Microbiologist

The magazine of the Society for Applied Microbiology ■ **March 2006** ■ Vol 7 No 1 ISSN 1479-2699

Microbiologist
Vol 7 No.1
March 2006
ISSN 1479-2699

Publisher: Society for Applied Microbiology.

Editor: Lucy Harper
lucy@sfam.org.uk

Contributions: These are always welcome and should be addressed to the Editor at: lucy@sfam.org.uk

Advertising:
Julie Wright
Telephone: 01234 326661
julie@sfam.org.uk

Art and Design & layout:
Pollard Creativity

Production and printing:
Pollard Creativity.
All technical questions should be addressed to:
sfam@pollardcreativity.co.uk
Tel: 01933 665617

Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK

Tel: +44 (0)1234 326661
Fax: +44 (0)1234 326678
email: info@sfam.org.uk
www.sfam.org.uk

REGULARS

MEETINGS

Microbiology in the news!

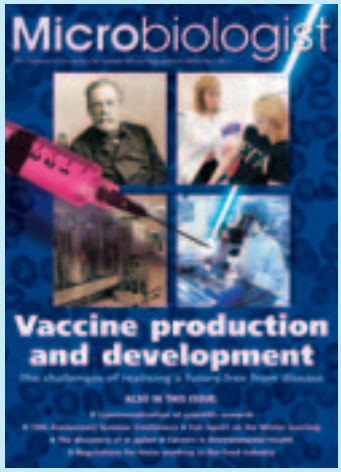
If you spot a microbiological story in the media which you think should feature in *Microbiologist*, please send it to the Editor at: lucy@sfam.org.uk

WRITE FOR US!

The editor is always looking for enthusiastic writers who wish to contribute articles to *Microbiologist* on their chosen microbiological subject.

For further information please email: lucy@sfam.org.uk

FEATURES



Gareth Healy reviews the history of vaccination and examines current methods of production and development

Microbiologist
Vol 7 No.1
March 2006

Contact the Editor:
lucy@sfam.org.uk

Microbiologist copy Dates: contributors please note that the final copy dates in 2006/2007 will be:

Vol 7 No.2 June 2006
Friday 10 March 2006

Vol 7 No.3 Sept 2006
Friday 7 July 2006

Vol 7 No.4 Dec 2006
Friday 15 Sept 2006

Vol 8 No.1 March 2007
Friday 15 December 2006

How to submit material
Please submit all articles, reports, meetings notifications, letters etc., as plain text (*.txt) or rich text files (*.rtf). Please submit all images as original photographic prints or transparencies rather than scanned images and these will be processed by us and returned to you promptly. If your images are only in digital format please make sure they are supplied at a resolution of 300dpi (dots or pixels per inch at a size of not less than 100mm (4 inches) square.

Advertisers: if you wish to advertise in *Microbiologist* you should contact the Society Office in the first instance. Advertising rates and Guidelines on how to submit advertisements are given on the website and are also obtainable by emailing the editor at: **lucy@sfam.org.uk**

Website: the society website is a timely source of up-to-date information on all Society matters and maintains a comprehensive archive of articles and reports on a variety of microbiological topics.

www.sfam.org.uk

Editorial

WE ARE CONTINUALLY reminded of the importance of vaccines, from the reporting of low stocks of the influenza vaccine in the UK at the end of 2005, to the introduction of vaccines for pneumococcal meningitis and the terrorism agent, Ricin. Vaccines have also been the subject of debate and controversy, such as in the case of the measles mumps and rubella (MMR) vaccine and its alleged link with autism. However, no-one can argue against the enormous benefit to society of immunisation—vaccines save millions of lives worldwide every year.

Since the introduction of *vaccinia* by Jenner, 200 years ago, and the work of Pasteur towards the end of the 19th century, many human diseases have been controlled through the use of vaccines. Immunisation is the most cost-effective public health intervention, and while some diseases haven't been completely eradicated, the overall beneficial effects of the administration of vaccines is marked—even in cases where the disease has not been controlled. For example the BCG vaccine against tuberculosis (TB) may not have eradicated the disease, but it has prevented complications in newborns.

On the subject of vaccines, the SfAM winter meeting this year was entitled 'Postcodes to Pandemics' and featured presentations on bio-terror vaccines, MMR and TB vaccines to name but a few. (We have a full report of this on page 38). In addition, our feature article takes us through the complex and time-consuming process of vaccine development and production (see page 28).

This issue of *Microbiologist* recognises the work of Nobel prize winners Robin Warren and Barry Marshall and their interesting research which lead to the discovery of *H. pylori* and its association with stomach ulcers (page 37). We also have an update on science policy from the Biosciences Federation (page 22) and a review of the Microbiological Criteria Regulations for those working in the food industry (page 19). In this issue we also address the commercialisation of scientific research, illustrating the concept with case studies from scientists who've had the opportunity to explore commercialisation as part of their career. In relation to our second feature article (page 32), I am challenging you with the following question and answer:

Q. When is a scientist not a scientist?
A. When he/she is a business person.

This an opinion held by some scientists. Scientists who are more involved in pure scientific research and don't have the opportunity (or perhaps don't realise they have the opportunity) to exploit their research in a commercial setting may not embrace this concept wholeheartedly. They may question the motivation behind those scientists who do commercialise their research. Many scientists do what they do for the pure love of finding something completely new and imparting complex theories and ideas to enthusiastic students, thereby paving the way for the next generation of equally altruistic scientists...don't they? On the other hand, we live in a global economy and if scientists in one country don't take the commercial opportunities presented to them through their research, the chances are that somebody, somewhere, will. The Society for Applied Microbiology, are committed to exactly that—*applied* microbiology. The word 'applied' lends itself to the application of pure scientific research, which can mean many things, including commercial development. In the rapidly changing times in which we find ourselves, some people consider commercial exploitation of scientific research essential.

What are your views? If you would like to join the debate send your thoughts on this sometimes contentious issue to lucy@sfam.org.uk.

Finally, registration for our 75th anniversary summer conference, on *'Living together: polymicrobial communities,'* in Edinburgh, is now open, and online booking is available. Places are limited so fill in the booking form on page 26 or visit www.sfam.org.uk/sumconf.php to book your place now!

COMMITTEE MEMBERS 2005 - 2008

HON PRESIDENT: **Dr Margaret Patterson**, Agriculture and Food Science Centre, Newforge Lane, Belfast BT9 5PX
margaret.patterson@dardni.gov.uk

HON GENERAL SECRETARY: **Dr Anthony Hilton**, School of Life and Health Sciences, Aston University, Birmingham B4 7ET
a.c.hilton@aston.ac.uk

HON MEETINGS SECRETARY: **Professor Martin Adams**, School of Biomedical & Molecular Sciences, University of Surrey, Guildford,Surrey GU2 7XH
m.adams@surrey.ac.uk

HON TREASURER: **Dr Valerie Edwards-Jones**, Research Development Unit, Manchester Metropolitan University, Lower Chatham St, Manchester M15 5HA
v.e.jones@mmu.ac.uk

HON EDITOR: Journal of Applied Microbiology
Professor Arthur Gilmour, Agriculture and Food Science Centre, DARD and Queen's University, Newforge Lane, Belfast BT9 5PX
arthur.gilmour@dardni.gov.uk

HON EDITOR: Letters in Applied Microbiology
Dr Jean-Yves Maillard, Welsh School of Pharmacy, Cardiff University, Redwood Building, King Edward VII Avenue, Cardiff CF10 3XF
maillardj@cardiff.ac.uk

HON EDITOR: Microbiologist
Dr Lucy Harper, Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ
lucy@sfam.org.uk

ORDINARY COMMITTEE MEMBERS until July 2006

Dr David McCleery, Chief Specialist Microbiologist, Safe Food, Food Safety Promotion Board, 7 Eastgate Avenue, Little Island, Cork, Ireland
dmccleery@safefoodonline.com

Dr Shona Nelson, Faculty of Applied Sciences, University of West of England, Coldharbour Lane, Bristol BS16 1QY
Shona.Nelson@uwe.ac.uk

Professor Diane Newell, Veterinary Laboratories Agency, New Haw, Addlestone, Surrey, KT15 3NB
dnewell.cvl.wood@gtnet.gov.uk

ORDINARY COMMITTEE MEMBERS until July 2007

Dr John Coote, Infection and Immunity Division, Glasgow University, Joseph Black Building. Glasgow G12 8QQ
j.coote@bio.gla.ac.uk

Professor Geoff Hanlon, School of Pharmacy and Biomolecular Sciences, University of Brighton, Moulsecoomb, Brighton BN2 4GJ
g.w.hanlon@brighton.ac.uk

Dr Karen Stanley, Biosciences, Faculty of Health and Wellbeing, Sheffield Hallam University, Sheffield S1 1WB
k.stanley@shu.ac.uk

Dr Susannah Walsh, H3.09b Hawthorne Building, School of Pharmacy, Faculty of Heath and Life Sciences, De Montfort University, The Gateway, Leicester LE1 9BH
swalsh@dmu.ac.uk

ORDINARY COMMITTEE MEMBERS until July 2008

Dr Tony Worthington, Department of Phartmaceutical and Biological Sciences, Aston University, Birmingham B4 7ET
T.Worthington@aston.ac.uk

Dr Andrew Sails, Health Protection Agency, Institute of Pathology, Newcastle General Hospital, Westgate Road, Newcastle-upon-Tyne NE4 6BE
andrew.sails@hpa.org.uk

SOCIETY OFFICE STAFF

CHIEF EXECUTIVE OFFICER: **Philip Wheat** **pfwheat@sfam.org.uk**

MEMBERSHIP CO-ORDINATOR: **Julie Wright** **julie@sfam.org.uk**

EVENTS ORGANISER: **Rachel Dowdy** **rachel@sfam.org.uk**

MEDIAwatch

Applied Microbiology and the Media

This is the era of Applied Microbiology with stories every day in the media about avian flu, MRSA, *C. difficile*, MMR etc. etc. and now those who missed our Winter conference were able to read about it in the media!

A measure of the respect that SfAM's and Med-Vet-Net's Communication Unit have gained is that Journalists are constantly phoning for background briefing and explanation as well as the names of microbiologists they can contact. If you would like to be involved in the media, please chat with Lucy Harper on: 01234 271020. SfAM is always ready to offer advice on communication to its members.

Media Briefing

On 4 January in response to requests from the media we organised, in partnership with the Science Media Centre at the Royal Institution, a background briefing for the national press on some of the subjects covered at our Winter Conference (see page 38 for the full report).

Three of our speakers Paul Hunter, Doug Lowrie and Jim Robertson kindly came to London and talked to the press. Their calm and highly professional presentation obviously impressed the media—our Winter conference was given excellent coverage in the most of the National press, the two London papers and on BBC radio (national and local networks, World Service and online).

Journalists from the UK Media attending our press briefing

Microbiology in the news

To keep up to date, don't forget to look at our 'News' section on the SfAM website:
www.sfam.org.uk/news.php

Microbiology is fun!

Our president, Dr Margaret Patterson was interviewed for Radio Ulster recently. She spoke about the importance of Microbiology in every day life, telling the audience that not only do micro-organisms cause disease, they are beneficial, for example in the formation of yoghurt. She promoted the 'fun' side of Microbiology, with some facts, such as there are ten times as many bacteria in a human body as there are human cells—10^{15} to be precise! Also, did you know that the average human is carrying approximately 2kg of bacteria?

If you spot a story in the media which you think should feature in this column, then send it to the Editor at: lucy@sfam.org.uk

How clean is your mouse?

Dr Margaret Patterson is not the only person who's been in the media spotlight recently. Our Hon General Secretary, Dr Anthony Hilton, has had his name in print. Freelance writer and broadcaster, Richard Hollingham interviewed Dr Hilton for an article which was to appear in *New Scientist*.

The basis of the article was the cleanliness of the office environment. An American scientist, Geber, decided that his work space was 'unclean' and in an attempt to rectify this situation he had taken to spraying the area with alcohol.

The study which Anthony carried out was based at Aston University and looked at the number of bacteria which are present on computer keyboards. Dr Hilton performed an aerobic colony count, and measured levels of bacteria associated with faecal contamination on the keys 'A' and 'Z' of a computer keyboard. The 'A' key is used relatively frequently, whereas the 'Z' key is infrequently used in comparison. He looked at the survival and transmission of these bacteria and his findings were discussed in the Christmas issue of *New Scientist* (24 December 2005). Visit http://www.newscientist.com/channel/life/mg18825312.000.html for an introduction to the full text article.

SfAM POLICY ON THE MEDIA

We will: ■ always do our best to provide facts, information and explanation. ■ if speculation is required, explain the rationale behind that speculation. ■ desist from hyping a story—whether it is the journalist or the scientist doing the hyping.

Putting the record straight

FROM: Eric Bridson
SUBJECT: W H Pierce Prize

The great success of the W H Pierce award has brought much pleasure to those who had the privilege of working with him at Oxoid Limited.

When I joined Oxoid in 1961, Bill quickly suggested to me that I join The Society for Applied Bacteriology. This I did and I have remained a member ever since. It opened microbiological doors that I had not entered in my earlier career of medical microbiology. Bill remained a helpful and good friend to me until he retired from Oxoid in 1965. Professor Sussman has written an excellent Foreword and Introduction about Bill Pierce in the publication contained abstracts of the preceding awards.

