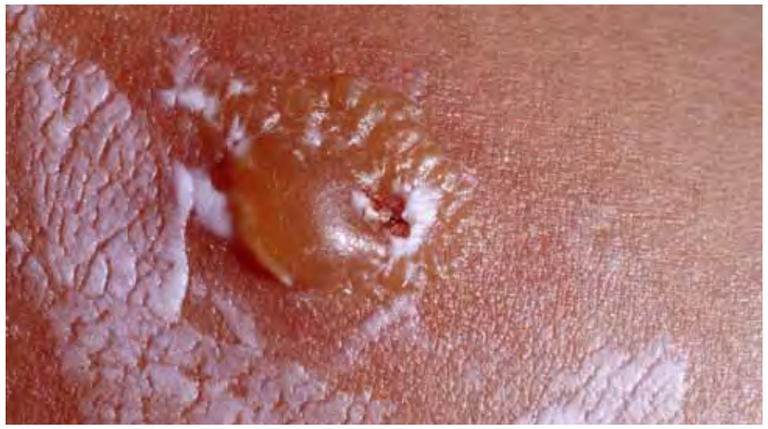
There are early trials of several new TB vaccines either ongoing, or starting in the near future, and most are using the *ex vivo* IFN-γ ELISPOT as the main read-out of immunogenicity, with a recommendation from a WHO TB vaccine working group that a longer term IFN-γ assay, such as the 6- to 7-day diluted whole-blood assay, be used as well. In studies of BCG vaccination in infants or adolescents, vaccination induces a marked increase in IFN-γ production to mycobacterial antigens in most immunologically naïve vaccinees. So far, in trials of novel TB vaccines, IFN-γ seems to be a good measure of vaccine immunogenicity.

IFN-γ may not be a correlate of protection

So can IFN-γ be used as a correlate of protection? It is a well behaved cytokine that is produced in excess in culture and that is stable in culture supernatants or on storage. Its production, by antigen-specific T cells, is increased by BCG or TB vaccines. And it seems to be important in immunity. Yet when asked about its value as a correlate of protection, the consensus among immunologists seems to be 'IFN-γ is necessary, but not sufficient'. So what is the problem?

The problem comes from three separate issues. First, although IFN-γ may be required for protection, it is a marker of disease as well as immunity. The finding that IFN-γ secretion is associated with Mantoux skin test induration in most, if not all, subjects also raises questions about exactly what IFN-γ production reflects. Second, when IFN-γ production is present, there are situations where more is not better – more IFN-γ production may mean more pathology or less protection, for example in bovine tuberculosis in calves. Another recent study showed a poor correlation between antigen-specific IFN-γ production by CD4 T cells and protection in BCG-vaccinated mice. And finally there really is no hard evidence in man to show that those with greater IFN-γ production are better protected against development of TB than those with less or no detectable IFN-γ production.

Although IFN-γ is a good indicator of TB vaccine immunogenicity, it is unlikely that it will prove to be a correlate of protection on its own.



◀ Arm of a person who has tested positive for tuberculosis (TB) in a Mantoux skin test. *Martin M. Rotker / Science Photo Library*

A complex future…

So what is needed? First, trials that will measure IFN-γ production prior to development of disease, to assess whether those who do make more or less IFN-γ (in shorter term or longer term assays) will have better or worse protection against tuberculosis. One such study is underway in South Africa, where production of IFN-γ (as well as other cytokines) in overnight assays following stimulation with BCG is measured 10 weeks after BCG vaccination and then the infants were followed for 2 years, so that immune responses in infants that did, or did not, develop tuberculosis could be compared. Other large multicentre studies are comparing immune responses in HIV-negative or -positive known TB contacts over time so that biomarker profiles can be compared in those who do or do not develop TB.

So although IFN-γ is a good indicator of TB vaccine immunogenicity, it is unlikely that it will prove to be a correlate of protection on its own. Additional assays that will measure more cytokines and chemokines using multiplex methods, that will assess whether IFN-γ is made by particular T cell subsets that simultaneously make one or more other cytokines, or that assess gene activation on the grand scale using microarrays, will be used in these studies. This is very sensible, because if IFN-γ induces expression of about 1,000 genes in a macrophage, true protective immunity may require a particular group of genes to be switched on (or alternatively, some genes to be switched on while others are switched off). Given the heterogeneity of real people, and the variability in the clinical features of tuberculosis, there is unlikely to be a quick or easy answer here. But what is discovered may give us further insights into immunity to intracellular infections, and to the complex interplay between *M. tuberculosis* and its host.

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Historical anecdotes

Adolf Mayer: a pioneer in virology 125 years ago

Adolf Mayer (1843–1942) studied agrochemistry in Stuttgart and Heidelberg in the Humboldtian tradition and became professor at the latter university in 1870. After his request to build a new agrochemical laboratory at Heidelberg was refused, Mayer accepted a professorship in Wageningen in 1876. He became the first director of the newly established Agricultural Research Institute there, which laid the foundation for the current strong position of Dutch science-based agriculture.

In 1882 Mayer described the first really scientific experiments on viruses of the modern era. He was asked by local growers to look into the problem of a disease in tobacco, which they described as 'vuil' or 'dirt'. He carried out a few seminal experiments. He inoculated healthy tobacco plants with filtered juice from infected tobacco plants. The plants soon showed the mosaic symptoms so characteristic of the disease. He could not find fungi or yeasts in the filtrate, nor could he see bacteria under the microscope. Mayer concluded that the infectious agent could be a very small bacterium or an 'infectious enzyme'. The latter suggestion was quite bold at a time when bacteria were considered to be the main cause of infectious diseases. His published paper went unnoticed as it was written in Dutch, but an updated German version was published in 1886. Mayer also coined the name 'tobacco mosaic disease' in these papers.

Mayer must have discussed his results on the mosaic disease in tobacco with a close colleague in Wageningen, the botanist Martinus Beijerinck (1851–1931). Beijerinck continued to research the mosaic disease, although he moved to Delft, where he became a professor and founded the 'Delft School of Microbiology'. Beijerinck postulated his infamous '*contagium vivum fluidum*' hypothesis on the nature of viruses in 1898 and also coined the word 'virus'. This year we celebrate the 125th anniversary of Mayer's paper, which marks the birth of modern virology and also highlights Adolf Mayer as a pioneer in the field. In his footsteps viruses are still being studied in Wageningen, the last 50 years via the Laboratory of Virology.

In 1904 Mayer retired because of ill health and returned to Heidelberg, where he continued to write on a wide range of scientific topics until his death nearly 40 years later.

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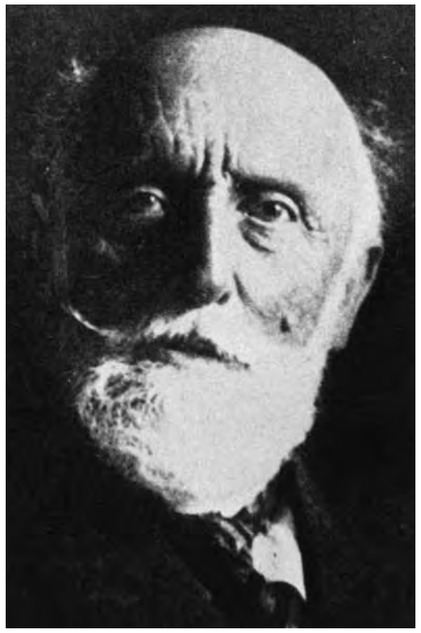

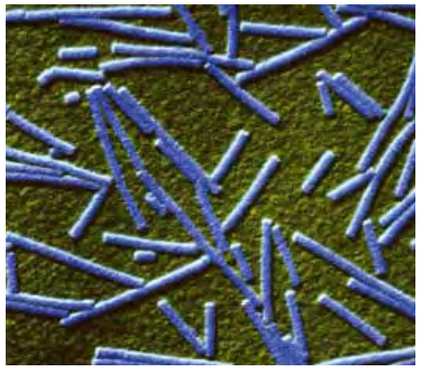

How the SGM Fleming Award began

In November 1974, SGM Council member Howard Rogers, an expert on bacterial cell walls working at NIMR, Mill Hill, proposed that the Society should establish an annual award for outstanding work by a young microbiologist. Council agreed to consider the idea and his paper on the award was discussed in March 1975. He suggested that the award should be named after Alick Isaacs who had died aged 45, 10 years after he and his co-worker Jean Lindenmann had discovered interferon. Opinion on Council was so evenly divided between those in favour and those opposed to such an award that the proposal was neither accepted nor rejected, but deferred for consideration on a future occasion.

At the following Council Meeting I asked that Howard Roger's proposal be circulated again and discussed at the next meeting. I pointed out that by then elections would have been held and that with a change in membership a firm decision, for or against the proposal, was likely to result. My proposal, seconded by Stewart Glover, was accepted by Council. In July 1975 Howard introduced his paper again, and explained the salient points. The concept of an award for young microbiologists was now accepted by Council, and it was agreed that the rules should be finalized at their October meeting. Detailed rules for the award were duly presented by Rogers, but there was little enthusiasm for the proposed name of 'Isaacs' Lecture'. Roger Stanier, Council's first overseas member, based in Paris, thought that the award should be named after a really well known microbiologist and suggested Alexander Fleming, asking if he had been a member of the SGM. It was confirmed that not only had he been a member, but the Society`s first President, and so the award became the Fleming Lecture.

The prize was set at £250 and the rules were published in the *Proceedings of the Society* that November. The first award committee included both Rogers and Stanier. I put forward the mycologist Graham Gooday as a candidate for the first Fleming Lecture, my proposal being seconded by Tony Trinci. I had been told that as mycologists were greatly outnumbered by bacteriologists and virologists in the SGM, none was likely to be on the award committee, and that I was probably wasting my time. However, this discreditable viewpoint was proved to be false, Graham Gooday becoming the first recipient of the award in 1976. He was later active on the Council of the SGM and President of the British Mycological Society, but died in 2001.

Members owe much to Howard Rogers for his far-sighted suggestion and his persistence with it. Since the award was instituted, 34 young microbiologists have delivered the prize lecture and many of them have gone on to achieve distinguished careers, honours and in one case (Paul Nurse) a Nobel prize. Rogers himself was an outstanding microbiologist and biochemist, who, after retiring from Mill Hill in 1983, was active in research right up until his death in 1990. He was an original member of the SGM, on Council 1973–1977 and International Secretary 1977–1982.

Michael J. Carlile
SGM Council member 1972–1976;
Meetings Secretary 1977–1980
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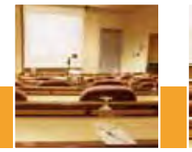
◀ Top. Adolf Mayer (1843–1942), German agricultural chemist. In 1886 he showed that mosaic disease could be passed between tobacco plants. It was not until 1936 that the actual culprit, *Tobacco mosaic virus* (TMV), was isolated. *Science Photo Library*

◀ Bottom. False-coloured TEM of tobacco mosaic virus (TMV) particles. *Omikron / Science Photo Library*

▲ Left. A young Alexander Fleming (1881–1955) in his laboratory at St Mary's Hospital, Paddington, London, in 1909. *St Mary's Hospital Medical School / Science Photo Library*

▲ Right. Howard Rogers (1918–1990), one of the original members of SGM and the instigator of the SGM Fleming Award. *SGM*

meetings



Spring**08** | Edinburgh International Conference Centre

31 March–3 April 2008 | 162nd Meeting

Plenary Bacterial secretion systems: commonality and diversity

31 March–1 April 2008
Organizers I.R. Henderson, H.M. Lappin-Scott, P.C.F. Oyston, T. Palmer & C. Winstanley

Speakers

A.J.M. Driessen The Netherlands – *Mechanism of ATP-driven translocation by the bacterial preprotein translocase*

T. Economou Crete – *The bacterial Sec translocase nanomotor: structure and function*

H. Bernstein USA – *The signal recognition particle targeting pathway in* Escherichia coli

R. Dalbey USA – *Inserting and assembling proteins into bacterial membranes by the YidC insertase*

T. Palmer Dundee – *Transport of folded proteins by the bacterial Tat pathway*

J. Cox USA – *The ESX-1 secretion pathway in virulent mycobacteria*

O. Schneewind USA – *Targeting proteins to the cell wall envelope of Gram-positive bacteria*

W.R. Zückert USA – *Bacterial lipoproteins: through the periplasm and beyond*

M.H. Saier USA – *The evolution of transport proteins: from simple peptides to complex metabolons*

T. Silhavy USA – *Outer membrane biogenesis in Gram-negative bacteria*

V. Koronakis Cambridge – *Type I*

G. Cornelis Switzerland – *Assembly of the* Yersinia *Ysc injectisome*

P.J. Christie USA – Agrobacterium *type IV secretion: mechanism of action and role in pathogenesis*

A. Pugsley France – *The secrets of secretins*

I.R. Henderson Birmingham – *Type V secretion: barrel mediated protein translocation across the outer membrane*

E.G. Dudley USA – *Type VI secretion systems: new players in the bacterial pathogenesis arena*

Special events

Communicating microbiology

Education & Training
31 March – *Workshop*
1 April – *Demonstrations*
Organizers B. Unsworth, J. Verran & J. Hurst

Postdoc and beyond – planning for a research career

2 April
Short talks on strategies to improve your chances of a career in research will be followed by Q&A, a buffet and wine. Entry is free, but by ticket only, so make sure you tick the box on the booking form. If applying for a PG conference grant, attending the workshop qualifies you for overnight accommodation on the Wednesday.

Social events

Monday 31 March
Welcome Reception
Ceilidh & Supper *(entry by ticket only)*
Tuesday 1 April
Society Dinner *(at the Hub)*

Registration

Registration is through the SGM website (www.sgm.ac.uk/meetings).

Registration fees per day *(incl. lunch, refreshments, abstracts book, conference literature, welcome reception)*

Earlybird (up to 29 February 2008)

Ordinary Members*	£45
Student/Associate Members*	£25
Non-members	£115
Retired/Honorary Members	Free

Full (after 29 February 2008)

Ordinary Members*	£55
Student/Associate Members*	£35
Non-members	£125
Retired/Honorary Members	£10

Please note: to qualify for earlybird rates, 2008 membership fees must be paid by the deadline of **29 February.*

Postgraduate Conference Grants

These will be available, subject to the usual conditions. See **www.sgm.ac.uk/grants/pg.cfm**

Abstracts

The deadline for receipt of titles and abstracts for offered presentations is **30 November 2007**.

Hot topic

Microbes and climate change

2 April
Organizers Hilary Lappin-Scott, M.J. Bailey & S.K. Burton

Other sessions

Type V secretion

Cells & Cell Surfaces – 2–3 April
Organizers I.R. Henderson & K.R. Hardie

Biological basis of infection control

Clinical Microbiology
31 March–1 April
Organizers S. Lang, M.M. Tunney & M.R. Barer

How to pass the MRCPath Part 2: tips for the exam

Clinical Microbiology / Clinical Virology / Education & Training
2 April
Organizers S. Collier, J. Clayton, S. Warren & J. Verran

Vaccines against viral infections from concept to practice

Clinical Virology
31 March–1 April
Organizers P.A. Cane & A.R. Fooks

Microbial metabolism of nitrogen, phosphorus and sulfur-containing compounds

Environmental Microbiology
31 March–1 April
Organizer J.W. McGrath

Commercial industrial bioprocess development

Fermentation & Bioprocessing
1 April
Organizers S.M.Stocks & P. Bentley

Transmission of viruses through the food chain

Food & Beverages – 3 April
Organizers K.H. Mellits, J. Gray & C.E.D. Rees

The horizontal gene pool: the mobilome and virulence

Microbial Infection / Physiology, Biochemistry & Molecular Genetics
2–3 April
Organizers H.E. Allison & G.W. Blakely

Prokaryotic cell biology

Physiology, Biochemistry & Molecular Genetics
31 March–1 April
Organizer D.H. Edwards

Cyanobacteria, architects of our environment: who are they and what do they do?

Systematics & Evolution / Environmental Microbiology
2–3 April
Organizers A. Willems & A. Wilmotte

Virus modulation of host defences

Virus – 31 March–1 April
Organizers R.E. Randall & G.W.G. Wilkinson

Control of virus gene expression

Virus – 3 April
Organizers S.G. Siddell, L.O. Roberts & A.J. Sinclair

Workshops

Virus Group Workshops

2 April

Plant viruses	DNA viruses
RNA viruses	Retroviruses
Prions	

Rapid diagnostics

Clinical Virology – 31 March
Organizer E. O'Kelly

Irish**Branch**

Regulatory mechanisms in host–pathogen interactions

National University of Ireland, Galway – 27–28 March 2008
Organizer Conor O'Byrne (e conor.obyrne@nuigalway.ie)

For details of Irish Branch activities contact Evelyn Doyle (e evelyn.doyle@ucd.ie).

Abstract**Book**

The full text of the abstracts book for the 161st Meeting, University of Edinburgh, is available as PDF files on the SGM website.

Other**Events**

Federation of Infection Societies Conference

Cardiff – 28–30 November 2007
www.fis2007.org.uk

Antibiotics – Where Now?

Royal Institute of British Architects, London – 21 January 2008
www.rsc.org/antibiotics08
Organized by the Bio-Organic Group of the Royal Society of Chemistry and co-sponsored by SGM. SGM members can attend at RSC member rate.

Molecular Biology of Archaea

St Andrews – 19–21 August 2008
www.biochemistry.org/meetings
Biochemical Society/SGM

Meetings on the web

For up-to-date information on future Society meetings and to book online see **www.sgm.ac.uk**

Meetings organization

The SGM meetings programmes are organized by the committees of the special interest groups, co-ordinated by the Scientific Meetings Officer, **Professor Hilary Lappin-Scott**. Suggestions for topics for future symposia are always welcome. See p. 199 for contact details of Conveners.

Administration of meetings is carried out by **Mrs Josiane Dunn** at SGM Headquarters, Marlborough House, Basingstoke Road, Spencers Wood, Reading RG7 1AG (t 0118 988 1805; f 0118 988 5656; e meetings@sgm.ac.uk).

Offered papers & posters

Many Groups organize sessions for the presentation of short oral papers or allow intercalated papers within their symposia. Offered posters are welcome at all Society meetings.

Offered posters

Each poster should be associated either with the Plenary topic or with a Group. The subject content of the latter should be relevant to the remit of a Group (see website for details); it does not have to relate to the topic of the Group Symposium taking place at a particular meeting. General Offered Posters will not be accepted.

Abstracts

Titles and abstracts for all presentations are required in a standard format and should be submitted through the SGM website. Deadlines for submissions are published in *Microbiology Today* and on the web. For further information contact the Events Administrator.

Schools Membership costs only £10 a year. Benefits include *Microbiology Today*, advance copies of new teaching resources and discounted fees on SGM INSET courses. To join see www.sgm.ac.uk/membership. Enquiries: education@sgm.ac.uk or go to www.microbiologyonline.org.uk for full details of resources and activities.

▲ The two Johns (JS, left) pause before clearing up and reloading the NCBE van – for the 50th time. *John Schollar*

The two Johns *rock*!

As the number of SGM Basic Practical Microbiology courses sparkles towards its diamond anniversary, the Two Johns, **John Grainger** and **John Schollar**, reflect on their 6 years on the road.

Little did we realize in 2001 when we responded to a call from Janet Hurst and Dariel Burdass to give a series of SGM courses on basic microbiology techniques for secondary school teachers and technicians that, 6 years later, we would still be in business. With the landmarks of 50 courses and 1,000 delegates behind us, and the programme for 2007–08 ahead (see Table 1), we mark the continuing success of this SGM initiative by describing what is involved.

The preparations

There are 9–10 full-day courses a year, each catering for up to 24 trainees. Most are held in university laboratories thanks to a local SGM member; others take place in university education centres and regional science learning centres. SGM headquarters staff, principally Yvonne Taylor, deal with publicity, bookings, etc. The cost to participants is subsidised and there is also a contribution to the cost of supply teacher cover. There is no charge for the small number of courses for PGCE students.

The entire practical resources for the courses are commissioned from the National Centre for Biotechnology Education (NCBE), University of Reading. They are assembled by Bene Watmore and transported in the NCBE van, driven by JS, accompanied by JG having pretentions to be navigator. Thus far, the courses have taken us more than 9,000 miles by land and sea.

The delivery boys

We have worked together for some 20 years, from when JS moved from being Head of Biology at a large comprehensive school in Berkshire to the NCBE at Reading which JG, an academic microbiologist, had recently co-founded – as an outcome, incidentally, of a previous SGM schools initiative.