Bill could have slipped unnoticed over the rim of retirement into his subsequent death but for the intervention of his very good friend in Oxoid, James MacDonald. In 1983, James came to me and suggested that Oxoid fund a W H Pierce Memorial Prize. We discussed it in more detail and we agreed that the SAB/SfAM was the appropriate body to administer such an award. I then took the proposal to the Oxoid Board and the CEO (Dr James Elstub) was in agreement and it was quickly accepted unanimously. I was especially pleased to be able to present the annual prize up to 1987 when I retired. Since then the award has increased in value over the subsequent 21 year period and remains a prestigious prize for young microbiologists.

The purpose of this letter is to make clear that James McDonald was the originator of this award. He is now happily retired in Southport and he gets constant delight from the fact that his old friend and colleague Bill Pierce is remembered every year.

write on.....

Do you have something to say? Write to the Editor at: lucy@sfam.org.uk

Career Boost

FROM: Vyv Salisbury
SUBJECT: Students into Work Award

I would like to thank SfAM for providing my student, Kerry Cutter with her Students into work grant. This grant has once again proved to be a valuable launching pad for a career in Microbiology research. We were very grateful for the funding and it has been most rewarding to observe Kerry's progress (see page 42) from undergraduate student to independent research worker, over the course of the project. She fitted well into the Bacterial Bioluminescence Research team at UWE, actively participating in team meetings (and social gatherings!) and discussing her research. She competently designed and carried out a series of significant and well planned experiments and I know that the experience played an active part in her decision to stay in Microbiology research and undertake a PhD Studentship.

Dr Margaret Patterson reports on the Society's strategic review and plans for the future

I GUESS AS YOU READ THIS IN March or April, many of you will have forgotten your 2006 New Year's Resolutions and Christmas 2005 is only a distant memory. However, I am writing this in early January, the days are still very short and people are still looking forward and making plans for the year ahead.

The SfAM Committee are no exception and we have just returned from an Away Day where we looked at what we are currently doing and discussed ideas for the future. This is the third strategic review we have held over the last six years. Each review has given us the opportunity to assess what we are doing well, what needs to be improved and what else we could be doing to better meet the needs of our members and society in general.

A number of ideas came out of the discussions. These can be broadly grouped into three areas—membership, meetings and communications. Many of the ideas are still at the embryonic stage and need to be thought through properly before we make any formal announcements but, for example, we would like to explore ways of increasing the numbers of both individual and corporate members. We would also like more feedback from our existing members. You may be getting a questionnaire later in the year, seeking your views, so I hope you take the opportunity to tell us what you think! We believe we have excellent scientific programmes at our Winter and Summer conferences and many of the topics should appeal to a wider audience beyond our core membership so we should do more to encourage a more diverse group of attendees.

Finally, good communications was seen as essential in all aspects of what we do. We are fortunate in that Lucy Harper works as our Communication Officer. I believe she is doing an excellent job with the Microbiologist and with the new look web site. SfAM is also responsible for the communications within *Med-Vet-Net*, and this has given us an excellent profile across Europe. The Society is now much more involved in 'external affairs'—such as responding to relevant government consultations and airing our views with other Learned Bodies such as the Biosciences Federation. All these activities improve the flow of communications and give credibility to our claim of being the voice of applied microbiology, which we see is our distinctive feature compared to other Societies.

I am pleased to say that many of the Committee willingly volunteered to form small sub-groups to develop the initial plans and report back to Committee at each of our meetings. We are also very fortunate that we now have a full complement of Office staff to help us implement our plans.

In addition to these longer-term strategic plans, we identified two deadlines that we will have to meet this year.

The first one the need to relocate to new premises as our lease on the Blore Tower expires in summer 2006. We plan to stay in the Bedford area but there will, inevitably, be some upheaval during the move.

The second deadline is the fact that we are planning to become incorporated as a Company Limited By Guarantee. The Charity Commission suggested that this was something that we should consider when they visited us in 2003. The Society will still be able to retain its Charitable status but the Trustees (who are the Committee Members) along with the Custodian Trustees will have more protection within the law. Many other Learned Societies have already successfully gone down this route and Committee have taken the decision that this is appropriate for SfAM. Discussions have already started with our Solicitors and the 'Memorandum and Articles of Association of the Company' have to be prepared to replace our current Constitution. Further details will be sent to all members over the next few months and they will be asked to approve these changes at the AGM in July 2006.

Finally, we cannot forget that we are now in our 75th Anniversary year. We have got off to a great start with an excellent winter meeting and the Inaugural Denver Russell Memorial Lecture (see page 38 for a full report on the meeting).

I am looking forward to seeing many of you at our summer conference in Edinburgh. This looks like being another exciting event and already a number of people have submitted abstracts and registered their intention to attend (and remember I am writing this in January, before registration has officially opened). Please book early if you plan to attend, as places at some of the social events are limited (Full details, the complete programme and a booking form can be found on page 24).

Dr Margaret Patterson
President of the Society

Philip Wheat talks about his first 12 months as the Society's Chief Executive Officer

Welcome to the first issue of the *Microbiologist* for 2006 and a belated happy new year to you all. I have now been in post nearly a year, where does the time go ?! I have experienced a full cycle of the main events the Society currently organises. This began with the Summer Conference held in Brighton in July, followed by the President's dinner in November. The dinner was held in a prestigious venue—the Horseguard's Hotel situated just off Whitehall, in London. The room we hired was part of the old Liberal Club which is attached to the hotel. The room provided a fine venue for all the dinner guests and was very much appreciated by all who attended.

The final event was the Winter meeting which was held in early January at another fantastic venue, the Royal Society just off Pall Mall, London. Judging from the questionnaires which were returned from delegates after the event the whole meeting was deemed to be very successful. In addition to the meeting being such a hit, the Society and certain of the topics covered in the meeting, were subject to significant coverage by the national media in the form of newspapers and radio. This was a direct result of a press briefing held at the Science Media Centre (SMC) on the previous day. This briefing consisted of some of our invited speakers giving an overview of their presentations to numerous journalists. Thanks are due to the staff of the SMC and to Professor Nigel Poole who organised and facilitated the day.

As briefly described in the President's column, the committee and myself had an 'away day' in early January in which we discussed the future strategic direction of the Society and in particular areas which we felt needed developing. A number of initiatives were generated from this exercise and in the coming year some of these will be initiated and implemented. What I can say is that the Society is for its members and feedback from you is always welcome. I need to know if you have any ideas of activities the Society should be involved with.

I would like to take this opportunity to remind you about this year's Summer Conference (Edinburgh, 3 – 6 July). The topic this year is 'Living together: polymicrobial communities.' Judging by the interest we have received so far I would strongly recommend early booking to reserve your place. Full details of the meeting including a booking form can be found on the SfAM website (www.sfam.org.uk/sumconf.php) and in this issue of this issue of the *Microbiologist* on page 24.

The Society will again be attending a number of international events this year. The first will be at the American Society for Microbiology meeting in May. This is followed by the International Food Technology meeting in June. Finally, for the first time we will be attending the International Food Protection meeting in August. All these meetings will have a number of delegates who work in the field of applied microbiology and could well be interested in joining the Society.

Finally, I would just like to introduce a new member of staff who has recently started work in the office. Rachel Dowdy recently joined us as the Events Organiser and has plenty of experience with event co-ordination. Some of you will have met her at the President's Dinner and Winter meeting. I expect many more of you will meet her at the Summer Conference which she is busily organising as I write this column!

Philip Wheat
Chief Executive Officer

MED•VET•NET

Teresa Belcher reports on Med-Vet-Net's five-year strategic plan and new scientific Workpackages

MED-VET-NET IS A EUROPEAN Network of Excellence that aims to improve research on the prevention and control of zoonoses by integrating veterinary, medical and food science research. Comprising 16 European partners and over 300 scientists, **Med-Vet-Net** will enable these scientists to share and enhance their knowledge and skills, and develop collaborative research projects. **Med-Vet-Net** officially commenced on 1 September 2004, and is funded to the value of €14.4 million for five years.

New set of scientific Workpackages for Med-Vet-Net

Approximately 50% of **Med-Vet-Net's** financial resources are committed to scientific research in four thematic areas: Risk Research, Epidemiology, Host-Microbe Interaction and Detection & Control. The scientific activities are undertaken through Joint Programmes of Activity (JPA) which are reviewed every 12 months.

In the first 18 months, eleven Workpackages (WP) were funded, and the final milestones and deliverables of nine of these Workpackages will be completed by the end of February 2006. Two Workpackages (WP4 and WP6) have been extended to enable completion of milestones and deliverables.

The scientific workprogramme for the next set of Workpackages was defined in Year 1, within Workpackage 2, by a 'bottom-up' approach involving expert scientists from each of the partner institutes in each of the thematic areas. Over two meetings, in London and Rome, these scientists developed a draft Five-Year Strategic Plan based on a state-of-the-art review in each thematic area. On the basis of this plan, a Workpackage programme was proposed and a 'Requirements Call' of 24 topics on the website was undertaken, resulting in brief proposals prepared and submitted by **Med-Vet-Net** scientists. Of these, 11 were fully funded and a further proposal was partly funded and will be fully funded if funds become available. These will commence in March 2006 and run for varying periods from 12 months to 36 months. A summary of each is found below under the relevant thematic areas:

EPIDEMIOLOGY

WP 21: Molecular epidemiology of Salmonella Genomic Island 1 (SGI). This WP aims to study the distribution and characteristics of the chromosomal gene cluster SGI1 in enteric bacteria (i.e. *Salmonella*, *Shigella*, *E. coli*) in a large collection of animal and human isolates. The result will be a database of strains harbouring (parts of) SGI1. This database will be a basis for future virulotyping, and risk assessment of isolates harbouring SGI1.

WP28: Methods of attributing human zoonotic infection with different animals, food and environmental sources.

In order to identify and prioritise effective food safety interventions, it is critical to attribute human zoonotic infections to the sources responsible. A wide variety of approaches and data for source attribution are used around the world and in the process of priority setting, it is very important to understand the differences and limitations of these approaches. This WP intends to apply, compare, discuss and recommend the appropriate use of five of the most commonly applied approaches: microbial sub-typing, risk (exposure) assessment, analytical epidemiological studies (including case-control studies of sporadic cases), analysis of data on foodborne disease outbreaks and, finally, intervention studies.

WP29: Surveillance of Emerging Antimicrobial Resistance Critical for Humans in Food, Environment, Animals and Man. Appropriate laboratory-based studies are required to demonstrate the possible transfer of resistant bacterial strains and/or resistance genes from animals to humans. This WP will analyse antimicrobial resistance determinants in bacteria from the environment, humans, food and animals. **Med-Vet-Net** possesses a unique bacterial strain collection, with bacteria from all possible origins, and this collection enables retrospective and prospective genetic analyses of selected resistance determinants. These strains, their antimicrobial profiles and sources, in bacterial collections throughout the network will be catalogued and then resistance induced through 16S rRNA methylases in Gram negative and Gram positive bacteria, which comprise a major novel threat in Europe, will be investigated.

HOST-MICROBE INTERACTIONS

WP 26: Virulotyping of new and emerging *Salmonella* and VTEC. This project aims to select appropriate isolates by PCR analysis and then using a subset of these isolates to assess the available virulence arrays for *Salmonella* and *E. coli*. Up to 10 known virulence determinants for *E. coli* and *Salmonella* will be selected and specific PCR primers and amplification conditions will be provided. All partners will use these

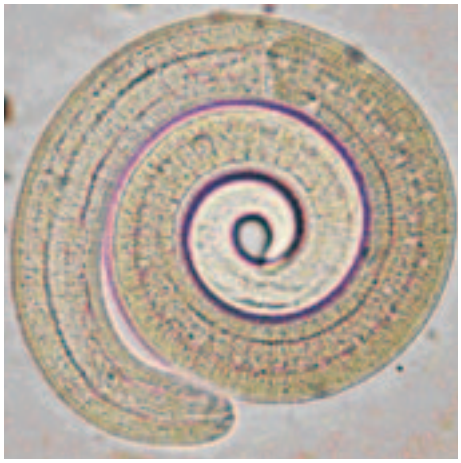
conditions to provide a template of the virulence determinants present in their selected strains and will curate their results into a simple database. Strains showing novel virulence combinations will be selected for further analysis using the *E. coli* and *Salmonella* virulence gene microarrays developed.

WP30: Towards a combined microbiological and epidemiological approach for investigating host-microbe interactions of *Campylobacter jejuni* - CAMPYNET III. CAMPYNET III will develop a discussion network between microbiologists and epidemiologists, with emphasis on host-pathogen interactions, with particular relevance to campylobacteriosis in humans. Meetings will provide updates on host pathogen interaction by a recognised expert in the field. A network forum will discuss the suitability of currently available tools for the investigation of (i) *Campylobacter* virulence characteristics, (ii) human host responses and (iii) the type of information epidemiologists need from microbiologists. The project will agree a strategy for microbiological and epidemiological investigation of human illness associated with *C. jejuni*. In addition the CAMPYNET database will be maintained and expanded, and the CAMPYNET website revived.

DETECTION & CONTROL

WP 22: Zoonotic Protozoa network (ZOOP-NET) - *Cryptosporidium* and *Giardia*. This WP aims to harmonise molecular methods useful to detect the protozoa *Cryptosporidium* and *Giardia* and to distinguish human from non-human pathogens. It will establish and maintain repositories of standards (nucleic acids and cysts/oocysts). In addition, validation tests for both *Cryptosporidium* and *Giardia* will be performed in the participating laboratories using a panel of DNA prepared from isolates collected by all partners during the project. An agreed panel of highly discriminatory markers for the analysis of species, genotypes and subtypes will be identified and online databases to store and analyse the data produced during the project will be produced.

WP 25: A forgotten pathogen in our midst? – Development and application of improved diagnostics for Q fever. This WP aims to allow epidemiologists, detection and pathogenesis experts to establish a critical mass of expertise regarding Q-fever caused by *Coxiella burnetii* in Europe. Currently, epidemiology is largely unknown and methods for surveillance are limited and their application sporadic, whilst existing data is localised and poorly standardised. This WP will encourage the development of a roadmap for future research in this area, and exploitation of the existing genome sequence (and those currently being produced), will be undertaken in order to devise molecular typing tools.



Trichinella spiralis digest larva (image courtesy of Dr. T. Streter, Centr.Vet.Inst. Budapest)

WP31: Food producing animals as a potential source of emerging viral zoonoses (ZOOVIR-NET). The changing epidemiology of several viruses has made it necessary to investigate possible risks associated with virus infected animals. This WP aims to evaluate the potential zoonotic role and/or foodborne transmission of emerging viruses like porcine hepatitis E virus (SHEV), Anellovirus and Encephalomyocarditis Virus (EMCV), as well as tickborne encephalitis virus (TBEV). Virological assays and epidemiologic data available in the countries participating in the Workpackage will be assessed and implemented. Diagnostic and epidemiologic studies on the prevalence of swine viruses will be performed, and identified viral strains will be characterized and compared by sequence analysis. Selected strains will be cloned, and recombinant viral antigens will be used for immunological assays and production of polyclonal and monoclonal reagents.

RISK RESEARCH

WP 23: Prioritising foodborne and zoonotic hazards at the EU level. This project will consider methods and collect data to support priority setting of foodborne and zoonotic pathogens at the European level. Available data will be integrated in two indicators for the societal impact of foodborne and zoonotic illness: disease burden (in Disability Adjusted Life Years) and cost of illness (in Euros). Attention will be given to existing as well as emerging zoonoses. The project will be based on methods developed in The Netherlands and will integrate data from other Member States, if available. Collaboration with non-European partners who pursue similar goals will be established.

WP 24: Comparison of *Campylobacter* risk assessment models: Towards a European consensus model? The different existing risk assessments on *Campylobacter*, developed by **Med-Vet-Net** partners, will be compared to explore differences and similarities, and to come to a consensus about the best risk assessment methodologies appropriate for different risk management questions. It is expected that the WP will focus on *Campylobacter* in broiler meat, but other routes will be considered as well.

WP 27: Harmonisation of *Trichinella* infection control methods, quantitative risk assessment in pigs and an early diagnosis in humans to increase treatment efficacy. Since human trichinellosis in the EU is characterised by a low frequency of infection but with a high human risk of disease, there is a need to develop an algorithm that permits a prompt diagnosis to prevent the spread of infection and allows for early and effective treatment. Establishment of a database on human infections, identification of molecular markers to trace back the infection from fork-to-farm, the use of GIS to map the infection among wildlife and the maintenance of the repository of *Trichinella* reference strains will represent additional important tools to monitor and control infection in EU countries.

Further Information

■ For more information about **Met-Vet-Net**, visit our website at http://www.medvetnet.org/ or contact Teresa Belcher at the SfAM offices in Bedford on: **+44 (0)1234 271020**

Teresa Belcher
Med-Vet-Net Communications Director

New Members

We would like to warmly welcome the following **new members** and hope that you will participate fully in the activities of the Society.

Finland

Dr A. M. Pihlanto

France

Professor G Thouand

Greece

Mr A Stamatiou

India

Dr S Mukherji

Iran

Dr J Hamedi

Ireland

Dr M Callalan

Japan

Dr H Nakayama

Mexico

Mrs L O Noriega Orozio

Nigeria

Mr O O Fadeyibi; Mr A C Obi;
Dr R E Ohenhen

South Africa

Dr H Atagana; Mr C J Van der Wath

Spain

Miss M Rodriguez-Diaz

United Kingdom

Miss N Ahmed; Miss K L Baker;
Mr D M Barton; Professor C B Beggs;
Ms C Benskin; Mr A H Colman;
Dr S Cottrell; Miss L A Coulthwaite;
Miss K L Cutter; Mrs J Davis; Dr M Fielder;
Miss K Fisher; Mr J Kabir; Miss J Kennedy;
Miss A Khan; Mr Y Kumar; Dr R Lagan;
Miss C Leverington; Miss R Long;
Miss V L McCune; Dr G McDonnell;
Miss A Mehinto; Mr D L Merrifield;
Miss L Oluoma; Mr D A Patterson;
Miss A L Renteria Monterrubio; Dr J Ross;
Miss A K Sowa; Miss S Spence;
Miss J M E Stirling; Dr C Thornton;
Mr T Vattakaven; Miss L Wheeldon;
Dr P Wigley

USA

Dr L A Blankinship; Mr D Robbins

Call for nominations to committee

Three members of committee are due to retire in July 2006 after their three years of service: Dr David McCleery, Dr Shona Nelson and Professor Diane Newell; thus there will be three vacancies to fill in July 2006. Nominations are invited from all full members of the Society for these vacancies. Nominations must be made in writing and received by the Society Office **by 5 May 2006.** Should nominations exceed vacancies, election will be by a system of postal voting arranged by committee.

Member gets MBE

Congratulations to Ray Osborne, a member of the society since 1971, who was awarded the MBE in the Queen's Birthday honours List. Ray is a retired member who worked in the diary industry – in particular with cheese. His MBE was awarded "for services to the cheese industry."

SfAM Holds Chair with ELG

We are pleased to announce that since the 1 February 2006 SfAM has held the chair of the ELG (European Liaison Group) of the Biosciences Federation. The European Liaison Group, was formed in recognition that UK bioscience organisations frequently have poor intelligence on emerging European legislation that will impinge on their members and their activities. All the Federation Committees bring together expertise from external organisations as members or observers, and the European Group is a good example, with representation from the Research Councils, Wellcome Trust, Royal Society, ABPI and biomedical charities. SfAM are proud to be chairing such an important group.

Erratum

In the September 2005 issue of the *Microbiologist* (Vol. 6, No. 3) we added a short note regarding the passing of Dr J. W. Hopton in February 2005. However, in this note we stated incorrectly that he had been a retired member since 1956. This should have read that he joined the Society in 1956 and was a retired member when he passed away. He was an active member of the society throughout his membership and was an archivist for a number of years. We would like to extend our sincere apologies to his friends and family.

Call for nominations for W H Pierce Prize Award

Do you know a young microbiologist (under 40 years of age) who has made a substantial contribution to microbiology? If so, why not nominate them for this prestigious and substantial award which is worth £2,000. The award was instituted in 1984 by Oxoid to commemorate the life and works of the late W H (Bill) pierce, former chief bacteriologist at Oxoid Ltd and a long-time member of the Society. The prize is presented annually at the summer conference. Full Members wishing to make a nomination for the 2006 prize should write in confidence to the Hon General Secretary, Dr Anthony Hilton, at the Society Office in Bedford, including a full cv of the person nominated and a letter of support. Please note there are no official forms for this award.

Closing date for nominations is 21 May 2006.

Please note that application is through nomination by Full Members of SfAM only.

History of the Society

Our archivists have been busy trawling the attic here at the Blore Tower researching the history of the Society as part of our commemorative 75th anniversary. They are nearing the end of their hard work collating the many boxes of journals and papers which is enabling Max Sussman to write a 'history' of the society. We thank them for all their hard work and in organising the archive.

Sponsor a new Member of the Society and win a £50 Book Token!

Could you be the next winner of the 'SfAM Sponsor of the Year' Award?

If you feel you could be our next winner for 2006, and would like some promotional material to help you recruit new members please contact Julie Wright, Membership Co-ordinator on 01234 326661 or email julie@sfam.org.uk.

SfAM Anniversary Fellowships

Are you a member of staff in a private, academic or government laboratory? Want to train in a new technique and add to your CPD points? Know somewhere you can go to get this training but don't have the funds to get there?
Why not apply for the new SfAM Anniversary Fellowship?
SfAM will pay a maximum of £1000 per week for a 1-4 week visit (to include staff travel expenses and laboratory consumables).
Contact the SfAM office for full details and an application form.

General Conditions

1. Applications should be made through completion, and submission, of the SfAM application form. The deadlines for applications are 1 March and 1 June 2006.

2. The SfAM Awards Panel will be responsible for making the decision on allocation of awards.

3. Normally, recipients of the awards, or their employer, will be members of SfAM.

4. Recipients of the awards are expected to provide a report on their Fellowship e.g. through an article in Microbiologist or by an oral or poster presentation at a SfAM conference.

5. SfAM is not responsible for any injury or ill effect suffered by the applicant during the course of the visit. It is the applicants responsibility to ensure that he/she is covered under the relevant personal indemnity insurance policies of the host laboratory.

6. Normally, recipients of the awards are not postgraduate students, but in exceptional circumstances such applications may be considered.

contact: 01234 326661

Sponsored Lecture Grant Report

Emerging significance and environmental control of nosocomial viral pathogens

While in the UK, Prof. S A Sattar (University of Ottawa), was invited to give a lecture at the Welsh School of Pharmacy as part of a seminar series on Monday 9 January 2006. Prof. SA Sattar is an extremely versatile scientist whose lectures are invariably fascinating, undoubtedly because of his wealth of experience (he has given over 225 invited lectures in his long career) and the time he spends in researching a subject before any presentation. Indeed his lecture lasted a full hour with no complaints from the audience and we could have listened to this elegant orator for much longer.

Prof. Sattar's lecture was highly topical since he presented information on infectious diseases, reminding us that we are certainly nowhere near controlling and eliminating infectious diseases despite early hopes at the beginning of the antibiotic era. The 'failure' of antibiotics to control some infections and the difficulties in developing adequate and efficacious vaccines, both emphasise the need for preventive infection control measures such as the use of microbiocides. It is true that within the last few years much attention has been given to the use of surface disinfection, hand antisepsis and the use of microbiocide-incorporated surfaces and fabrics (the so-called "self disinfecting surfaces"). It is also pleasing to note an increase (although very modest) in the funding for research in this field. Not all infections can be controlled through the use of microbiocides, but those transmitted indirectly (via surfaces, water, fomites etc.) are an obvious target.

This is a huge field of investigation, especially when one considers that for many infectious diseases (over 200) the mode transmission is unknown. Prof. Sattar concentrated on the control of nosocomial viral pathogens in his lecture and provided selected examples reminding us that often a viral infection is asymptomatic although they might have a chronic effect that may not be detected for many years. Therefore, viruses constitute a particular challenge in the hospital environment. Viruses can be separated into enveloped and non-enveloped viruses, the former being the most sensitive to disinfection and least able to survive on surfaces. Non-enveloped viruses are more challenging and research into their susceptibility to microbiocides often depends on our ability to culture these viruses in vitro. To illustrate these points, Prof. Sattar provided two examples, the study of rotaviruses and noroviruses. The latter, which is highly infectious and causes many episodes of viral gastroenteritis in the hospital environment (leading to the closure of the hospital in extreme cases), cannot be cultured *in vitro* and thus advances in research and understanding of this virus rely on the use of a surrogate such as the feline calicivirus.

Microbiocides play an important role in the control of specific nosocomial viral infections, but adequate control requires knowledge of the way a virus is transmitted. Our understanding of the efficacy of a microbiocide relies also on the use of appropriate efficacy test protocols. Here one can note that frequently the long contact time recommended in many standard tests is often inappropriate. It is easy to envisage an increase in the use of microbiocides in the future for the environmental control of viral pathogens and other organisms. However, such usage needs to be appropriately justified as an effective infection control measure (Prof. Sattar expressed his concerns over the use of self-disinfecting surfaces) and the additional environmental toxicity must be recognised.

Dr Jean-Yves Maillard and Prof S P Denyer
Welsh School of Pharmacy

For further information about the Society's Sponsored Lecture Award please visit: **www.sfam.org.uk/prizes.php**

Welcome!

Our new Events Organiser, Rachel Dowdy, introduces herself

As the new events organiser for the Society, I have had a very exciting time since I began at the start of November. I attended the President's Dinner on my fourth day and the Winter Meeting in early January. Both events were of a high standard and were well organised. The team in the Bedford office have been fantastic, friendly, supportive and helpful. I can't help but feel a part of the team already and really look forward to helping organise a memorable 75th Anniversary Conference in July.

A bit about myself: well, I was born and raised in Perth, Western Australia and decided to come out to the UK 18 months ago to broaden my horizons and meet family that I have only seen in photo's (both my parents are English).

My previous role in the UK was as Events co-ordinator with a large charity (RSPB) helping organise their Members Weekend's and Summer Expositions. Prior to leaving Australia I was a Corporate Events Co-ordinator for a Luxury Cinema Complex. I had started a Business Degree part-time but unfortunately my work load was too much to do both so my studying suffered. I'm looking forward to meeting you all!