The course

The course is accredited by SGM. It consists of mainly hands-on activities and draws on the SGM's *Basic Practical Microbiology: a Manual* which was written specially for the course. So far, some 4,000 copies of this 40-page book have been distributed on courses and by request (available free of charge), a significant coverage among schools and colleges. There is attention throughout to health and safety issues which are often viewed, quite unnecessarily, as sufficiently daunting to prevent or limit practical work in microbiology.

The day begins with 'The basics', starting with a discussion of risk assessment, followed by a familiarization with equipment and apparatus, culture media, and disinfection (spillages'r'us!) and the use of the autoclave/pressure cooker, all with attention to costs. Then there is experience in aseptic technique, including pouring agar plates, making streak plates and transferring cultures between test tubes by loop (two methods, 'pathetic' and 'professional', as we call them!), and instruction in labelling, incubation and safe disposal.

Table 1. Basic Practical Microbiology Courses 2001–2008: around the country in 80 months (clockwise)

Venues and no. of courses		
Reading (12)	Liverpool (1)	Leicester[b] (1)
Plymouth (1)	Manchester (1)	Leicester[c] (5)
Exeter (2)	Chorley (1)	Birmingham (1)
Bristol (1)	Douglas, IoM (1)	Warwick (1)
Cardiff (1)	Belfast (4)	Hatfield (1)
Swansea (1)	York (2)	London (3)
Aberystwyth[a] (2)	Leeds[b] (1)	Kingston[a] (4)
Wrexham (1)	Leeds[a,c] (6)	Guildford (5)
Northwich (2)	Lincoln (1)	

Totals: 62 courses at 26 venues
[a], for PGCE students; [b,c], different venues.

After lunch, there is advice on maintaining, preparing and using cultures, followed by 'Microbiology in action' which consists of two activities, testing sensitivity to antimicrobials, and Gram's staining method and microscopy. Some of the techniques covered in 'The basics' are reinforced here, but others are also introduced, e.g. using pipettes, forceps and spreaders, and making smears and their examination using oil-immersion.

The accreditation

An accreditation certificate is awarded for attending the course and successful completion of an assessment. There is a theory test, an open book, multiple-choice test based on the day's course, and a practical proficiency test involving three manipulations that have been learnt during the day, re-done if necessary until competence is achieved. The very few participants who do not pass the theory test are invited to have another attempt later; but very rarely does anyone take up this opportunity.

The evaluation

Feedback from the evaluation forms is very positive. Members particularly appreciate the hands-on nature of the course as they are more used to enduring a 'sit-and-take-notes-all-day' format. The course manual and resources pack of SGM and Microbiology in Schools Advisory Committee (MiSAC) teaching support materials and careers information are greatly valued. Participants also appreciate the opportunities to ask us questions and pick up tips, and to share experiences.

There are occasional suggestions for improvement, but more usually the responses are along the lines 'If it ain't broke, why fix it?'. Although it is a very demanding day, particularly for those technicians who have little or no experience of being on a course, comments such as '*The best course I have ever attended*' and '*Thank you for a most informative day that was also great fun*' – and '*The Two Johns rock!*'– are not unusual.

And we thoroughly enjoy ourselves as well!

John Grainger
Chairman of MiSAC and Visiting Fellow at the School of Biological Sciences, University of Reading. (e j.m.grainger@reading.ac.uk)

John Schollar
Co-Director, NCBE, University of Reading (e j.w.schollar@reading.ac.uk)

Forthcoming courses

Courses this term are at:

University of Reading – 4 October

East Midlands Science Learning Centre, Leicester – 13 November

University of York – 12 December

For full details and to download an application form see www.microbiologyonline.org.uk/BPM.htm

If you are interested in hosting a course in your lab, contact Janet Hurst (j.hurst@sgm.ac.uk)

In brief

Big picture on epidemics

Published by the Wellcome Trust, this 16-page A4 booklet gives an excellent overview of the threats to human health from infectious disease. The booklet is attractively laid out, well illustrated and includes case studies and activities. There is supplementary material on the Wellcome website. Single copies are free; class sets are available at a small charge. See **www.wellcome.ac.uk/bigpicture** for details.

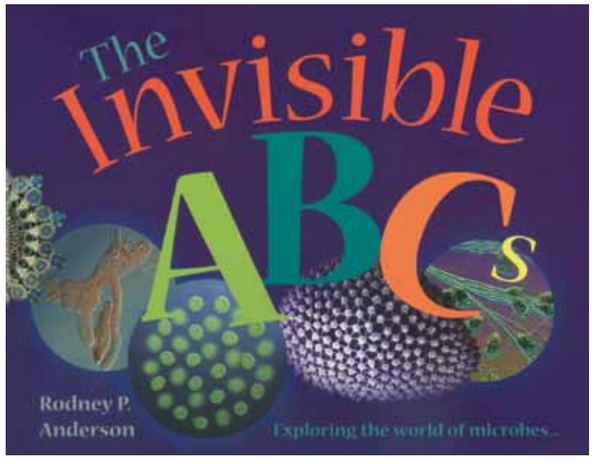
Book review

The Invisible ABCs: Exploring the World of Microbes

R.P. Anderson, ASM Press (2006)
US$19.95 pp. 64, ISBN 1-55581-386-0

This book aims to stimulate interest in microbes and is intended for a young audience – school-age children and younger. As the title suggests, the book is in an alphabetical format, i.e. each letter represents a microbial topic, or organism. This puts tight constraints on the content, which is sometimes stretched and can put information in an illogical order, for example 'lichen' must appear before 'mold'. There are wonderful photographs, which are interesting and attractive, but they can be poorly labelled and credited, and sometimes irrelevant. It is difficult to determine whether the book was intended to be a 'dip in' reference or a bedtime story, either way there are shortcomings. The book has nice touches – thoughtful questions to provoke discussion, an enlightening size scale – but they are not entirely successful. The questions may prove to be difficult for non-scientist parents and the scale, although fascinating, is confusing. The glossary is useful in places, but can repeat information and seems to serve as a holding bay for the things that could not fit into the main section. Poor editing lets the book down overall. The book is wonderfully imaginative and would certainly spark an interest in the subject. If only micro-organisms had evolved to fit the alphabet!

Lucy Goodchild, SGM



MiSAC competition 2008

Medicines from Fungi

Many of the medicines in common use are produced by fungi. Not only do they cure diseases, but they are big moneyspinners too. Patients are often unclear about how the drugs they have been prescribed work and how they are produced. In this competition, sponsored by the British Mycological Society, students in two age groups (KS3 and KS4) are asked to research and produce a factsheet about a drug of fungal origin. There are cash prizes for both the winning schools and students in each category. The closing date for entries is **31 March 2008**. Check out **www.microbiologyonline.co.uk** for details and to download an entry form or email **education@sgm.ac.uk** for a competition flier.

Teacher Scientist Network North East

Volunteers wanted!

Microbiologists are needed to partner teachers in schools in the North East of England to offer advice and promote science education. Help is particularly needed in primary schools. This work is very rewarding and fun, and only takes up as much time as the volunteer can spare. Contact Claire Willis for further information (claire.willis@durham.ac.uk).

BA CREST Awards

Through BA CREST, young people aged 5–19 explore the real nature of science and technology by doing their own creative problem solving through mini research projects. At 11–19, projects are awarded at three levels: Bronze, Silver and Gold, to reflect the hours of work put in. CREST awards are delivered regionally by SETPOINTS and are sponsored by Research Councils UK and Astrazeneca. New for 2007/8, CREST Star Investigators are for younger children, who work through activities in a supplied pack. Full details are available at **www.the-ba.net/crest**

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).

Vacation studentships – opportunities for all

Every year the SGM funds about 50 Vacation Studentships, but it's not just undergraduates that can benefit, as **Jane Westwell** describes.

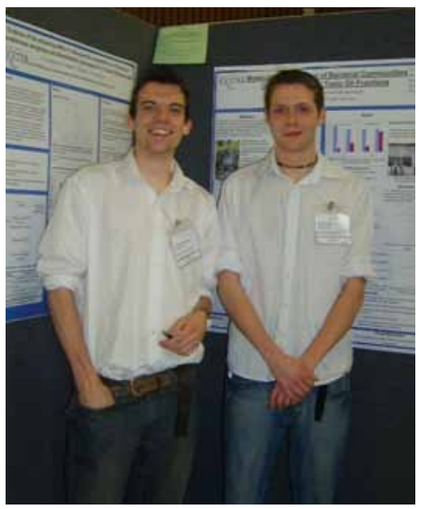
SGM vacation studentships support a short project by undergraduate students in the vacation after their second year of study. For undergrads the studentships provide an opportunity to get a taste for what microbiology research is really like. Some students love it and go on to do a PhD. However, others discover that research is not quite what they expected and they pursue different career paths after graduation. Either way, the studentships are a valuable opportunity to try out research without any commitment to a 3-year project. Students also learn new techniques, develop planning and organization skills, and experience working with a team of other researchers. All this and a bursary of £180 per week – what's not to like? If you are an undergrad and interested in the scheme, you will need to find a lecturer in the department who can apply on your behalf.

Postgrads and postdocs might be wondering 'What has this got to do with me? How can I benefit?' The answer is that summer studentships can be an opportunity to develop as researcher. Do you ever have an idea that you just don't have time to explore? Could it be turned into a project for a summer student to carry out in 6–8 weeks? If you are a postdoc planning a long-term research career it is essential to develop your own interests and start to think about your strategy as an independent researcher. All this needs to happen whilst still fulfilling the demands of your own project – but it can be done and makes a big difference when you start applying for lectureships or research fellowships.

Applications

If you do have an idea that could be turned into a project there are a few things to bear in mind. Competition for the vacation studentships is tough; we get many high quality applications each year which are assessed stringently by an award panel. The best route to success is to work up an idea with an experienced vacation student supervisor who knows how to balance research aims with the educational needs of undergraduates. For PhD students and early-career postdocs it is essential to make a joint application with an established researcher, going it alone will not be successful. Grants are awarded to projects that are achievable in 6–8 weeks, give the students good experience of research and allow some opportunity for initiative on their part. Anything that looks like the applicant just needs an extra pair of hands for a few weeks does not get past the panel.

Rules and application forms for the 2008 Vacation Studentship awards are at **www.sgm.ac.uk/grants/vs.cfm** The deadline for receipt of applications is **15 February 2008**.



▶ Robert Goldstone (right) standing by his poster at the SGM Manchester meeting in 2007, with fellow student from Exeter University, Phillip James. *Sara Burton*

Jane caught up with two 2006 summer students and asked them to share their thoughts.

Helen Davies

University of Nottingham
BSc (Hons) Microbiology
Project The microbial diversity of raw ewes' milk cheese; a metagenomic study
Supervisor Dr Tim Aldsworth

What led you to study microbiology?

Throughout school I always had a keen interest in biology, particularly at a molecular level. I became interested in microbiology whilst working in a dairy, making cheese, during summer holidays. So even though I studied very little microbiology at school, when I was looking at universities the course still stood out to me.

Why did you decide to apply for a vacation studentship?

My tutor told me about the summer studentships. I contacted the dairy I worked at previously about the possibility of researching into the microflora of their raw milk cheese and after discussing methods with a member of the department we applied to the scheme.

How did you make the adjustment to full time research during the studentship?

I really enjoyed focusing on one full-time project rather than several smaller subjects in modules during university semesters. I found it to be much more satisfying and in some ways easier even though it was full time.

What was the most rewarding aspect of this time?

Being able to develop my lab research skills whilst being paid was really beneficial. When I was writing my report, during the last week of my studentship, I had to review what skills and results I had developed – it made me realize how much I had gained from the experience.

You presented your research as a poster at the SGM Meeting in Manchester – how did you find the experience?

I was quite nervous before the poster viewing session. However, once I began talking to interested people it turned out to be the most enjoyable part of the day. What really made the experience very rewarding though, was discovering I had won the Food & Beverages Group Science Communication prize sponsored by the Institute of Food Research.

What are your career plans?

I am starting a 4-year PhD in September at the University of Nottingham looking at the effect of probiotics on pig health. The PhD is still microbiology-based as I am looking particularly at probiotic effect on bacterial and viral pathogen loads. After this I plan to continue a career in microbiology research.

What advice can you offer future SGM vacation students?

Definitely make the most of the opportunity. Learning how to plan and conduct my own experiments (as well as adapting them when they didn't go according to plan) during the studentship was in some ways more beneficial than the results I obtained. The experience of working in a lab prepared me for my degree project and – I hope – for my PhD.

Robert Goldstone

University of Exeter
BSc (Hons) Biological Science
Project Biofilm and virulence gene expression in polymicrobial communitites – a molecular approach to understanding clinical infections
Supervisors Professor Hilary Lappin-Scott and Dr Sara Burton

What led you to study microbiology?

I became interested in microbiology whilst studying biology at college. In my first year at university I was lucky to have an environmental microbiologist as an academic tutor and much of my tutor group work was microbiology-based. I took a second year microbiology module and found the medical and molecular content very interesting.

Why did you decide to apply for a vacation studentship?

I talked with my tutor about work experience options and the studentship appeared ideal as it offered a great opportunity in a familiar environment. In all honesty, after being given the chance to apply it would have been foolhardy not to.

How did you make the adjustment to full time research during the studentship?

This was remarkably easy, made so in no small part by the support I received

from other members of the lab. During my second year I had begun to use peer-reviewed literature as a primary resource – this was invaluable as it prepared me for the sorts of technical language I would encounter during research. Effective time management and keeping a detailed record of my work was key to adjusting to full-time research.

What was the most rewarding aspect of this time?

I really enjoyed having the freedom to explore areas of microbiology I found most interesting within the bounds of the research proposal. I could take my own ideas through experimental design and find out about something that was important to me. It was particularly satisfying to discuss with technical staff ways around problems as this made me feel like a real researcher! It was very rewarding to be right in the middle of a hugely active and important area of biology. It was great to interact with researchers – asking questions and expanding my own knowledge. I feel that I improved academically as a result of the experience.

You presented your research at the SGM Meeting in Manchester – how did you find this experience?

It was a fantastic experience, a must for any undergraduate lucky enough to have the opportunity. This was my first conference, which I anticipated to be quite daunting; however, the atmosphere was very receptive and made me feel at ease. I attended talks and also enjoyed being able to move around between the diverse sessions. I presented my research as a poster, which was displayed alongside others. Many of the other posters were incredibly interesting and I felt proud to have mine presented among them.

In what way have these experiences influenced your future career plans?

Working in the lab with research students influenced my decision to apply for a PhD. I enjoyed using research techniques and the wealth of information and online tools available. I realized that I would like to include this in my future career. The SGM meeting was particularly influential since it was there I met my future PhD supervisor.

What will you do next?

This September I am starting a PhD in bacterial quorum sensing at the Institute for Infection, Immunity & Inflammation, University of Nottingham.

What advice can you offer future SGM vacation students?

Have a good idea of what you're doing and where you're going before you begin and don't slack; 8 weeks is not a long time to carry out meaningful research! Take every opportunity to learn new techniques. If you do present your findings at a conference – don't worry, it's normal to be apprehensive, but it really will be fine!

To boldly go … into primary schools

PhD students from Sheffield were given a challenge. Going out to promote microbiology in a local primary school was daunting, but not only did the kids enjoy the experience, the students learned a lot about their own capabilities too.

Our mission, and we chose to accept it, was to plan and implement a science engagement project as part of our PhD training programme. We formed a six-strong group, with a developmental biologist, a cancer researcher and four microbiologists. We chose to present a microbiology workshop to primary school children, as microbiology rocks and the microbiologists were in the majority!

Our first major hurdle was to decide how to present the subject in an engaging manner that would keep the children interested for at least an hour. We decided to have a short introduction, followed by four workshops (good microbes, bad microbes, make your own microbe and microbes in the environment) for which the children were split into groups, and then some drug resistance games, a summing up and Q&A session with the whole class to finish. How these sections would then fit together and flow on the day was another matter entirely, and one we left mostly to luck!

On the day of the workshop we arrived at the school early so we had plenty of time to sort ourselves into something resembling a team. We were to present our workshop to Year 5 children at Hunters Bar Junior School, Sheffield, which has three classes, and so we had about an hour and a half with each class. As the children started to mill about the school, the thought of keeping control of a class of 35 suddenly seemed a lot more of a challenge than we had anticipated. But Kelly dressed up as a mad scientist for the start of each session to challenge the children's perceptions of a scientist and the sight of her looking like Einstein lightened the mood. We began to think we might be able to wing the sessions and get some children interested in microbiology too!

In our first session, as all the children were seated and looking attentive, one of the boys on the front row pointed at Kelly in her Einstein outfit and remarked '*look at him*'. At this point we felt the work we had planned was aimed at the correct level and Mel launched into the introduction: what does a scientist have to be like? Lab coat? White hair? Glasses? Male? As we discarded each aspect Kelly lost that part of her disguise. The children thought this was very funny and it set the session off to a great start.

Once the basic idea of 'microbes are small' had been put across, we split into the four workshops with Kelly running bad microbes, Megan running good microbes, Rachel B doing make your own microbe and Marie doing bacteria in the environment. Rachel J and Mel floated around the workshops, helping where needed and ensuring smooth swap-overs.

The bad microbe workshop was full of nasty pictures. The good microbes workshop had fantastic facts like, 'there are more bacteria in a tub of Yakult than people on the planet'. Microbes and the environment had the children touching agar plates before and after washing their hands, and the make your own microbe workshop was a chaos of coloured paper, sticky tape, bubble wrap, wool and string.

When everyone had completed the four workshops, Rachel J brought the whole class back together for a few games. The children played Chinese whispers to see how bacteria can pass on antibiotic resistance, where the secret 'resistant' word was 'sausages'. Then they played resistance tag, where children acting as antibiotics 'tagged' children acting as bacteria, showing that the more antibiotics, the quicker the bacteria die. Finally, Mel wrapped up the session with a recap and a Q&A session, and we were delighted at how much the children had learnt. They knew about bacteria, viruses and fungi, what flagella were (although one boy was convinced they were called fla-jelly), why you had to finish your course of antibiotics and why antibiotics don't work on viruses.

After the first class, the other sessions flew by. We were amazed at how much all the children had learnt, the fact we didn't have to tell a single person off and that we, remarkably, seemed to have put all the different bits of the day together seamlessly.

We incubated the plates from the environment workshop overnight at the university, sealed them all up and returned to the school the following day. The children were amazed by what had grown on their plates, and we were surprised at the number of boys who had more bacteria on their hands after they had washed them than before! This, we were told, was because they played football with the soap in the boys' toilets. The children had lots more questions for us and had obviously enjoyed our lesson and thought about it after we had gone.

Overall, the sessions ran really well and we were all surprised by the amount of knowledge we managed to pass on in a short period of time. The concept of going into a primary school with very little experience and being able to make a difficult subject easily accessible to a large group of children was daunting, but in reality was fun and very rewarding. It made us realize that the public are interested in the knowledge we have, and that it's our responsibility to communicate it at a level they understand and are enthused by. We'd recommend that every scientist goes back to school for a day – you never know what you might learn!

Melissa Wragg and **Kelly Davidge**
University of Sheffield
(e mbp05mmw@sheffield.ac.uk)

◀ Kelly in her Einstein disguise with the team.

▲ Children making their own microbes.

▲ Children listening intently to Marie.

All photos Ron Adams

A gut reaction at the Royal Society

This year, as **Bob Rastall** describes, he and his colleagues from the University of Reading were selected to put on a display at the Royal Society Summer Science Exhibition in London. Not content with that, the show moved on to the World Scout Jamboree in Essex where SGM's **Lucy Goodchild** lent a hand on the stand.

◀ The team of volunteers and visitors to the stand experiencing a microbial journey through digestion.

Each year the Royal Society holds a summer science exhibition to showcase the best of British science (www.summerscience.org.uk). The range of topics covered is very wide and this year we were selected to put on an exhibit on our research in the Department of Food Biosciences in Reading.

Our topic, *A Microbial Journey Through Digestion*, was one of a very few microbiological exhibits ever selected by the Royal Society. The display started with a microbiology shopping trolley and a look at how micro-organisms are involved in the manufacture of many of our everyday foods. This then led onto discussion of micro-organisms in the human gut and featured an *in vitro* model of the human colon (inoculated with a simulated faecal mixture!) and finished with some thoughts on how the gut microbiota might influence health and disease. The exhibit was accompanied by a PC game on probiotics in the gut, kindly provided by the Alimentary Pharmabiotic Centre in Cork (http://microbemagic.ucc.ie) and a Powerpoint presentation featuring a pillcam journey through the gut (kindly provided by David Barlow in association with the BBC). The display was illustrated with images from Reading's Centre for Advanced Microscopy (www.rdg.ac.uk/cfam). We had a dedicated exhibition team composed largely of postdocs from our research groups, with Janet Hurst and Jane Westwell from SGM also putting in time on the stand. Yakult also helped us to man the stand and field questions on probiotics.