Rachel Dowdy
SfAM Events Organiser

CAREERS

Environmental Health

Further Information

- CIEH: www.cieh.org
- Careers advice: www.ehcareers.org
- Safer Food Award: www.norwich.gov.uk
- EH for medics: www.ehresources.co.uk

ENVIRONMENTAL HEALTH does not just mean food safety. To be successful in this career, you need to be able to make decisions about a wide range of situations, such as: whether it is more economical to repair a house or to have it demolished and rebuilt; the dangers facing a shoe repairer; the acceptable levels of air pollution from a crematoria chimney; how smelly a neighbour has to be before action can be taken; the dangers of cockroaches; who owns which piece of a sewer pipe; to how to prepare a case for court.

There is little laboratory-based microbiology in the everyday activities of an Environmental Health Officer (EHO). However, I still think of myself as a scientist; I qualified and worked in microbiology and molecular biology and now I am working as a Food Safety Officer (AKA EHO) at Norwich City Council.

My career has been varied. Like many scientists of my generation I undertook short-term contracts which varied in length from three months to three years. After an Applied Biology degree from the then Hatfield Polytechnic, I stayed on to read for a PhD in Yeast Genetics. In the late 1980s, at the time of the *Salmonella* and *Listeria* scares, I was employed at the Institute of Food Research in Norwich, improving detection methods for *Listeria monocytogenes* on a project with food industry funding. It seemed that, as quickly as funding was made available, the project finished, leaving me with a taste for industry. In order to pursue this interest, I read for a Masters in Food Safety at South Bank University in London. The students on this course were mainly environmental health officers and they gave me a strong sense of the duties that were involved in their line of work. After a contract in the microbiology lab at the Haagen Dazs ice cream factory in France, I returned to contract lab research in the UK, until I was offered a two-year position at the University of California, Davis. I spent my time there developing a new rapid immuno-molecular test for *E.coli* O157, and returned to the UK with an impending patent and the decision made to reconsider my options.

At this point, I decided that I wished for a job which was not deskbound, involved dealing with people, required problem solving, and which would give me the opportunity to work in the public sectors or for myself. The area of environmental health ticked all these boxes and also fit my personality, giving me a degree of independence over my daily workload. It would also make use of my inquisitive nature. I also noted that there was (and still is) an increasing shortage of EHO's.

In order to pursue this career change, I decided to study at Birmingham University, on their MSc Environmental Health course. At that time, the course was split into a two-year integrated sandwich course, with the advantage of reducing the intensity of the teaching. However, this course structure did make it very expensive from a student's point of view.

I found the course tough. I was older and it was hard to be a student again, especially having taught some similar courses myself. The scale of the subject means that there is a huge amount of information to take in. This, coupled with the requirements of the practical training and the professional logbook, meant that I was working harder as a student than I ever had before. I managed to find unpaid training with the London Borough of Hammersmith and Fulham and later, fortunately, some paid training with the then Birmingham-based health and safety department of Allied Domecq retail, the owner of a large estate of managed pubs. Both places provided me with excellent experience and I particularly valued the experience in the private sector, seeing environmental health from the other side of the fence.

The course peaked in December 2000 with my final University exams, my professional exams and interview. I left college in a near state of exhaustion but luckily with just enough energy to walk straight into a job at Norwich City Council (NCC). This was a great experience. I worked on a series of short-term contracts covering refuse, cemeteries and drainage, pollution, night time noise and food safety. I also carried out some consultancy work and some teaching on a local environmental health course. Fortunately, the NCC job turned into a permanent health and safety officer position and I spent two years in that role before transferring to the position of food safety officer last year.

As a food safety officer at Norwich City Council I am responsible for inspecting food premises for food safety and for health and safety, and the investigation of complaints and accidents at these premises. If there is an outbreak of an infectious disease I will be the person carrying out the legwork on the investigation, trying to stop the progress of the outbreak with a mind to collecting evidence for possible future formal action.

The activities of the job vary considerably from one day to the next, sometimes starting early and sometimes

finishing very late. Here is an example of one of my working days.

I arrive at work at around 8.00 am and check my email, check the computer management system for 'complaints' and then check my diary to review my appointments for the day. I decide on two inspections to be carried out that day and read through files and previous letters to check on problems that need to be followed up. I then catch up on my letter writing and other admin tasks, phone a witness to a tripping accident to arrange a time to take a statement and then, after a mug of coffee, leave the office and head off to inspect a new coffee bar for food safety and health and safety. The inspection is routine. I find a small number of food safety and health and safety concerns and I discuss these with the coffee bar manager at the end of the inspection. I then pay a visit to a nearby shopping centre to follow up on a complaint about the state of their toilets. I first call at a burger bar and confirm that their customers use the toilets, and then I notice that a new food business has started trading nearby. I visit the food business and discuss the Food Standards Agency's new publication of a Food Safety Management System designed for small caterers (basically a simplified and directed HACCP based system which should, if implemented, mean that a business will comply with the new European regulations). I ask the manager to try to integrate this model with his present systems so that he can discuss it when I return, on another day, to inspect his business. Then I head off to the shopping centre management to have a discussion with the operations manager about toilets, cleaning schedules and monitoring. After a quick lunch, I carry out the inspection of the second premises, a small independent Chinese grocery that also offers cooked buffet lunches. The place is small, clean and bright, and the proprietors are charming but have little English. We do have interpreter services available but I determine that the husband's English is sufficient for me to carry out the inspection without an interpreter. Generally, everything at the grocery is very good, except that there is no formal food safety management system and the toilet leads directly off the kitchen area with no lobby. I have a variety of options at this stage and I decide to make an informal agreement with the couple that they will install a lobby to the toilet and

Christopher Gooding checking the temperature of food stored in a chiller

formalise their food safety system. Finally, I return to the office and re-check the computer for new email or complaints. One of my colleagues is out of the office dealing with a fall down a cellar hatch in the public areas of a restaurant—the second such incident in a month.

However, I stay in the office to update a prosecution file concerning a mouldy roll I found in the fridge of a catering pub in the summer. I then do some internet research on the dangers of small-scale fruit juice production, as one of the local students has decided to supplement his loan by squeezing juice and delivering it on a bike to his customers. I update the database with the basics of my inspections and calculate their star ratings (the new scores on doors scheme piloted by Norwich City Council) and then I pack up for the day at around five. But I'm not quite finished; this week I'm on the rota for out of hours noise, and so between 9 and 12 this evening I could be called out to deal with, for example, a neighbour complaining about a misfiring alarm.

This was a fairly active day. As I mentioned earlier, there is a great deal of administrative work and I will deal with that further, later in the week. Aside from these routine tasks, I have also recently helped on a study of all of the 13 spa baths in the Council area, two of which tested positive for *Legionella*. There are always interesting new queries from members of the public and businesses; meetings with other council departments; and joint working with other enforcement agencies.

I work in a good strong team and between us there is a lot of expertise in many areas. The real asset of the EHOs to the community is the breadth of knowledge that they have, but this is threatened by increasing specialisation. I have tried to maintain a broad skill base but it is increasingly difficult to keep abreast of the changes to the legislation and the new developments in technology in the different subject areas. The key personality traits that an EHO needs are: an interest in people; patience, humour and respect; and a desire to improve peoples' lives and environments. The job can also be frustrating and unrewarding and you have to be able to make continual decisions based on your best judgement and knowledge at the time. The work takes you to places you would never normally see and occasionally places you would never have wanted to visit, but that is the beauty of it. When working in both the private and public sectors, there is always too much to do and a constant pressure; however, the variety of duties and people make for a lively working life.

Environmental health is a graduate profession. This means that the first step towards this career is to obtain a degree accredited by the Chartered Institute of Environmental Health. There are then a number of further professional steps you will have to take to qualify fully, including work-based learning which normally involves a sandwich year, the completion of a log book, professional exams and an interview.

If you are a little more mature, as in my situation, and already have a science-based degree, then you can qualify using the accredited MSc route. This qualification can be studied on either a full or part time basis; however, if you are coming in from outside the profession you will probably need good access to funds and flexibility to move around the country, both to attend the course and to obtain the vital work experience.

If you are interested, you should also consider other routes to becoming an EHO. The armed services use EHOs and they provide training opportunities. Also, you may consider initially finding a job as a technical officer at a local authority and then taking up any EHO training opportunities that are offered, with a view to becoming a fully trained officer.

The views expressed above are my own and do not reflect those of Norwich City Council or the Chartered Institute of Environmental Health.

Christopher Gooding
Food Safety Officer, Norwich City Council

EU Microbiological Criteria Regulations

There are outstanding issues to be resolved at European level regarding enforcement of the **Microbiological Criteria Regulations** which came into force in January 2006, however, many companies may still be unaware of the consequences of the new legislation, which simply sets criteria to be used as part of **HACCP**

THE EUROPEAN UNION (EU) Microbiological Criteria Regulations (MCR) were published on 22 December 2005 and came into force in January 2006. The MCR relate to the package of new EU hygiene regulations that also came into effect at that time, and to the General Food Law Regulation 178/2002, which came into force on 1 January this year.

Over the past four years the Chilled Food Association (CFA) has played a key role both in the UK and internationally in the development of the MCR, aiming for the HACCP focus to be maintained in EU law and for science-based targets to be set. CFA has input on this directly to the European Commission (EC), through the European Chilled Food Federation, other trade organisations and the UK Food Standards Agency (FSA). However, there are a number of outstanding issues to be finalised regarding enforcement.

There is nothing fundamentally new for a company applying HACCP (European Commission):

"The Regulations do not bring any new obligations or new administrative requirements for food businesses and do not cause additional costs for food businesses"

What it's NOT about – myths

Increased sampling of foods even where HACCP is in place

No! No change proposed to current HACCP-based approaches, but specified sampling frequency for minced meat/preparations etc (1 product per site per week).

I have to test every batch

No! Frequency is HACCP-based except for minced meat/preparations etc.

Five samples need to be tested per batch (e.g. RTE foods)

No! Compositing is allowed for between comparable lots

Positive release is required

No! Using functioning HACCP-based systems is required

Challenge testing required to demonstrate safe shelf life

No! Hierarchy of approaches is set out in the Regulation

Testing emphasised over control – diverts resources

No! Having functioning HACCP-based systems is the key legal requirement

It all means extra work for labs

No! No change if sampling is already HACCP-driven

Reduced emphasis on controls?

We will doubtless see microbiological testing laboratories and test kit manufacturers increasing promotion of their wares to the industry under the general banner of: 'the MCR requires testing'.

Already enforcers in the UK have queried how much testing would constitute the minimum. However, the MCR clearly states that food business operators must (with certain notable exceptions) determine the level of testing on the basis of HACCP for each product.

The EC does NOT intend that there will be any increased product testing where GMP (good manufacturing practice) and HACCP are in place and verification is carried out as it is now. However, in the case of minced meat/preparations the MCR specifies the sampling frequency (one product per plant, per week). These points need to be made clear to all parties, particularly in enforcement of the MCR as different enforcement approaches could result across the EU (see Interpretation and Enforcement).

HACCP implementation is key, not testing, since testing is NOT a control (Food Standards Agency guidance for food business operators):

"It will not always be necessary to

carry out microbiological testing to show compliance with the criteria. For example, routine monitoring of physical parameters associated with food safety management procedures (such as monitoring time/temperature profiles, pH, level of preservative and aw) may provide adequate assurance that the criteria are being met."

The EC recognises the key point of principle that microbiological testing *per se* is not a control measure and in itself does not ensure food safety, whereas the implementation of GMP and HACCP do. Beyond periodic HACCP verification the only time that pathogen testing is required is during validation of a new process or in the case of a new material being used.

The EC has also stated that a company having implemented GMP, HACCP and supporting systems and following the shelf life assessment approach set out in Annex II of the MCR is NOT expected to have to carry out *Listeria monocytogenes* (Lm) challenge testing.

The EC agrees that it is vital that the emphasis remains on control (GMP, HACCP) and that already scarce technical resources remain focused thereon in order to prevent many millions of Euros being spent unnecessarily on unwarranted escalated testing that will do nothing directly to improve food safety and will divert funds away from food safety measures such as GMP and HACCP implementation.

Cost estimates for testing and recalls were generated by industry at the request of the EC. Indications are that the consequences of the required regime in relation to minced meat and meat preparations may run into several hundred million Euros each year. Other aspects, such as the absence of any legal requirement to carry out Listeria monocytogenes challenge testing, if not interpreted in line with the EC's intentions (i.e. it is NOT required where shelf life has been assessed), may cost the chilled prepared food industry more than Euro 10M in the first year alone. There therefore needs to be clarity, particularly in local implementation and enforcement, to ensure that gold plating of the MCR is avoided in enforcement approaches.

Interpretation and enforcement

Due to differing legal systems in EU Member States, criteria may be viewed as being absolute in some countries and merely desirable targets in others. This problem of interpretation and enforcement of the legislation could impact on the competitiveness of industry in individual states, and lead, for example, to more recalls being required in one Member State than another under equivalent microbiological circumstances.