The exhibition ran from Monday evening through to Thursday evening. From start to finish we were kept busy with 4,906 post-16 science students, members of the public, the press and invited guests through the doors. The immense level of interest in the stand was greater than our team was expecting. We had a simple quiz to get people engaged in the display and this proved to be a huge success and sparked off some very good discussions. The PC game was also very popular, particularly with younger visitors who rapidly populated the high scores list with some impressive numbers. Generally visitors approached the exhibit with an open mind and asked intelligent and pertinent questions.

Wednesday and Thursday evenings were given over to two black tie soirees with invited guest lists including Fellows of the Royal Society, press and other VIPs. These were certainly interesting occasions with a very different kind of visitor.

Mounting an exhibition of this nature is no trivial task – we had a pair of excellent designers in the form of Nicola Shenton and Stephen Hardy, both students on Reading's Design for Graphic Communication degree in the Department of Typography & Graphic Communication and we had professionally printed display panels. We were very fortunate to have a team of postdocs who really took ownership of the project and they worked very hard to pull everything together – from deciding which give-away items to have (the furry 'poos' were very popular!) to ensuring the logistics came together and assembling the stand. We had generous sponsorship with an SGM PUS grant and from Yakult and Clasado. The Royal Society exhibition staff were immensely helpful and the Society provided a comprehensive briefing in January and a training day in science communication.

The exhibit has now taken on a life of its own – it has subsequently travelled to the World Scout Jamboree, with SGM's Lucy Goodchild (see p. 190), a team from Reading and Yakult in attendance, and is getting invitations to science fairs. It also makes guest appearances at our open days. Overall the exhibition was an immensely satisfying if very tiring experience and one I would recommend to anyone!

Bob Rastall
University of Reading
(e r.a.rastall@rdg.ac.uk)

Scouting out microbes

Researchers at the Department of Food Biosciences, Reading University have been looking at the microbes that manufacture our food, and the ones that help us digest it. By using a laboratory model of the human gut, our internal flora can be analysed and the effect of certain substances on its populations tested. As described by Bob Rastall on p. 188, we took the department's stand for the Royal Society exhibition to the 2007 World Scout Jamboree, and a very different audience.

The 21st Jamboree, entitled *One World*, marked the 100th anniversary of the Scouts and was an event to remember. Close to 40,000 participants enjoyed the celebrations at Hylands Park, Essex. The park was split into sections and the scouts were guided to each section in large groups. The microbiology stand was placed in the 'Elements' zone of the camp, in the main tent for 'Earth'. Of course, microbiology is notoriously difficult to classify in this sense, so the placing seemed as appropriate as any other.

In the morning, the first group was shown an introductory film to the section. The 10 minute presentation showcased the history of the universe and man's impact on climate change – a tall order, but skilfully done. The music was loud and graphics exciting; the presentation managed to hold the attention of 200 scouts eager to get out and explore. The crowd dispersed and broke into small groups, challenged to complete as many activities, including volcano making and walking on custard, as they could.

The first group approached us with caution. '*What's that?*' A puzzled scout pointed at the gut model. Following a brief but graphic explanation, they were hooked. The group picked up a quiz and began to search for clues: where do most microbes in the human body live? What does probiotic yoghurt look like under a microscope? The final question asked participants to identify the lone product in a shopping trolley that neither contained nor involved microbes in its production. The trolley was quickly emptied. '*It's coffee*' pronounced one of the group, with some certainty. The quizzers were intrigued as we explained the microbial fermentation process that gives coffee its drinkable qualities. *Shredded Wheat*, we showed them, just contains baked wheat, and nothing else.

▼ Scouts enjoying the exhibits at the Reading University display at the 2007 Scout Jamboree. *Lucy Goodchild*

Yakult, co-sponsors of the project, kindly provided drinks and the scouts were more than happy to partake. Empty bottles were soon discarded (and recycled as volcanoes in the next tent) in favour of the T-cell computer game that was also on offer. The player is a lymphocyte and the aim of the game is to look after the host by protecting it from infection. The group caught on quickly, and soon surpassed our best efforts. Probiotic bacteria, such as *Lactobacillus* and *Bifidobacterium* species must be collected for ammunition before the pathogens, *Helicobacter pylori* and *Salmonella*, can be attacked. The game was a wonderful way of illustrating the role of probiotics. It was also very successful at overcoming language barriers – only three countries were not represented at the Jamboree. For those who spoke little or no English, the interactive nature of the display was invaluable and the participants engaged with the subject and each other. Teams that had never met before were joining forces to find answers to the quiz, and to master the game. By the end of the second day, some scouts had set up a 'high scores' table and were very proud of their achievements.

The overriding benefit of the exhibit was the interest it sparked with the teenagers. After being amazed that the average weight of faecal bacteria a human excretes in a lifetime is equal to that of 12 elephants, the scouts began to give each other pieces of information they had assimilated from the stand. Observing this same thirst for knowledge in so many different people was very exciting. Each visitor took something away with them: an interesting fact, a new idea for a future career, or even that probiotics serve as ammunition to kill disease.

Lucy Goodchild
SGM External Relations Office

Alan Cann has been raising the profile of microbiology through the web, assisted by a Public Understanding of Science grant from SGM.

MicrobiologyBytes podcasts: one year on

The aims of the *MicrobiologyBytes* project were to promote:

> understanding and awareness of current issues in microbiology to the general public, potential students of microbiology and the media;
>
> awareness of SGM, benefits of membership, and resources available on the Society's website;
>
> awareness of career possibilities in microbiology and microbiology-related fields.

After one year of operation (August 06–July 07), 50 podcasts have been produced, and they have received over 78,000 downloads. There are about 1,200 regular subscribers to the podcasts, although the number of files accessed through direct downloads via the Wordpress blog (**microbiologybytes.wordpress.com**) exceeds those delivered via podcast subscriptions by ~7:1.

It was always intended that the blog would form a front end to the podcasts, allowing search engine discovery and direct file downloads to complement the subscription model.

In the event, the *MicrobiologyBytes* blog has proved to be an extremely attractive platform in its own right, attracting 82,000 visits over the year. According to recent Google results this site has grown to become the number one microbiology blog (**tinyurl.com/2t9mrh**). Approximately 5–10 % of visitors to the website (and presumably of podcast listeners) are UK-based, 20–30 % from North America and the remainder from elsewhere (over 100 countries). Since the *MicrobiologyBytes* blog and podcasts are 'branded' with an SGM identity, this increases the Society's online presence worldwide. The blog publicizes SGM events such as meetings, and delivers a significant number of visitors to the main SGM website and to **www.biocareers.org.uk**

In addition to complementing the podcasts, the blog has utilized the interactivity ethos of web 2.0 technologies (**en.wikipedia.org/wiki/Web_2.0**), with each post attracting an average of at least one comment from visitors to the site (226 posts, 230 comments), and building a community of users. The latest development has been to invite contributions from guest bloggers, a feature which I hope will continue.

I have begun to investigate the interactive potential of social network sites such as MySpace and Facebook. *MicrobiologyBytes* already has a presence on MySpace (**www.myspace.com/microbiologybytes**), but with the rapid increase in the popularity of Facebook in the last few months and the more professional community this network attracts (**tinyurl.com/36nxcq**), this resource is worthy of further development. I already input the contents of the blog and podcast into my personal Facebook profile (**tinyurl.com/yodckx**) by importing the RSS feed.

I have also experimented with video formats in the podcast and blog, and these seem to have been popular. I would be eager to explore the possibility of regular video podcasts to allow *MicrobiologyBytes* to harness the rapid growth in popularity of sites such as YouTube, e.g. **youtube.com/watch?v=9v1cCEuSJZg**

The widespread availability of broadband internet makes it highly feasible to distribute short video clips online. Although the penetration of this technology into the student demographic is very high, teachers and academic staff are lagging seriously behind in the take-up of this new form of communication. Online video has a high acceptability to young learners and can be accessed via computers, game consoles and mobile devices such as phones and video players. However, since the production of video is more time-demanding than that of an audio podcast and blog, development of this channel would require further funding.

In summary, the *MicrobiologyBytes* project has been very successful over the last year and continues to attract a growing number of listeners and readers. I am confident that this trend will continue in the foreseeable future.

Alan Cann
University of Leicester (**e** ajcann@leicester.ac.uk)

*SGM PUS grants offer up to £1,000 for projects to promote the public understanding of microbiology. See **www.sgm.ac.uk/grants** for full details and an application form.*

hotoffthepress

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

Rotavirus versus coronavirus in newborn calves

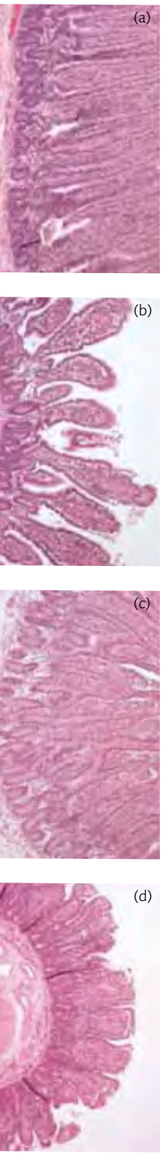
Aich, P., Wilson, H.L., Kaushik, R.S., Potter, A.A., Babiuk, L.A. & Griebel, P. (2007). Comparative analysis of innate immune responses following infection of newborn calves with bovine rotavirus and bovine coronavirus. *J Gen Virol* **88**, 2749–2761.

Diarrhoea, especially in developing countries, is a serious cause of illness and death in children. It also affects young farm animals and results in greater financial loss to cattle producers than any other infectious illness. Many species of bacteria and viruses produce the symptoms, including bovine rotavirus (BRV) and bovine coronavirus (BCV). BRV infections clear up more rapidly than those of BCV, which can persist and re-occur in adult cattle. Apart from this, both viruses cause similar clinical and physiological consequences in calves, despite many physical differences. They both infect the lining of the digestive tract, seriously damaging its surface and causing diarrhoea.

The body has protective immune responses to infections, some of which are specific to the digestive tract. Researchers in Canada wondered whether these responses differed between BRV and BCV. One way to check was to look at which genes were switched up or down during the infection. The researchers did this using commercial DNA microarrays that allow thousands of genes to be screened simultaneously, as well as methods to monitor individual genes. They were particularly interested in what happened to genes known to be important in cell growth and the immune system.

Both viruses affected the amount of product from some genes involved in cell proliferation, reducing some and increasing others. They frequently had the same effect, but sometimes had opposite effects. The overall result was to increase the products from genes that promoted cell proliferation in the infected tissues. Interpreting effects on the immune system was more difficult because less is known about how this operates in the intestine during viral infections. The researchers focused on genes that are known to be activated following viral infection and realized that each virus induced a distinct immune response. There were some very important differences that affected the proinflammatory response and also the production of the important antiviral interferons.

The researchers gained an overall impression that intestinal cell division and proliferation were more active after BRV infection than following BCV infection, which fits with the fact that the intestine recovers more rapidly from BRV infection. The two viruses have developed different strategies to fox the natural antiviral defences. Although they may both use the same strategies to evade the immune response, they activate different aspects of the innate immune response. Successful new treatments for diarrhoeal disease will need a good understanding of the ways that different viruses cause the same symptoms, as illustrated by this study.



◀ Histology of jejunal mucosa in control and BRV- and BCV-infected loops. Tissues were collected 18 h post-infection, fixed and stained with haematoxylin and eosin. (a) Control loop and (b) BRV-infected loop were collected from the same animal. (c) Control loop and (d) BCV-infected loop were collected from the same animal. *Palok Aich, VIDO, University of Saskatchewan, Saskatoon, Canada*

A sticky problem

Corrigan, R.M., Rigby, D, Handley, P. & Foster, T.J. (2007). The role of *Staphylococcus aureus* surface protein SasG in adherence and biofilm formation. *Microbiology* **153**, 2435–2446.

Staphylococcus aureus is a bacterium that lives inside the noses of up to 80 % of people. Most of the time it is a harmless inhabitant, but it can cause disease once inside cuts or operation wounds. To do this, *S. aureus* has several proteins that each interact with specific proteins on the surface of the human cells. Once the bacterial cells are attached, they grow into multiple layers embedded in a matrix material that results in the bacteria becoming resistant to both antibiotics and the immune system.

Researchers in Dublin, in collaboration with colleagues in Manchester, have reported their latest work on a gene that encodes one of the proteins known to be involved in these processes, SasG. One end of the protein contains a region called the A domain that is exposed on the surface of the bacterial cell, while the other end anchors the protein to the cell wall. In between there are from 2 to 10 identical structural protein blocks, called B repeats. SasG forms fibrils that coat *S. aureus* cells and these can prevent other *S. aureus* proteins attaching to their targets on human cells. However, it was discovered that SasG also has the property of sticking *S. aureus* to nasal epithelial cells.

The number of B repeats affected the role of SasG. SasG with five or more repeats could stick to human cells and form biofilms, but physically blocked binding of other *S. aureus* proteins to human cell surface proteins. The fact that clinical isolates have both more and less than five B repeats implies that SasG may interfere with biofilm formation in some strains, but be part of the process in others. The researchers speculate that these contradictory properties might become important during an infection if the *S. aureus* cells gained an advantage by detaching from the human cells to spread further around the body.

No answer to blocked catheters

Macleod, S.M. & Stickler, D.J. (2007). Species interactions in mixed-community crystalline biofilms on urinary catheters. *J Med Microbiol* **56**, 1549–1557.

Caring for patients with long-term bladder catheters is often complicated by the catheters becoming blocked by crystalline deposits. Bacteria form biofilms on the surface of the catheter and generate ammonia from the urea in the urine. This creates conditions in which salts in the urine can crystallize, blocking the catheter. This can result in kidney infections that can be very difficult to treat effectively.

Proteus mirabilis is well known for causing this problem. Researchers at Cardiff have recorded the species of bacteria they have isolated from catheters. Out of 106 patients, only 30 had biofilms caused by *P. mirabilis* alone. All the others had been colonized by two or more species. Almost half the catheters colonized by *Providencia stuartii* were also colonized by *P. mirabilis*. In contrast, only one of 14 catheters colonized by *Morganella morganii*, and no *Enterobacter cloacae*-containing biofilms, was infected by *P. mirabilis*. This obvious difference immediately suggested that *M. morganii* and *E. cloacae* might be in some way antagonistic to *P. mirabilis*.

To test this, a temperature-controlled glass chamber was used as a model bladder, with a catheter as its outlet through which artificial urine could drain. The authors inoculated it with bacteria and waited until the catheter blocked up. These model infections took around 18.7 hours to block the catheter if *P. mirabilis* was used on its own, compared with about 50 % longer when *P. mirabilis* was mixed with *E. cloacae*. On its own, *E. cloacae* never managed to block the catheter during the experiments. The results indicated that *P. mirabilis* out-competed the other organism so that the catheter blocked, although more slowly than from a *P. mirabilis* infection alone.

The researchers wondered what would happen if the other bacteria were given a head start, so they carried out another series of experiments where they let the other bacteria grow in the model system for 72 hours and then added *P. mirabilis*. All the other bacteria managed to form a biofilm on the surface of the catheter within the 72 hours, although their numbers decreased once the *P. mirabilis* cells arrived. Again, the catheters only became encrusted once *P. mirabilis* was added.

Unfortunately, these experiments showed that any antagonism between *P. mirabilis* and other bacteria commonly found in clinical catheter infections has only a minor and temporary effect. The implication is that infection with *P. mirabilis* is always likely to lead to a blocked catheter.

Classifying phytoplasmas

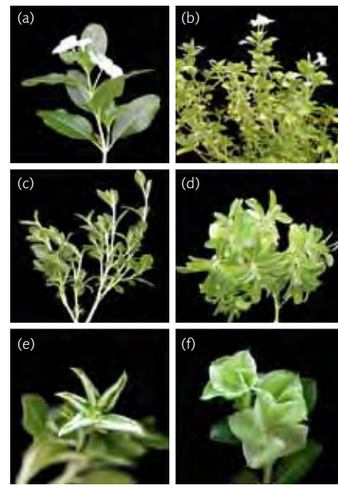
Wei, W., Davis, R.E., Lee, I.-M. & Zhao, Y. (2007). Computer-simulated RFLP analysis of 16S rRNA genes: identification of ten new phytoplasma groups. *Int J Syst Evol Microbiol* **57**, 1855–1867.

Martini, M., Lee, I.-M., Bottner, K.D., Zhao, Y., Botti, S., Bertaccini, A., Harrison, N.A., Carraro, L., Marcone, C., Khan, A.J. & Osler, R. (2007). Ribosomal protein gene-based phylogeny for finer differentiation and classification of phytoplasmas. *Int J Syst Evol Microbiol* **57**, 2037–2051.

Phytoplasmas are small, wall-less bacteria that live within plant cells; they are associated with over 600 plant diseases and are transmitted by insects. They cannot grow outside their hosts, which makes identifying them quite a challenge. Most conventional methods for identification of bacteria cannot be applied to the phytoplasmas, and therefore criteria for formal naming of species cannot be fulfilled. However, the advent of molecular biological methods has significantly improved understanding of diversity and genetic inter-relationships among phytoplasmas. The currently accepted method to distinguish each species involves analysing the essential 16S rRNA gene. The standard way to do this involves digesting the DNA with a series of enzymes to generate a characteristic RFLP pattern. The current phytoplasma classification scheme, designed in the early 1990s by researchers at USDA, is based on distinct RFLP pattern types. Now this research group has published new developments in phytoplasma classification.

The researchers found more than 800 sequences of phytoplasma 16S rRNA genes in computer databases, and analysed these sequences to create virtual RFLP patterns. They found that the virtual patterns matched experimental gel patterns. Moreover, they identified several new patterns characterizing previously unrecognized groups of phytoplasmas. These results support the value of RFLP patterns in phytoplasma identification and provide a new practical identification tool that will be available through the internet (www.ba.ars.usda.gov/data/mppl/virtualgel.html). However, some phytoplasmas with distinctive biological or ecological properties are not distinguishable on the basis of 16S rRNA analysis. In collaboration with colleagues in Italy, Oman and Florida, the USDA team tested whether other genes could provide fine-scale differentiation. The genes for two proteins, RpIV and RpsC, gave the results they were looking for and allowed discrimination amongst biologically distinct strains that could not be distinguished by 16S rRNA.

These new developments advance identification and taxonomy of phytoplasmas, and contribute to deepening knowledge of these intriguing microbes in the 21st century.



▲ Phytoplasma infection in *Catharanthus roseus*. Compared to a healthy plant (a), symptoms include yellowing (b), shoot proliferation (c), witches'-broom growth (d), phyllody (e, leaf-like structures in place of flowers) and virescence (f, green colour in place of normal flower colour). *Yan Zhao, Molecular Plant Pathology Lab, Beltsville, USA*

reviews

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.

Fields Virology, 5th edn, Vols 1 and 2

Edited by D.M. Knipe, P.M. Howley, D.E. Griffin, R.A. Lamb, M.A. Martin, B. Roizman & S.E. Straus
Published by Wolters Kluwer Health (2007)
US$369.00 pp. 3,177
ISBN 0-78176-060-7

Fields Virology was conceived by Bernard Fields, a distinguished Harvard virologist of the 1980s and 1990s, as a means of bringing fundamental and medical aspects of virology together in a more integrated manner than previously available in contemporary textbooks of virology. The project fulfilled the need and has progressed to become one of the classic resources of virology. *Fields Virology* has now been carried forward to a 5th edition. The general organization of previous editions as a virology reference textbook has been maintained. Section I contains chapters on general aspects of virology, and Section II displays chapters on the replication mechanisms and medical aspects of specific viral families. In comparison with the 4th edition (2001), the replication and medical chapters have been combined for some virus families with the beneficial effect of minimizing duplications. New chapters or new/expanded parts of chapters relate to emerging viral infections, viruses infecting protists, mechanisms of viral conquest of the cell, innate responses to viral infections, henipaviruses, metapneumovirus, SARS virus, avian influenza viruses and human polyomaviruses. Prions have still been included as infectious agents although they are not viruses.