The EC is developing guidance on Official Control aspects of the MCR for Member States but has stated that it is for industry to develop its own guidelines under EU food hygiene legislation. In the UK, this work has been led by CFA with the BRC and involving Campden & Chorleywood Food Research Association and a number of trade associations.

Zero Tolerance?

The EC has stated that regarding *Listeria monocytogenes* for ready to eat (RTE) foods the objective is to keep levels below 100 cfu/g during the shelf life of food, 'according to scientific opinion.' The introduction of a potential zero tolerance policy in relation to *Listeria monocytogenes* is a technically unachievable standard particularly where uncooked ingredients are used. However, if a product's shelf life has been determined in accordance with the approach set out in the Regulation and the level of 100 cfu/g will not be exceeded throughout the shelf life zero tolerance does not apply. Guidance as to how to demonstrate this is given in CFA/BRC guidance on implementation of the Regulations, freely available on both organisations' websites.

This implied zero tolerance approach, whilst intended to target companies which cannot substantiate the shelf lives given, is contrary to the views of the World Health Organization, CODEX, the EC's own Scientific Committee for Food and Scientific Committee for Veterinary Measures, the UK's Advisory Committee for the Microbiological Safety of Food and Health Protection Agency, which have agreed that targeting the reduction of high levels of *Listeria monocytogenes* is of the most significant health benefit.

For minced meat/preparations, a derogation is available to Member States until 1/1/10 from the zero tolerance criterion for *Salmonella* for these materials if they are only to be sold nationally and labelled by the manufacturer indicating the need for thorough cooking prior to consumption. It is not yet clear which, if any, Member States will notify the Commission of their intention to use the derogation.

Confusion between Ready to Eat (RTE) & non-RTE foods?

If a product requires cooking prior to consumption or carries heating instructions, the food manufacturer must be able to demonstrate that the instructions on the pack deliver a heat process to ensure safety and compliance with the microbiological criteria. No particular reduction factor is specified however.

Other Requirements

The MCR introduces some other important concepts:

- **Article 7(1)** requires producers to find the cause of unsatisfactory results.
- **Article 7(2)** requires conditional recall if food safety criteria are not met.
- **Article 9** requires trend analysis of test results and demands that if an adverse trend is identified it is remedied.

Implementing legislation (e.g. Food Hygiene (No.2. England. Regulations 2005) will bring the requirements of Article 7 into local law. Note that exceeding the criteria is not an offence per se; not doing what is required by Article 7 is.

Next steps

CFA/BRC guidance on the MCR was published prior to the MCR coming into force, to enable companies to be fully acquainted with their requirements. It will be reviewed periodically to enable users' feedback to be taken into account.

The guidance is available on the CFA website. EC guidance on Official Control (enforcement) is being developed. FSA guidance to food business operators and implementing legislation have been published.

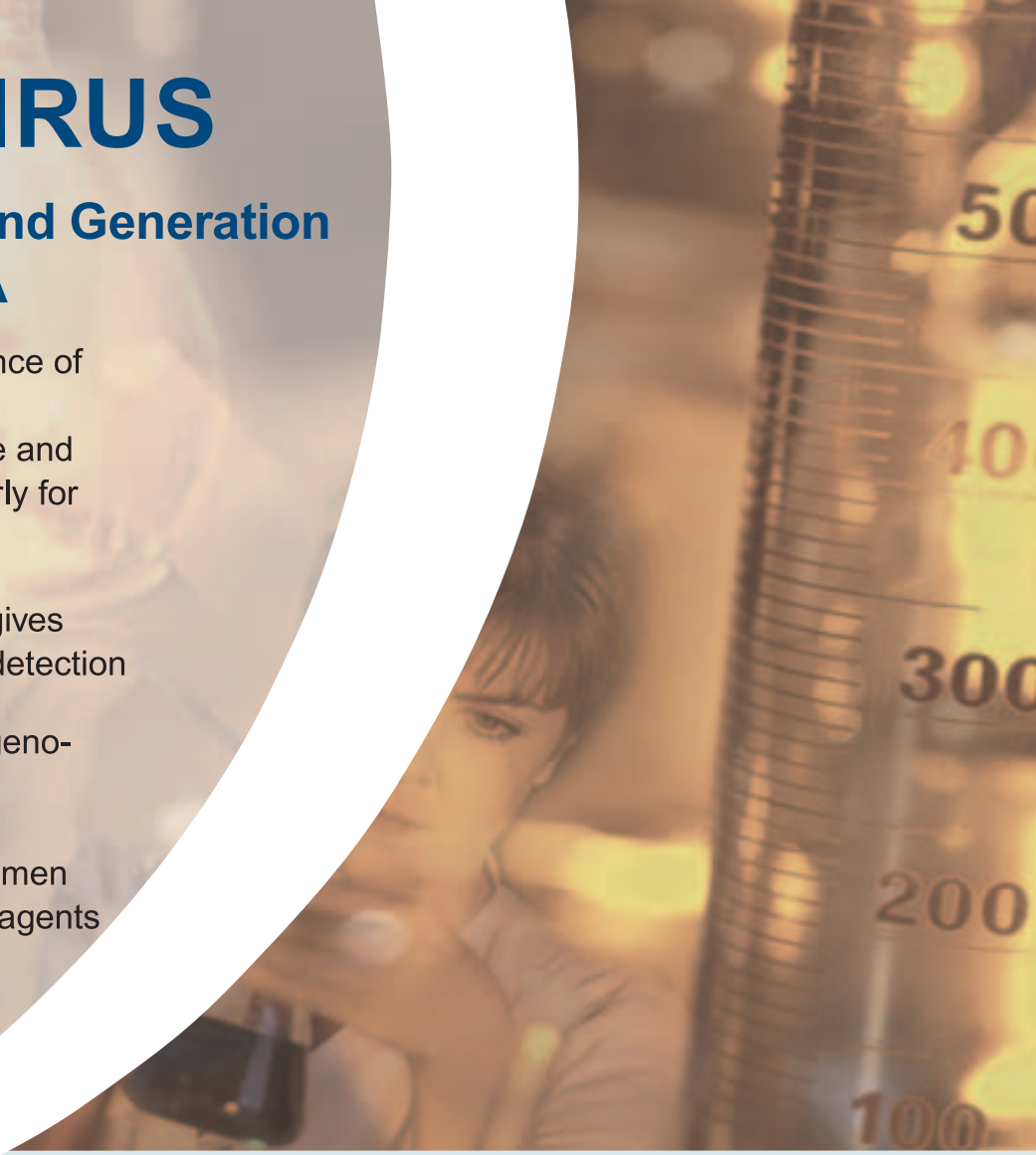
Further Information

- A number of presentations on the Regulations are freely available on the CFA website: www.chilledfood.org/content/presentations.asp
- Free guidance documents are available at: www.chilledfood.org/content/guidance.asp

Kaarin Goodburn
Secretary General of the UK Chilled Food Association. Rapporteur for the European Chilled Food Federation on the MCR legislation

NOROVIRUS

RIDASCREEN® Second Generation ELISA



The rapidly increasing occurrence of severe viral gastroenteritis has highlighted the need for reliable and rapid antigen assays, particularly for the detection of Norovirus.

- An optimised antibody mix gives high sensitivity in outbreak detection
- Simultaneous detection of geno-group I and II in one test
- Simple procedure and specimen preparation, ready to use reagents
- Results in less than 2 hours
- HPA evaluated

faxback

For further information on any of the R-Biopharm range of products, just tick below and faxback to **020 8786 7822**

- ☐ Norovirus EIA
- ☐ Rotavirus EIA
- ☐ Adenovirus EIA
- ☐ Rotavirus/Adenovirus rapid
- ☐ Astrovirus
- ☐ Clostridium perfringens
- ☐ Clostridium difficile
- ☐ Campylobacter
- ☐ Verotoxin
- ☐ Giardia/Cryptosporidium rapid

Name _____ Position _____

Department _____

Address _____

_____ Postcode _____

Telephone _____ E-mail _____

Quadratech Diagnostics Limited
PO Box 167, Epsom, Surrey KT18 7YL
t: 020 8786 7811 f: 020 8786 7822
email: quadratech@btinternet.com www.quadratech.co.uk

QUADRATECH

BIOSCIENCES FEDERATION

Science and education policy

The Biosciences Federation report on the government's Science and Education December 2005

IN HIS PRE-BUDGET SPEECH, Gordon Brown declared his intention to improve the nation's health and wealth by making the UK a world-class environment for medical research, development and innovation, through a programme of investment and reforms, including setting up a National Institute of Health Research to streamline R&D management and funding ten world class clinical research centres.

The biomedical industry—through Sir David Cooksey, Chairman of the Industry Reference Group of the UK Clinical Research Collaboration—responded with a willingness to significantly increase their investment in medical R&D in the UK by up to an additional £1 billion per year in the medium to long-term, conditional on the Government's success in improving NHS R&D infrastructure and making significant progress on stopping animal rights extremism (Treasury press release, 2/12; Res Ft, 7/12). Also in the pre-budget report the Government announced a review of UK energy policy and is considering the case for further support for R&D in energy efficiency as part of the 2007 spending review.

The DTI launched the latest round of its £370 million Technology Programme, inviting proposals from UK businesses to help drive forward innovation and create prosperity for the UK economy. Businesses are being urged to exploit emerging technologies, taking ideas out of the lab and into the market place, to ensure UK competitiveness in the growing global economy. £63 million will be available for collaborative research and development projects in six priority areas identified as key in progressing the UK's science and innovation base and moving the UK towards its target of increasing R&D in the UK (as a percentage of GDP) to reach 2.5% by around 2014 (DTI press release, 24/11; Res Ft, 7/12).

In an interview with *Research Fortnight* (7/12) Mike Depledge FIBiol, Chief Scientific Advisor to the

Environment Agency, discussed his intentions to change the makeup of the agency's science teams to include fewer, more highly skilled people and to increase awareness among research scientists of how science feeds into policy-making. The agency is in discussions with NERC and universities on tackling interdisciplinary skills and training needs.

The Wellcome Trust announced a new deal with three leading academic publishers —Blackwell, Springer and Oxford University Press—on open-access. The publishers have agreed to change their author licences so that any Wellcome-funded research published in their journals will be made freely available online as soon as it is published (*Guardian*, 15/12). The Royal Society has urged RCUK to defer self-archiving until they have completed a thorough study of the costs and benefits of such a move. However, 61 fellows of the Royal Society have urged the Society to support RCUK's proposals (Res Ft, 21/12).

The Treasury announced the revision of the spending rules that limited the amount of money the Research Councils could win from the EU. Under the old rules, councils were required to give the Treasury half of the total EU grants their institutes received over an agreed cap. The removal of the cap will provide stronger incentives for Research Councils to compete for EU funding for research (Res Ft, 21/12).

Science Policy: International

An editorial in *New Scientist* (17/12) questioned the achievements of the Montreal International Climate Change conference, referring to the deal as 'little more than a commitment to hold more talks.' Under the deal, existing signatories to the Kyoto protocol agreed to begin negotiating tougher targets for national emissions of greenhouse gases after the existing targets end in 2012. Meanwhile, countries that have yet to accept targets, including the US, Australia, China and Brazil, agreed to join in an 'open and non-binding' dialogue about their own emissions. The US signed up for future talks only after stipulating that the dialogue would not open any negotiations leading to new commitments.

The controversy over the work of the South Korean cloning researcher Woo-Suk Hwang rages on, moving from the ethical to the scientific. New questions over the scientific validity of the research follow Hwang's admission that, despite his previous denials, two junior members of his lab had donated some of the oocytes used in the experiments (*Science*, 2/12). While Seoul National University has launched an internal investigation into data reporting the creation of 11 cloned lines of human embryonic stem cells, leading cloning researchers are calling for independent verification of the data (*New Scientist*, 17/12). Questions over the validity of the data surfaced after Hwang told *Science* that the 2005 paper contains four instances in which the same photographs were mistakenly used to represent cells cloned from different patients (*Science*, 9/12). Questions are now being raised over the DNA fingerprint data in a 2004 paper claiming the creation of a single cell line form a cloned human embryo.

The budget deal agreed by the European Council fell short of the proposed doubling of the Seventh Framework Programme (FP7) budget, but by 2013 will have risen by 75% (*Res Ft*, 21/12). A vote on the detail of the Framework 7 specific programmes is not expected before April 2006.

Higher Education

The provisional allocations of the third round of the Higher Education innovation Fund (HEIF) have confirmed fears that small research-intensive institutions will lose out. 75% of the total £164 million is allocated by a funding formula, a large proportion of which is based on the number of academic staff at each institution rather than research intensity. Nine large universities will receive the maximum £3 million share of the funding while some smaller institutions such as the Institute of Cancer Research are to receive less than £400,000. The remaining £55m of HEIF 3 will be allocated by competition (*Res Ft*, 7/12).

In its pre-budget report the Government announced its intention to boost its higher education exports. Proposals include a 50% increase in government spending on promoting UK higher education to non-EU students, academic exchanges and scholarships between the UK and China, improving visa procedures and, under the new points-based system for immigration, to award bonus points to people who have previously studied in the UK (DTI press release, 24/11). The international student market is worth over £3 billion to the UK per annum. Universities UK have welcomed the proposals and will work with the Government to take the initiatives forward (*Res Ft*, 7/12).