The Editors, many of them previous co-editors of Bernard Fields, have taken particular care in entrusting the individual chapters to internationally recognized experts in their fields; many of them have contributed to previous editions, others have been recently recruited. All chapters have been substantially updated compared to the 4th edition. Among the many scientific advances achieved over the past 5–6 years, to me the most prominent ones are in the determination of atomic structures from crystals (or crystal complexes) of various viral proteins. Detailed knowledge of structures has allowed unprecedented informed and rationally designed structure–function analyses. Many of the chapters (some more, some less) reflect this progress. In parallel, secondary structure analysis and probing of nucleic acids, mainly viral RNAs and mRNAs, have contributed enormously to our understanding of molecular events during viral replication. Room is now given to the techniques and various applications of molecular engineered (reverse) genetics in the study of many RNA viruses for which this approach started around 2000 or has been achieved more recently. Last, but not least, the exploration of host-cell signalling pathways, host-cell proteins involved in viral replication mechanisms, innate host-cell responses and viral mechanisms to escape such responses has progressed steeply.

The figures and tables are on the whole of excellent quality and clarity. As a new feature, the 5th edition contains a software disk (within the cover of Vol. 1) with all the figures (reproduced in the book) and supplemental figures (not shown, but mentioned in the texts) which can be used under different forms of licensing agreements (single user, institutional, etc.). This represents a particularly useful tool for various purposes. All chapters are up-to-date with references from 2005 and some from 2006.

This is not the place to comment on individual chapters in more detail. Suffice it to say, although there are other outstanding books on fundamental, applied and clinical virology and excellent monographs on particular viral families and orders, this is the most comprehensive textbook in virology, tying together detailed accounts of the molecular biology, molecular pathology and medical features of individual viruses in the broad context of general virology. Not in vain is this opus regarded as the 'bible of virology' by many virologists for whom it is indispensable and – apart from all its other values – great fun to study. Students of all biomedical sciences at various stages of their careers and established researchers of various disciplines will profit as well from consulting this book. Physicians, immunologists, vaccinologists, epidemiologists and public health physicians (to name just a few specialist groups in close contact with virology) will experience the full depth of virus research as part of their particular interests. The book should be available in all libraries of higher education, various specialist libraries and public libraries. The purchase price is considerable, but is more than outweighed by the rewards of enabling the study of virology in its full complexity and richness.

***Ulrich Desselberger**, Cambridge*

Introduction to Modern Virology, 6th edition

By N.J. Dimmock, A.J. Easton & K.N. Leppard
Published by Blackwell Publishing (2006)
£32.99 pp. 516
ISBN 1-40513-645-6

This is the latest update of a volume that has been the 'classic' undergraduate virology textbook for three decades. The text is well written and accessible, and provides content that is comprehensive, authoritative and scientifically accurate. The layout is logical and it is easy to navigate through the volume to find specific information. Throughout the book the extensive use of illustrations and several types of text boxes provide important complements to the main body of the text. In my opinion, this revision provides more than just an introduction to modern virology, it is a detailed consideration of the topic that will prove to be instructive not only to undergraduates but to anyone else needing or wishing to learn about viruses, from postgraduates to professors! As such it should be a compulsory item in institutional libraries, but I would also recommend it as a cost-effective addition to personal bookshelves.

***Mark Harris**, University of Leeds*

HIV and the Pathogenesis of AIDS, 3rd edn

By J.A. Levy
Published by American Society for Microbiology (2007)
US$99.95 pp. 678
ISBN 1-55581-393-2

Ten years on from the 2nd edition, Levy's book remains an invaluable reference of HIV/AIDS. Levy helpfully lists 15 significant advances in his preface, and suggests that HIV research has reached a stage of incremental change rather than significant advance (the 'pioneering' research of times past is celebrated by an eclectic photo gallery of HIV/AIDS alumni, including the current SGM president). Levy's assertion is probably true in respect of research into the virus itself, but the interaction of the virus with its host remains a huge challenge that will require significant advance if, for example, we are to develop an effective vaccine or predict post-infection survival. Either way, HIV/AIDS remains a disease of significant unmet need in the sense that Developed World patients benefit from an armament of treatments that are often not available to Developing World patients, where 90% plus of all HIV-infected persons are resident. In 2006, 3 million people died from AIDS, taking the cumulative total to almost 25 million, and so Levy's book is both a reminder of past success but also a reality check on what remains unfulfilled.

***Eddie Blair**, Integrated Medicines Ltd*

Superantigens and Superallergens

Edited by G. Marone
Published by S. Karger AG (2007)
€125.50 pp. 243
ISBN 3-80558-266-7

Since we coined the term 'Superantigen' to replace the somewhat cumbersome phrase 'V-specific deleting ligand' back in October 1988, I have followed research in the field with interest. This volume provides fascinating reviews of the recent work on bacterial and viral superantigens that bind intact to MHC class II molecules and trigger T cells by interacting with the T cell receptor V domain. In addition, studies on B cell superantigens that bind to immunoglobulin and so may activate or lead to apoptosis of B cells are covered. Although it is difficult to produce a timely review, there are many 2006 and 2007 (in press) references included and there is certainly utility to bringing discussion of these various endogenous, bacterial and viral superantigens together in one volume.

Immunoglobulin-binding B cell superantigens interact with conserved epitopes on framework regions of certain heavy chain or kappa light chain variable domains, this results in binding to IgE that is itself bound with high affinity to the receptor Fc RI on mast cells and basophils. The term 'Superallergen' was coined to highlight the fact that such immunoglobulin-binding superantigens can therefore trigger release of inflammatory mediators and cytokines in both tissues and the circulation, and hence may contribute to a variety of allergic disorders. This aspect of the volume will certainly widen the appeal of this book to include those with an interest in the clinical aspects of allergy. The volume is definitely also worthy of institutional purchase and would be a valuable resource for academics, as well as postgraduate and undergraduate students working in the fields of microbiology or immunology.

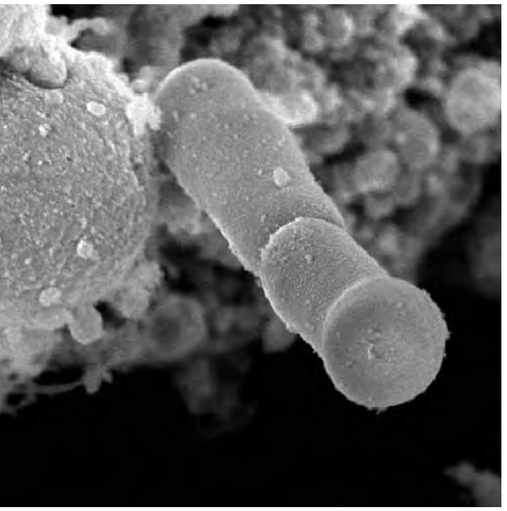
***Ann Pullen**, University of Bristol*

Reviews on the web

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

Soil Microbiology, Ecology and Biochemistry, 3rd edn
Salmonella*: Molecular Biology and Pathogenesis*
Bacillus*: Cellular and Molecular Biology*
Prions in Humans and Animals
Archaea: Molecular and Cellular Biology
Introduction to Fungi
Recombinant DNA Genes and Genomes – A Short Course
Modern Industrial Microbiology and Biotechnology
Physiology and Biochemistry of Extremophiles
Medical Mycology
Parasitology, 10th edn
Fungi in the Environment
Medical Microbiology, 17th edn
Manual of Environmental Microbiology, 3rd edn
Complete Course in Astrobiology
The Biofilm Mode of Life: Mechanisms and Adaptations
Electron Crystallography of Biological Macromolecules
Molecular Biology of Streptococci
Wolbachia*: A Bug's Life in another Bug*
Antibiotic Basics for Clinicians
Cryopreservation and Freeze-Drying Protocols, 2nd edn
Bacteriophage: Genetics and Molecular Biology
Manual of Microbiology: Tools & Techniques
Bacterial Conversations: Talking, Listening and Evesdropping [Phil Trans R Soc B 362(1483)]
Phycotoxins: Chemistry and Biochemistry

The Scottish Infection Research Network



▲ Scanning electron microscope image of *Clostridium difficile* bound to the intestinal surface. *Dr Gill Douce, University of Glasgow, and Dr Dave Goulding, Sanger Institute*

▶ Glasgow Biomedical Research Centre. Administrative home of SIRN. *Tim Mitchell*

Hospital-acquired infections (HAIs) such as *C. difficile* and MRSA are a major problem in healthcare. In Scotland, HAIs probably cost £180 million per year. Although these infections are common, there are fundamental gaps in our knowledge of HAIs and the causative organisms. Treatment and prevention requires medical intervention as well as good infection control. Traditionally this has been an area in which it is difficult to obtain funding and many clinicians and scientists have avoided working in this field.

As part of the Scottish Executive's commitment to reduce HAIs, the Scottish Infection Research Network (SIRN) has been set up, funded by the Scottish Executive Health Department and hosted at the University of Glasgow.

A 15-person steering group, consisting of representatives of academic research, clinicians, nurses, behavioural scientists, statisticians and educationalists, co-ordinates the functions of the Network. Its multidisciplinary nature is key to its aims in promoting interaction between scientists, clinicians, healthcare professionals and patients in addressing the problem of HAIs. The Director of the Network is Dr Alistair Leanord. The Network currently operates using expertise from within Scotland, but this is expanding through links with other UK and European bodies.

The Network's primary objective is to facilitate, promote and deliver research that will significantly contribute to the prevention and control of HAIs. It is also essential to build a high quality research infrastructure that will foster effective collaboration among members of the HAI research and academic communities. SIRN will also build capacity and the capability of the HAI research community, and develop and shape high quality research proposals within themed programmes that meet the funding criteria of the Chief Scientist Office. SIRN will also assist in the development of major HAI research priorities for future needs. A major factor in the process is the clear definition of the problems and development of a strategy to address them. The ultimate goal is to apply and disseminate knowledge that enhances the delivery and quality of patient care.

SIRN is keen to promote interaction with other networks and groups with an interest in HAIs. For more information about SIRN see our website at www.gla.ac.uk/sirn and if you would like to be part of this effort please contact us at sirn@bio.gla.ac.uk

Professor Tim Mitchell
University of Glasgow, SIRN Steering Group

What's a girl like you doing in a place like this?

West Midlands Virology Symposium – 20 March 2007

The universities of Warwick and Birmingham, and the associated CRUK Institute for Cancer Studies, have a long tradition of virology, but – until now – relatively little formal contact. Your correspondents' move to the Midlands from Glasgow – where the annual workshop formed a focus for virological interactions north of the border – prompted the establishment of the West Midlands Virology Symposium. The inaugural meeting was held in the University of Birmingham's Barber Institute of Fine Arts, a stunning Art Deco gallery with a fine tiered music auditorium.