Secondary education

In QCA's Annual Report on Curriculum and Assessment for Science it is announced that the numbers of students taking biology, chemistry and psychology AS and A levels have increased in 2004/2005. There still needs to be an improvement in the teaching of primary science as it is believed to have a knock-on effect at secondary Key Stage (KS) 3 and KS4. Another major area for improvement is Sc1 (scientific enquiry) at KS3 particularly in view of the changes introduced in 2006 regarding 'How Science Works' in the new GCSEs. It may be of interest that less than 20% of students have been shown how to use a microscope in the science classroom for KS3 and KS4. Overall workloads, scarcity of resources (particularly in ICT), and teacher training are today the main hindering factors for the implementation of the new Science GCSEs. Science outdoor classroom activities are however thriving following the trend marked in the previous year, in spite of some concerns over health and safety issues (QCA/05/2177). In a letter to *TES Highlights* (23/12) written by John Holman from the National Science Learning Centre the urge to draw people's attention to the new 'How Science Works' section of the new GCSEs is emphasised.

The implementation plan for the 14-19 reform was set out by the government with a new entitlement to guarantee a choice of 14 specialised Diplomas (DfES press release, 14/12). The government's aim is to ensure that post-16 participation rises from 75% to 90% by 2015. The designed diplomas are designed in partnership with employers that combine skills development and education. The Education Secretary, Ruth Kelly, also announced changes to the inspection arrangements for services regarding children, young people and adult learners (DfES press release, 13/12). The Schools Minister, Jacqui Smith, announced the school funding settlement for the next two years (DfES press release, 07/12). These should help schools and Local Education Authorities to deliver key reforms included 14-19 White Paper. The improved areas for funding include the support for more practical learning options for pupils taking GCSEs (aged 14-16).

75th Anniversary Conference 1931 - 2006

Living together: polymicrobial communities

Apex International Hotel, Edinburgh, UK
Monday 3 to Thursday 6 July 2006

- Including: **Lewis B. Perry Memorial Lecture**

There will be sessions on:

- Physiology and functionality of polymicrobial communities
- Influencing polymicrobial communities
- The gut microflora
- Bioremediation

CPD ACCREDITATION

A total of **13 credits** have been awarded for this meeting

Call for Posters!

Poster and oral submissions welcome (not restricted to topic of meeting). Abstracts of less than 500 words, to include aims and objectives, brief methodology, results, conclusions and implications of the work, should be submitted only as a Microsoft™ Word document attachement to an email addressed to: info@sfam.org.uk with the subject line 'Summer Conference 2006 submission, no later than 28 April 2006.

Student Session

Making good use of your supervisor. An informal workshop with refreshments to help you get the most out of your supervisor.

Please note that the conference programme was correct at the time of going to press but may be subject to change.

For the latest information, please visit us online at:
www.sfam.org.uk

Programme

Monday 3rd July

Arrive and Register: Apex International Hotel, Edinburgh.

18.00-19.00 **Lewis B Perry Memorial Lecture: Out of a dusty archive – from SAB to SfAM, the first 75 years.**
Professor Max Sussman.Lecture Theatre, The Royal Museum of Scotland

19.00-20.00: **Drinks Reception.**

From 20.00: **Evening at leisure / Quiz night (optional)**

Tuesday 4 July

Session 1. Physiology and functionality of polymicrobial communities.

09.00-09.35 **Interspecies signalling communication.**
Dr Miguel Camara, University of Nottingham, UK.

09.35-10.10 **Co-ordination and Competition in specialised microbial communities.**
Dr Andrew Whiteley, University of Oxford, UK.

10.10-10.45 **Adaptation and evolution in a two-species structured community.**
Prof. Soren Molin, Technical University of Denmark.

10.45-11.15 **Coffee/ posters.**

11.15-11.50 **The role of niche differentiation in the community assembly and coexistence of uncultured bacteria from the genus *Achromatium.***
Dr Neil Gray, University of Newcastle, UK.

11.50-12.25 **Genomics, ecophysiology and interactions of yet uncultured nitrifying bacteria.**
Dr Holger Daims, Vienna, Austria.

12.25-13.00 **Living together while being eaten: *Bdellovibrio* predation in polymicrobial communities.**
Dr Cary Lambert, University of Nottingham, UK.

13.00-14.00 **Lunch.**

Session 2. Influencing polymicrobial communities.

14.00-14.35 **Combating polymicrobial communities: learning from Nature.**
Prof. Peter Steinberg (Director, Centre for Marine Biofouling & Bio-Innovation).

14.35-15.10 **Probiotic modulation of the oral flora.**
Prof. Jeffrey Hillman, University of Florida, USA.

15.10-15.45 **Using synbiotics to address major gut problems.**
Prof. Stig Bengmark, University College London, UK.

15.45-16.15 **Tea/posters**

16.15-16.50 **Impact of antibacterial usage on polymicrobial communities.**
Prof. Peter Gilbert, University of Manchester, UK.

16.50-17.25 **Impact of antimicrobial residues on gut communities: are the new regulations effective?**
Prof. Peter Silley, MB Consult, UK.

17.30-19.00 **Trade Show**

Wednesday 5th July

Session 3. The gut microflora

09.00-09.35 **Bacterial metabolism and interactions in the gut.**
Prof. Harry Flint, Rowett Research Institute, Aberdeen, UK.

09.35-10.10 **Probiotics and gut biofilms.**
Dr Sandra MacFarlane, University of Dundee, UK.

10.10-10.45 **The gut flora in early life.**
Dr Christine Edwards, University of Glasgow, UK.

10.45-11.15 **Coffee/ posters.**

11.15-11.50 **Intestinal bacteria and ageing.**
Dr Emma Woodmansey, Smith and Nephew Research Centre, York, UK.

11.50-12.25 **Microbial interactions with the gut immune system.**
Dr Elizabeth Furrie, University of Dundee, UK.

12.25 -13.30 Lunch.

Session 4.

● Offered papers ● Student presentations ● WH Pierce Prize ● Annual General Meeting.

19.30-20.00 **Drinks reception**
The Hub, The Royal Mile.

20.00 - late: **Conference and 75th Anniversary Dinner**

Thursday 6th July

Session 5. Bioremediation

09.00-09.35 **Bacterial and fungal transformations of metals, minerals and metalloids.**
Dr Geoff Gadd, University of Dundee, UK.

09.35-10.10 **Contaminant degradation in terrestrial environments: multiple roles of fungi and protists.**
Dr Hauke Harms UFZ, Germany.

10.10-10.45 **Phenolic degrading communities: functional phylogeny, assembly and stability.**
Dr Andrew Whitely CEH, Oxford, UK.

10.45-11.15 **Coffee/ posters.**

11.15-11.50 **Polymicrobial community strategies for mediating the bioremediation of complex organic mixtures.**
Dr Mike Larkin, Queen's University, Belfast, UK.

11.50-12.25 **Themes and variation: emerging patterns in microbial remediation of spilled oil.**
Dr Ian Head, University of Newcastle, UK.

12.25-13.00 **Natural attenuation (or lack of it) in two highly contaminated UK aquifers.**
Dr Roger Pickup, CEH, Lancaster, UK.

13.00-14.00 **Lunch and Close**

BOOKING FORM and INVOICE

SFAM SUMMER CONFERENCE 3 - 6 JULY 2006

Living Together: polymicrobial communities

Only ONE person per form please. If additional forms are required please photocopy this one
CLOSING DATE FOR REGISTRATIONS: Friday 9 June 2006. A LATE BOOKING FEE of £30.00 will be applied to all bookings made after this date.

FEES

	Full Members	Student, Honorary, Associate & Retired Members	Student Non - Members	Non - Members
Whole Conference Rate: inclusive of registration fee, coffee breaks, lunches, Society dinner and accommodation in the Apex hotel for the entire conference	£500.00	£250.00	£500.00	£700.00
Day Rate: 08.30 - 17.00 hours per day, or part thereof, inc. of registration fee, coffee lunch and tea	£100.00	£50.00	£100.00	£150.00

YOUR COSTS

Charges - please tick the applicable box(es)	Amount
☐ **Whole Conference Rate:**	£
☐ **Day Rate** (please tick the DAY(S) you wish to attend)**:** **Tues 4th:** ☐ **Weds 5th:** ☐ **Thurs 6th:** ☐	£
☐ **I wish to attend the Society Dinner on Wednesday evening (This is included in the Whole Conference Rate but costs £50.00 for delegates who elect to pay the Day rate).** Please note that numbers are limited**:**	£
☐ **Additional overnight accommodation per night inclusive of breakfast: £150.00.** If you wish to stay extra NIGHTS please enter the additional NIGHTS you wish to stay: _____	£
☐ **LATE BOOKING FEE** Payable for all bookings made after Friday 9 June 2006	**£30.00**
TOTAL AMOUNT REMITTED:	£

YOUR DETAILS

Title:_____ **Family Name:**_____ **First Name:**_____

Address:_____

_____ **Postcode:**_____

Tel No:_____ **Fax No:**_____ **Email:**_____

Please indicate any special dietary or other requirements (such as disabled access): _____

_____

YOUR PAYMENT

● **For all participants: The Society DOES NOT INVOICE for conference fees. Please treat your completed booking form as an invoice. Cheques must be in £ STERLING ONLY and made payable to 'The Society for Applied Microbiology'. Foreign cheques/ drafts MUST be negotiable for the full amount due. Please note that AMERICAN EXPRESS and DINERS CARDS are NOT ACCEPTED.** However the following credit and debit cards are acceptable: VISA, Mastercard, Eurocard, Delta, Electron, JCB, Maestro and Solo.

☐ **Cheque enclosed** ☐ **Please charge my *Mastercard/Visa card /Debit card*** *(please delete inapplicable items)*

TOTAL Amount enclosed/ to be debited: (*Remember to include your LATE BOOKING FEE if booking after 9 June 2006) **£** _____

Card number: ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ ☐☐☐☐ Solo Cards only: ☐☐

Issue No. ☐☐☐ Expiry Date: ☐☐☐☐ Start Date: (*Debit cards only*) ☐☐☐☐

Signature: _____ *Date: _____ Cardholder's address to which credit card statement is sent:

_____

_____

Please return the completed form by fax (post if you are enclosing a cheque) to: **The Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK. Tel: 01234 326661. Fax: 01234 326678. Email: meetings@sfam.org.uk**

SUGGESTION: please photocopy this form to save mutilating your copy of the Microbiologist!

STUDENTSHIP Application

Only ONE form per student please. If additional forms are required please photocopy this one

The Society meeting you wish to attend

Please tick the meeting you wish to attend: ☐ **sfam Summer Conference** ☐ **sfam January Meeting**

About this award

The Society offers Studentships to enable **student members** to attend Society meetings. These grants cover registration, accommodation, meals (where appropriate) and modest travel expenses. Preference is given to students offering a paper or poster and who have not previously received this award. To be considered for a Studentship grant, please complete this form in **BLOCK CAPITALS** and return it to the Society Office **no later than 6 weeks before the date of the meeting you wish to attend.**

Your details

Title:_____ **Family Name:**_____ **First Name:**_____

Address:_____

_____ **Postcode:**_____

Tel No:_____ **Fax No:**_____ **Email:**_____

University or College:_____

Your Department:_____ **Position in Department:**_____

Grant authority:_____

Your intended career:_____

Your costs

Expected Travel Costs:_____

Other costs - please specify:_____

_____

_____

Why do you wish to attend this meeting?

Please give your reasons:_____

_____

_____

Your signature:_____ **Date:**_____

(If you need more space for your answer please continue on a separate sheet)

Will you be contributing to the meeting by offering a Poster or presenting a paper? ☐ **Offering a Poster** ☐ **Presenting a Paper**

Your Supervisor's support

This section **MUST** be completed by your Supervisior or Tutor. Applications which are not supported by your Supervisor will be automatically rejected. **Please give your reasons why the applicant should receive a studentship:**

_____

_____

_____

Supervisor's name:_____ **Tel and extension:**_____

Supervisor's signature:_____ **Position:**_____ **Date:**_____

(If you need more space for your answer please continue on a separate sheet)

In signing this application I agree to reimburse the Society for any costs it may incur in awarding this grant should the applicant fail to attend the conference or fail to notify the Society of their inability to attend the conference within 14 days of the start of the meeting.

Please confirm your agreement by ticking the appropriate box: ☐ **I agree** ☐ **I do not agree**

Please return your completed application by fax or post to: **The Society for Applied Microbiology,**
The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK. Tel: 01234 326661. Fax: 01234 326678. Email: meetings@sfam.org.uk

SUGGESTION: please photocopy this form to save mutilating your copy of the Microbiologist!

Gareth Healy reveiws the long history of vaccination and examines current methods of vaccine production, development and research

Vaccine production and development: The challenges of realising a future free from disease

VACCINATION, arguably one of the great successes of contemporary medicine, has been around for over 1000 years. The first accounts of its use date to 1000 AD in China (Fenner *et al.*, 1988) when the scabs from smallpox patients, only mildly affected by disease, were used to intranasally inoculate healthy individuals, a process called variolation (Levine, 1990). These early attempts at immunoprophylaxis are thought to have been fairly successful, in comparison to the number of victims of natural smallpox infection.