Over 110 registered for the meeting, lured by an eclectic mix of virology, bagels and the Barber's current exhibition of 'The Parrot in Art'. Opening presentations by Alan Rickinson and Andrew Easton provided an overview of virology in Birmingham and Warwick, respectively. Each gave a historical perspective, an introduction to the departmental/institutional structure and current research activities, and a brief overview of future goals and aspirations.

Coffee and pastries (in place of non-existent bagels) were separated from an excellent buffet lunch by a series of short presentations on diverse subjects. These included translational control in HIV (Emma Anderson, newly appointed in Warwick), EBV latency (Gemma Kelly), cell–cell transfer of HCV (Jennifer Timpe) and modulation of the innate immune response to KSHV (Cristina Arestê), together with talks on adenovirus (Andy Blackford) and reverse genetics of pneumoviruses (Roger Ling).

The purpose of the meeting was to encourage interaction between all participants. The organizers had therefore replaced the first of two afternoon sessions with 'Speed dating the Virology way'. Using a combination of coloured badges, three circulating subgroups, a clock and a tambourine (don't ask), a significant proportion of attendees met everyone else in the room in an exhausting whirl of introductions and thumbnail sketches of research interests. Only an alleged lack of familiarity with speed-dating prevented the organizers from achieving the goal of getting everyone to meet.

Refreshing tea and cakes were followed by further short presentations that demonstrated the excellent strength and breadth of virology in the West Midlands – topics included adenovirus persistence and vector construction (Sue Morris and David Onion), EBV modulation of interferon signalling (Khilan Shah), HPV replication (Ian Bell) and RNA structures in HCV (Andy Tuplin).

Further social interactions were enabled by a concluding wine reception and, for those with an interest in parrots, a tour of the art gallery.

The organizers gratefully acknowledge the support from SGM/SfAM, commercial sponsors and the contributing institutions to make this meeting possible.

David Evans (e d.j.evans@warwick.ac.uk)
David Blackbourn (e d.j.blackbourn@bham.ac.uk)

SGM/SfAM joint regional meeting grants

All Wales Microbiology Meeting 2007

Gregynog Hall – 19–21 March 2007

This year's meeting was attended by 62 scientists from all levels, undergraduates to senior academics, from Aberystwyth, Bangor, Cardiff and Swansea Universities, and the Institute for Grassland and Environmental Research. A broad range of very high quality talks on current research was presented for the main part by PhD students and postdocs, complemented by excellent presentations given by six visiting speakers. Perhaps the highlights of the latter were the two speakers invited from Newcastle, bracketing dinner on Tuesday evening: Rick Lewis with a superbly presented talk on structural studies of the stress response of *Bacillus subtilis*, and Tom Curtis with an entertaining and provoking exposition on theory and microbial ecology. As usual, the unique rural setting of Gregynog, complemented by fine spring weather, stimulated highly productive discussions on many areas of microbiology, ranging from rumen microbiology to quorum sensing, and from viral biocides to planktonic protozoa.

Competition for the SGM/SfAM Microbiology Communication Prize was intense with a standard of presentation by the young microbiologists not seen before. The judges nominated talks from David Yanez-Ruiz (Aberystwyth) on rumen microbial ecology, Mark Malpass (Bangor) on chicken wing microbiology, and Elizabeth Steiner (Aberystwyth) on phosphorylation on Spo0A in clostridia for merit. The prize was awarded unanimously to Sandra Pierre (Aberystwyth) for her very clear and informative talk on proteomic analysis of the cacao fungal pathogen *Crinipellis pernicosa*.

A highly stimulating meeting finished on Wednesday lunchtime with all participants determined to return in 2008.

Paul Dyson (e p.j.dyson@swansea.ac.uk)

Professor Douglas Watson (20.11.**1931**–04.09.**2007**)

Members will be sad to hear that Douglas Watson has died. Douglas was a respected internationally renowned virologist, a dedicated teacher and a very thorough and capable administrator. He was enthusiastic, wise, empathic and had a piercing dry wit. During his career Douglas gave unstintingly of his time and expertise to the SGM in a number of roles.

Born in Sheffield, Douglas was educated at the city's King Edward VII School and later at the High School of Stirling. He graduated from the University of Glasgow with a First in Chemistry and was awarded the Mackay Prize as most distinguished graduate in his discipline. His postgraduate work, also in Glasgow, centred on electron microscopic studies on crystal growth. As an Assistant Lecturer he went on to collaborate with John Norris to investigate crystals in *Bacillis thuringiensis*. In 1960 Douglas accepted the offer to join Michael Stoker and Peter Wildy as the electron microscopist in the newly formed Institute of Virology in Glasgow. Prior to moving into the Institute, Douglas worked with Tony Waterson and Bob Horne in Cambridge. On returning to Glasgow in 1961 he began a long and happy collaboration with Peter Wildy, this resulting in a very significant contribution to electron microscopic quantitative and structural studies of herpesvirus. On Peter Wildy's appointment to the Chair of Virology and Bacteriology in the University of Birmingham, Douglas followed him in 1964 and was soon promoted to the role of Senior Lecturer. It was here that he began his lifelong studies on the proteins and antigens of the herpesviruses. In 1968 he took up a Visiting Fellowship in Canberra at the John Curtis School of Medical Research's Department. His work on polyacrylamide gel electrophoresis with Nigel Dimmock proved to be one of the most cited articles on the subject. In 1969 he returned to Birmingham as Reader in Virology.

In 1972 Douglas was appointed to the newly formed Chair of General Microbiology at the University of Leeds and served as Head of Microbiology for two decades. He was joined by fellow virologists Ian Halliburton and Dick Killington, and later Bob Honess, Ken Powell and Dorothy Purifoy. Douglas led a major transformation in the Department which became the largest of its kind in the UK. In 1984 under his research leadership the Virology unit at Leeds received the significant accolade from the Medical Research Council as the MRC Herpesvirus Research Group.

Douglas used his management skills to the advantage of the University of Leeds and served on the major policy-making committees. He commanded enormous esteem and respect for his finely honed intellect and capacity for incisive analysis and commitment to the well being of the institution, its staff and students. He served as Dean of Staff (1989–91) and as Pro-Vice Chancellor from 1991 until his retirement in 1993.

On a personal note, Douglas was my mentor at Leeds for several years. During that time he helped shape my career and made me realize just how important it is to be an all round academic. I am grateful for his direct, fair and caring advice. My fondest memories will always be of Douglas with a wee dram in one hand and a cigarette in the other late at night at a scientific meeting discussing science in the way that only Douglas could.

Douglas was a member of the Editorial Board of the *Journal of General Virology* from its inception in 1966, was appointed Editor in 1969 and Editor-in-Chief from 1971 to 75. Thereafter, he was Convenor of the Virus Group. In 1980 he was 'honoured and privileged' to become Treasurer for the SGM, a position he held for 7 years. He transformed the financial status of the Society to the point whereby in 1987 it had assets of £2.6m, with no increase in membership fees. In addition his innovative approach led to the creation of, amongst others, the SGM Research Fund, the Third World Microbiology Fund and the Postgraduate Meetings Fund. The SGM also brought romance for Douglas and in 1993 he married Hilary Bower, the Executive Secretary of the Society.

Our condolences go to Hilary, and to Douglas' children from his first marriage, Shirley and Donald and their families.

Dick Killington, University of Leeds

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comment

microbiology – a degree of concern?

Microbiology departments may have disappeared from universities, but **Sue Assinder** believes that this does not reflect the amount of microbiology being taught to undergraduate students.

The last decade has witnessed a steady trend towards merging university departments devoted to individual bioscience disciplines into large multidisciplinary units. The consequent fall in the number of microbiology departments has been mirrored by a decline in the number of 'named' microbiology degrees. Should those of us with a professional interest in nurturing the next generation of microbiologists be worried about the declining visibility of our discipline?

Analysis of the SGM undergraduate microbiology prize scheme suggests that we should not be too concerned. It appears that substantially more microbiology is taught in universities than the number of microbiology degrees might lead us to believe. Every year the SGM makes around 50 awards to second year undergraduates who have excelled in one or more microbiology modules designated by their university. The nomination forms provide both the degree for which the winning student is registered and also the number of other students attending the designated module(s). This year, only 24 of the 49 prizewinners were enrolled in named microbiology degrees and their classmates rarely exceeded 20 in number. However, the remaining prizewinners had followed microbiology modules within a whole host of degrees (including Biomedical Science, Biotechnology, and Biology), sometimes in classes of over 100 students. In other words, although the number of named microbiology degrees may be falling, a large number of university students are still being exposed to a significant amount of microbiology.

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On the other hand, we should not be complacent that microbiology is alive and well provided we know where to look for it. The key question is whether prospective students will also know where to look. This is particularly important at a time when there is more microbiology being taught in schools than we have seen for many years. Due in no small part to the lobbying efforts of the SGM, the microbiology content has been strengthened both in the new GCSE curricula introduced last year and in the new A levels which will come into effect from 2008. We hope that this will translate into an increased number of students wishing to study microbiology at university. However, will these students find it easy to identify suitable degrees?

The SGM is currently contributing to a review by the Higher Education Academy of the student learning experience in microbiology. One of the most difficult jobs for the panel has been to deduce where and how much microbiology is being taught in universities. A search of the UCAS database with 'microbiology' as a key word gives 123 degrees with the 'C5' microbiology JACS code for 2008, although many of these are variations on a theme at a single institution or microbiology offered in combination with another (sometimes unrelated) subject. It also lists 41 other degrees with a variety of codes, including Biology, Molecular Biology, Cancer Biology and Pharmaceutical Science. The non-C5 degrees appear on this list because they have been designated in the UCAS database as containing microbiology. This designation is left to the discretion of individual universities and there is inconsistency in how it is applied. This leads to a muddled and incomplete picture of the overall amount of microbiology provision in universities and is a source of confusion for prospective students.

The need for trained microbiologists has never been greater and this is true also of the need to actively promote our discipline, even if it is within the context of broader bioscience degrees. With fewer named microbiology degrees on offer, we need to be pro-active in helping students to identify non-named degrees that will still give them a significant exposure to the discipline. A simple step is to ensure that a UCAS search will accurately identify degrees with a substantial microbiology content. However, there is more that we should be doing to raise the profile of microbiology, from ensuring that students can get detailed information about microbiology course contents from university prospectuses and websites through to actively evangelizing the discipline in schools and careers fairs. Microbiology has been called the 'science of the invisible'. We must take care that it does not become the 'invisible science'.

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Please note that views expressed in Comment do not necessarily reflect official policy of the SGM Council.