The first appearance of purposeful vaccine research was during the late 18th century (Jenner 1801), although the first major developments in the field took place toward the end of the 19th century. These began with the observation of attenuation and development of an anthrax vaccine by William Smith Greenfield in May 1880, although the discovery is generally credited to Louis Pasteur following his fortuitous discovery of the attenuation of anthrax in chickens (Pasteur, Chamberland, & Roux 1881) a few months after Greenfield.

The progression of this new field over the next century, sometimes through questionable methodologies, led to a number of variably efficacious vaccines against diseases such as anthrax, cholera, tuberculosis, typhoid, rabies, yellow fever, polio and measles. In the mid-20th century, the tissue culture revolution followed later by the advent of molecular biology and genetic engineering, transformed the field of vaccinology. These advances not only provided greater opportunities for the selection of antigens and targeted attenuation (Plotkin, 2005), but enabled the beginnings of rational vaccine design and the production of safer vaccines.

The goals of immunisation are: to protect the individual from infectious diseases; to prevent outbreaks of disease; and ultimately to eradicate infectious diseases world-wide. Such idealistic goals are, as might be expected, fraught with complexity. The identification of suitable vaccine candidates is thus only one of many hurdles involved in the translation of a vaccine candidate from the bench to the clinic. Public demand for safe and effective vaccines continues, and it is the need for strict regulatory requirements, driven by the fact that vaccines are usually injected into the bodies of healthy people, that have led rightly to an emphasis on the importance of well characterised, safe vaccines.

The process of vaccine development nowadays rarely follows the path of serendipitous discovery combined with the astute application of the knowledge gained, as was the case for pioneers such as Jenner and Pasteur. It begins, more often, with a good understanding of the underlying biology

involved. This is highlighted by the increasing role of immunologists within vaccine development driven by the need to understand virulence mechanisms and characterise host protective immune responses. Vaccine development can be divided into three major phases (Figure 1); preliminary research (up to 10 years plus), research (8 to 10 years) and development (4 – 6 years).

The preliminary research phase underpins the development program, providing data on the infectious organism for which the vaccine is required. This is a characterisation phase, establishing the mechanisms of pathogenicity, identifying suitable animal models of disease and investigating the physical structures of the organism such that protective antigens might be identified. Importantly, this period of research rarely has a defined end point. Even following identification of a possible vaccine candidate, research continues with an aim to further improving understanding of the organism and disease, and possibly providing a future improved candidate.

Following identification of a vaccine candidate, however, research moves into characterising this candidate more fully. Animal models of disease, established during the preliminary research phase, are used to evaluate the suitability of vaccine candidates suggested by the preliminary data. This phase is thus predominantly about demonstrating protection against disease within suitable animal models and, if protection is demonstrated, investigation into the mechanisms involved. The data produced also forms the basis of the scientific justification for regulatory submission and applications for intellectual property rights

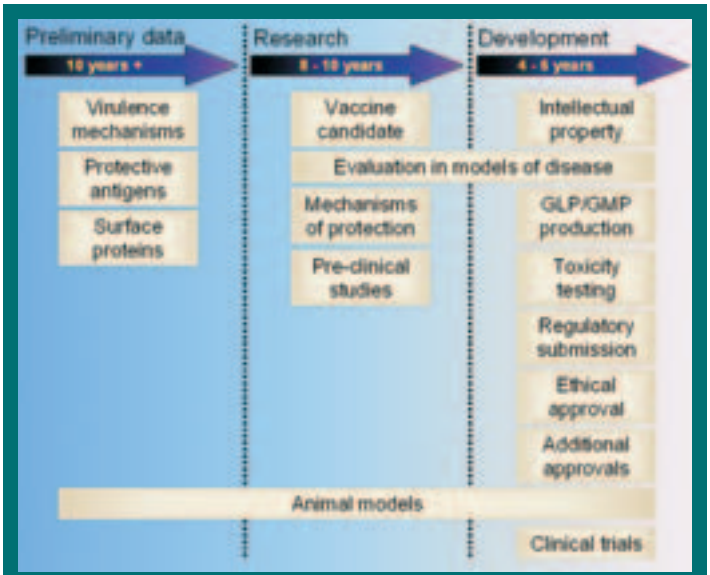


***Fig. 1**. The three major phases of vaccine development*

that might be attached to the product. Intellectual property rights form an important part of the vaccine development process. Not only from the perspective of scientific credit but also to ensure that as the vaccine moves through the regulatory and manufacturing process, sponsors, indemnifiers, GMP producers etc. know exactly what they are dealing with and that no one else will be working unlicensed with the same product.

This also marks the start of the development phase of production, often the shortest phase, but also the most highly regulated and thus most expensive part of the process. It is during this phase that the vaccine is taken from basic science to a safe, marketable product. First the vaccine must be produced to good laboratory and manufacturing practice standard so that all the doses produced are of a reproducible standardised quality. This is essential for the regulators, ensuring that each batch is identical and can be tracked. Before regulatory submission (e.g. to the European Medicines Agency, EMEA or the US Food and Drug Administration, FDA) toxicity testing must also be performed investigating acute toxicity and the distribution and persistence of the vaccine following immunisation.

Regulatory submission follows a standard procedure, requiring the submission of detailed information about vaccine safety and immunogenicity, methods of manufacture, full protocols, standard operating procedures of assays used, details of safety monitoring, definition of endpoints, statistical calculations and details of data handling. Also incorporated into the regulatory submission process are details of proposed clinical trials including ethical and other (such as genetic modification) approvals. Besides details of all the protocols, ethical approval requires details of informed consent and how volunteers will be recruited, explanations of the trials to volunteers and letters to family doctors explaining why the trials are required and how they will be conducted.

If approved, the vaccine is assigned an investigational new drug (IND) status enabling the start of clinical trials. These usually progress in three phases; the first (phase 1), safety and immunogenicity studies, are performed in a small number of closely monitored subjects. Phase 2, dose-ranging studies, are performed in a larger group, often hundreds of subjects. Finally, phase 3 trials are performed on thousands of subjects and provide critical documentation relating to the efficacy of the vaccine and additional safety data required for licensing. If at any stage of the clinical or animal studies, data arises that gives significant concern about the safety or efficacy of the vaccine, the regulatory body may request additional information or studies and/or the process may be halted.

Successful clinical trials mean that a license application can then be submitted. This provides a multidisciplinary reviewer team (comprising, medics, microbiologists, immunologists, chemists, statisticians' etc.) with the efficacy and safety information necessary to make a risk/benefit assessment and recommend or oppose the vaccine. In addition, the proposed manufacturing facility undergoes an inspection during which a detailed examination of the vaccine production process is undertaken. Following review, the regulatory body together with the sponsor then present the findings to an independent committee who provide independent advice to the regulatory body regarding the safety and efficacy of the vaccine. Final approval also requires the provision of adequate product labelling, such that health care providers can properly understand the vaccines use, benefits and risks, can communicate this to patients, and can safely deliver the vaccine to the public.

But, as the famous military saying goes, 'all plans fail once the enemy is engaged,'

and similarly, all potential adverse effects and events cannot be anticipated until the vaccine is given to the public. Thus many vaccines undergo phase 4 trials, which are designed to study the vaccine after marketing, together with extensive monitoring for adverse events by governments.

This highly complex system of vaccine licensing, whilst essential for ensuring safety, also ensures that potential vaccines take a long time to reach the market and that they are generally very expensive. New vaccines cost in the region of £200 to £500 million (Plotkin 2005) to develop alone, meaning that companies who do the research and development must recover those costs by marketing their products at an equally high price. These costs also mean that there are few companies that can afford vaccine development and production. As such there are currently only four major pharmaceutical companies, together with a handful of smaller companies, with the knowledge and facilities to develop and manufacture a new vaccine candidate (Buckland 2005).

This 'bottle neck' in production and manufacture leads to two main problems. Firstly, the high costs of new vaccines put them well beyond the reach of the poorer third world countries, many of which have a total annual budget for public health of below US $5 per capita (UNAIDS 2004;World Health Organisation 2004). This is a serious problem facing countries combating diseases such as AIDS, malaria and tuberculosis who desperately need newly developed vaccines to combat these problems but historically have had to wait up to 20 years longer than the developed world to get the vaccines they need. Secondly, whilst cost may not necessarily be too much of an obstacle in the developed world, the speed and capacity of the manufacturing process might.

History is replete with evidence of the devastating effect of epidemics and pandemics. Infectious diseases introduced by Europeans, killed 95% of the pre-Columbian Native American population. The 1918 influenza pandemic caused 50 million deaths whilst severe acute respiratory syndrome killed 8,500 people world-wide (Ritvo *et al.*, 2005). Currently, fears of a potential influenza pandemic caused by the avian influenza strain H5N1 have led to serious questions about the capability of governments to protect their populations.

The process of influenza vaccine production is 'highly evolved'; with new vaccines being produced every year to combat the emergence of new strains caused by natural antigenic drift in the virus. It is the World Health Organisation (WHO) Influenza Surveillance Network that is responsible for monitoring this process and biannually (once for the Northern Hemisphere and once for the Southern Hemisphere) recommends strains for incorporation into the influenza vaccine. This information is usually made available to industry in February in the Northern Hemisphere and by March or April the new strains and reagents are available for the production process. Clinical trials are conducted from mid May and production occurs over the summer ready for vaccinations to be carried out between October and December.

This highly accelerated production system is made possible through an internationally coordinated effort coupled with well-established, quality controlled production systems. However, today's production capacity is directly related to current vaccine demand meaning there is little capacity to respond to a sudden increase in demand (Cox, Tamblyn, & Tam 2003). In the UK nearly 13 million doses of influenza are delivered each year covering about a quarter of the total population, whilst world-wide 250 to 300 million doses are delivered. This however, accounts for less than 5% of the world population.

The problem with an H5N1 pandemic, should it occur, is that it could potentially affect everyone in the world. Thus even after an appropriate vaccine strain had been identified, it may be the production system, coupled with a limited capacity to produce the number of doses required, that lets us down. The problem may then be further compounded by countries whose governments simply can't afford the vaccine, making stopping the spread of the virus impossible even if it was produced quickly enough.

The challenges of realising a future free from disease through vaccination are complex. They stem from many different avenues, health and safety, fiscal, political, and yet are all inextricably linked to the same goal. It would be easy to say that we need to increase production capacities to cope with pandemic needs or that vaccines should be made affordable to the third world, but this is not currently economically viable and is therefore unlikely to happen.

In the end, as scientists our goal is to provide answers to problems, but global economics mean that quest is becoming as driven by political agendas as it is by public health needs. Whilst this often stifles our efforts, in the end it may define them, driving the development of greater scientific collaboration and better technologies, which will eventually allow scientists to more easily identify vaccine candidates and manufacturers to produce them faster and more cheaply

Gareth Healy

References

- Buckland, B. C. 2005, "The process development challenge for a new vaccine", *Nature Medicine*, **vol. 11**, no. 4, p. S16-S19.
- Cox, N. J., Tamblyn, S. E., & Tam, T. 2003, "Influenza pandemic planning", *Vaccine*, **vol. 21**, pp. 1801-1803.
- Fenner, F., Henderson, D. A., Arita, I., Jezek, Z., & Ladnyi, I. D. "Smallpox and its erradication", Geneva: World Health Organisation.
- Jenner, E. The origin of vaccine inoculation. 1801. London: Shury.
- Levine, M. G. 1990, "Vaccines and vaccination in the historical perspective," in *New Generation Vaccines*, G. C. Woodrow & M. M. Leivne, eds., Marcel Dekker, Inc, New York and Basel, pp. 3-18.
- Pasteur, L., Chamberland, C., & Roux, E. 1881, "Sur la vaccination charbonneuse", *Comptes Rendus de l'Académie des Sciences*. Paris, vol. 92, p. 1378.
- Plotkin, S. A. 2005, "Vaccines: past, present and future", *Nature Medicine*, **vol. 11**, no. 4, p. S5-S11.
- Ritvo, P., Wilson, K., Willms, D., & Upshur, R. 2005, "Vaccines in the public eye", *Nature Medicine*, **vol. 11**, no. 4, p. S20-S24.
- UNAIDS 2004, *Report on the global AIDS epidemic*, Geneva.
- World Health Organisation 2004, *The world health report 2004 - Changing history*, World Health Organisation, Switzerland.

Commercialisation of research
from lab bench to market

Alexandra Perry reveiws the increasing trend to commercialise research within our universities

ACADEMIC nstitutions are increasingly pursuing a range of 'third stream' activities in addition to their main business of teaching and research and are exploiting this to bring in income and fund research.

Consequently, it is now recognised that Universities' research base has a value beyond that of education and the traditional output of research publication. The government in the form of the Department of Trade and Industry (dti), Higher Education Funding Council for England (HEFCE), the regional development agencies and regional government offices are all placing more focus on the commercial potential to be found in innovation and particularly in Universities. This is reflected in the findings of the Higher education-business and community interaction survey 2002-03 (HEFCE) which showed continuing improvement in interactions between higher education and business by almost every indicator and that the turnover from active formal Higher Education Institutes spin-offs was £358 million that year.

Universities have methods of developing commercial outputs through their third stream activities which include consultancy, licensing, the formation of spin-out companies and the creation of economic and regional development projects. These are seen as forms of knowledge transfer which refer to the process of transferring ideas, research findings and skills between other research organisations, business and the wider community to allow the development of innovation and enhance economic growth. The process of commercialisation can be complex but with the right support, research may result in a licensing opportunity or a spin-out company. In fact, the majority of universities now have a dedicated team to offer training, expertise and assistance in all stages of the technology transfer process.

So how is research commercialised and taken from the laboratory bench into the marketplace?

Firstly, why commercialise? There are many beneficial reasons to commercialise research including: obtaining funding from new sources, to build business links and collaborations, to contribute to the economy, to see good ideas turned into reality and money!

The first part of the commercialisation process is known as opportunity assessment and will usually involve contacting technology

transfer professionals within the University organisation. Most Universities use a technology disclosure form which is used to assess the commercial and technical viability of the invention and evaluate whether to proceed with Intellectual property protection. Questions that will be asked will include:

- is this good science?,
- does it work?
- is there anything similar already on the market?
- Is it novel and not obvious?

It is also essential to have a good assessment of the market for your product from these initial stages as well as throughout the process of commercialisation. If the invention or idea appears to be viable then the next stage is to gain protection in the form of intellectual property.

Intellectual property allows an individual to own their own creation and innovation such that it can be traded like any other commodity. There are four main types of intellectual property: patents, trademarks, designs for product appearance and copyright; only patents will be discussed in detail in this article. In most cases protection is needed for intellectual property, however protection for copyright arises automatically as soon as there is a record of the creation in some form. Any public disclosure of a technology without protection such as a patent will make subsequent protection near impossible and should be avoided at all costs.

To be patentable an invention must be novel and non-obvious and can be either a product or a process. Protection is then usually 20 years from the initial filing date and gives the inventor/s monopoly on the innovation. During the next 12 months the patent is still undisclosed giving the inventor time to file in other countries and develop the invention further. During this time the patent can be withdrawn and if not withdrawn will be published 18 months after the filing date. To gain protection abroad, applications would normally have to be made in each country. However the Patent Co-operation Treaty has simplified the process and by filling one application, protection can be gained in the member countries of the treaty. It is important to mention here the differences in UK and US patent law. In the UK ownership of an idea is given to whoever files first, however in the US it is given to whoever invents first. This stresses the importance of keeping good laboratory notebooks. This is particularly important in the US, as these may be used as evidence in disputes regarding the true inventor. To be considered reliable evidence, laboratory notebooks must be bound, have no missing pages and entries corroborated and signed by someone not directly involved in the project; electronic notebooks are not acceptable.

Having a patent on its own however, will not make an invention a success. That's where the hard work comes in. The next step is to decide the commercialisation strategy. Market research is essential for this and may identify other applications and markets for the product that may not have been previously identified. Funding can be obtained in order to conduct external market research.

The two main commercialisation strategies are licensing or the formation of a spin-out company. By adopting the licensing approach companies can gain exclusive rights to use the inventor's intellectual property and will most commonly be recompensed with royalties from a percentage of the sales. Licenses can be exclusive: a single company has the rights including exclusion of the licensor, non-exclusive: several licensees have the rights to use the intellectual property and sole: where there is one licensee but the licensor also retains the use of the technology. Intellectual property in the form of know-how, copyright works, patents and trademarks can all be licensed. Licensing is most appropriate in situations where there is only a single patent, where the technology fits an existing company's portfolio, or where there are major barriers to a new company entering the marketplace.

Alternatively budding entrepreneurs may wish to directly control their own IP and set up a spin-out company (Case study A). This is a particularly viable option when a group of related patents are held, the invention has a number of applications, relatively few market barriers are present and most importantly, venture capital can be obtained. Forming a spin-out company can be a daunting but exciting prospect. It requires a high level of commitment from the founding inventor and requires significantly more investment than any other commercialisation route. Spin out companies have the potential to create revenue, jobs and economic growth, however they have a high failure rate.

An example of one of the initiatives encouraging entrepeneurship in universities

Commercialisation Initiatives

The HEFCE has committed to fund initiatives that promote third stream activities and productive interactions with business, public sector organisations and the wider community, for the benefit of the economy and society. A number of different schemes and collaborations exists both nationally in the UK and regionally and these cover a wide array of activities, including licensing, spinouts, awareness raising, extension services to local communities, work based placement and enterprise education.

Midlands **M**edical (Biosciences) **E**nterprise **D**evelopment **I**nnovation **C**onsortium **I**nitiative (MEDICI) is a partnership of 15 Universities funded through the HEFCE under the Higher Education Innovation Fund (Case study B). Medici aims to improve the commercial development of research by fostering a climate of entrepreneurship and delivering a cultural change that will embed commercial awareness within the Universities. Medici fellows undertake extensive training in enterprise and entrepreneurship which allows them to identify and develop a portfolio of commercial projects through either their own research, or by collaboration with members of

their University department.

Knowledge Transfer Partnership (KTP) is a UK wide programme led by the dti that allows businesses to take advantage of the expertise available in Further and Higher Education institutions, Research and Technology Institutions and Public Sector Research Institutes (Case study C). Knowledge Transfer Partnership involves a graduate working on a project identified as central to the company's future commercial development. The Partnerships work by establishing a link between a company and an academic who can then jointly make a bid for KTP funding. Once funding has been approved the final member of the partnership is recruited—the KTP associate—these are normally recent graduates/post graduates. The work of the KTP associate is then jointly supervised by the business and academic staff. Each partnership is funded by a government grant (up to 60% of the costs) and the company partner. Companies therefore have access to specialist expertise held within academic institutions and gain a skilled graduate working on a strategic project. Companies that have taken part in the scheme have seen a wide range of benefits to their business performance. Benefits for the knowledge base partner (the academic) include experience of working on real industrial problems, lasting collaborations with industry, contribution to the Research Assessment Exercise (RAE) of University research and financial support for release of staff involved in the project. KTP is widely regarded as the most successful grant funding initiative available to Small and Medium-sized Enterprises (SMEs) in the UK today.

There are many other initiatives and schemes designed to enhance knowledge transfer in Universities and information about these can be found on the HEFCE website.

Summary

The commercialisation of research is an increasing activity within our Universities with many now having a dedicated technology transfer team. Current funding is aimed at increasing awareness and facilitating knowledge transfer so that this becomes embedded in our academic institutions.

Alexandra Perry
MEDICI Fellow, Aston University, Birmingham

Case study A

Dr Anna Hine is a former Medici fellow and a founding director of a University spin-out company, ProtaMax Ltd. Originally CEO of the fledgling company, Dr. Hine is now ProtaMAX's Chief Scientific Officer. "Medici gave me the time and experience needed to get a University spin-out to the point of incorporation. I then managed ProtaMAX for a year, into the early stages of discussions with venture capitalists and first customers, before handing on control to an experienced CEO, Dr. John Slack. It has been hard work, but incredibly exciting and invigorating."

Case study B

Dr Alexandra Perry is a Full time Medici fellow in the School of Life and Health Sciences at Aston University. "The Medici program has taught me to understand the importance and principles of intellectual property and commercialisation of research in Universities. The training has enabled me to be involved with a project on novel antimicrobial catheter coatings and to drive this forward, not only through development of the technology in the laboratory, but to realise the technology's commercial potential."

Case study C

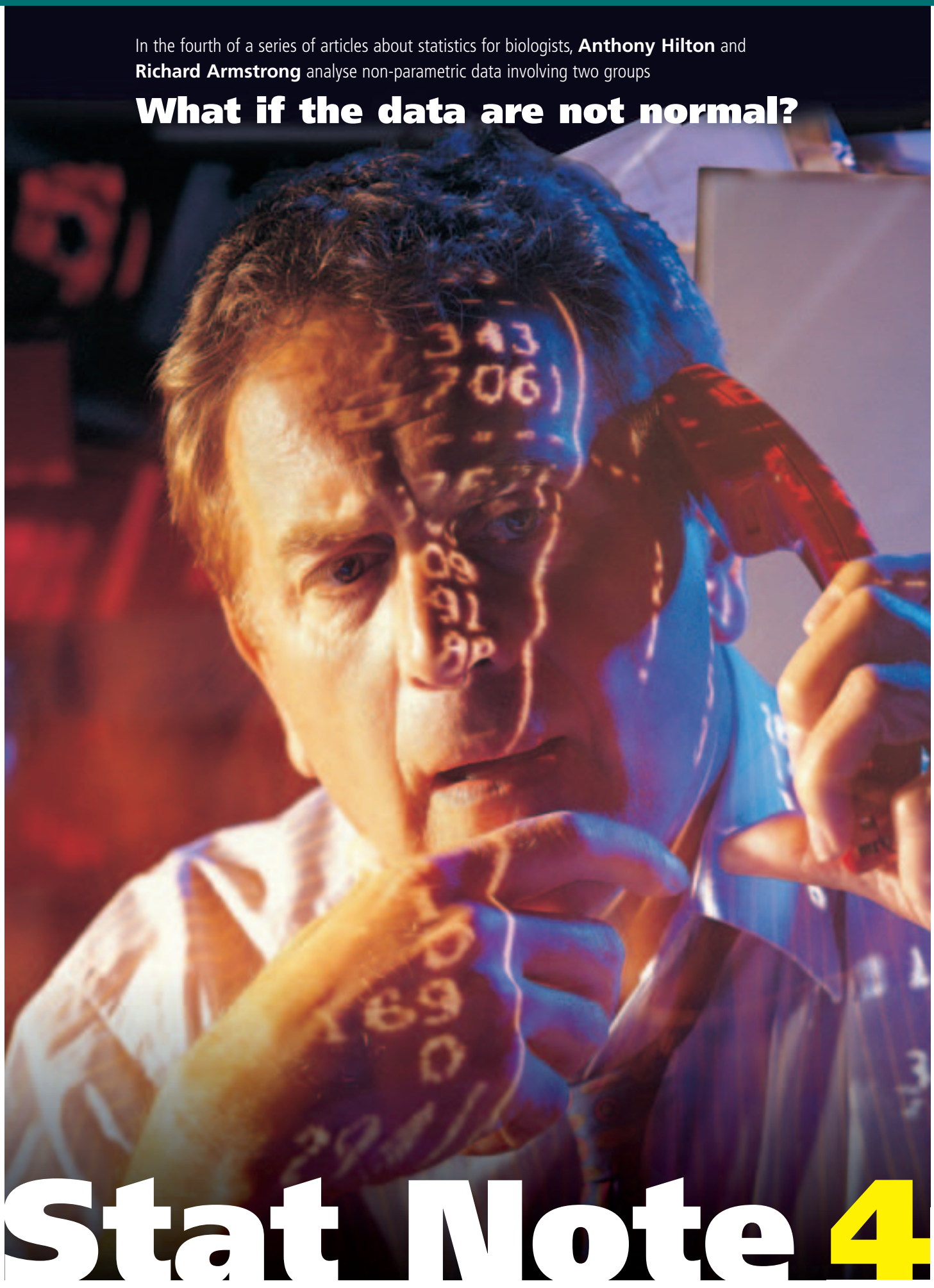
Dr Jonathan Caddick is a KTP associate with Rozone LTD and Wolverhampton University. "My primary role as a KTP associate is to improve Rozone's existing environmentally friendly detergents by investigating properties such as how long they take to degrade, how effective they are at cleaning and how effective the microbes in the detergent are at degrading oils and greases (hydrocarbons). I am gaining further industrial experience in quality control assessment and important management skills. Through the KTP initiative, I receive training in business and marketing, which will help improve my leadership and presentation skills. The partnership scheme allows me to utilise the specialist knowledge and equipment at Wolverhampton University which otherwise the Company would not ordinarily have access to. I feel that as a KTP associate I am gaining invaluable experience in both scientific and commercial disciplines that will aid my career progression."

Further Information

- http://www.bbsrc.ac.uk/biobusiness_guide/Welcome.html
- dti knowledge transfer partnerships: http://www.ktponline.org.uk
- HEFCE http://www.hefce.ac.uk
- MEDICI: www.midlandsmedici.org
- NESTA inventors handbook: http://www.nesta.org.uk/
- UK Patent Office: www.patent.gov.uk

In the fourth of a series of articles about statistics for biologists, **Anthony Hilton** and **Richard Armstrong** analyse non-parametric data involving two groups

What if the data are not normal?



Stat Note 4

THE STATISTICAL tests described in previous Statnotes (see *Microbiologist* September and December 2005) make a number of assumptions about the experimental data.

The most important of these assumptions is that the quantity analysed, whether an individual measurement, treatment mean, or difference between two means, must be a parametric variable, i.e., a member of a normally distributed population. When this assumption is met, the 'z' and 't' distributions can be used to make statistical inferences from the data. In some circumstances, however, a variable may not be normally distributed and this Statnote is concerned with the analysis of non-parametric data involving two groups.

How do we know if the data are not normally distributed?

An investigator may know in advance from previous studies whether or not a quantity comes from a normal distribution. In other circumstances, data may have been collected to specifically test whether the data come from a normal distribution, a procedure that was described in Statnote 1 (*Microbiologist*, June 2005). In many experimental situations, however, there may be insufficient data available to carry out a test of normality and to obtain such data may be either too expensive or time-consuming. In situations such as these, the following points should be considered. First, many measurements in the biosciences made to at least three significant figures have a reasonable chance of being normally distributed. Second, the distribution of sample means taken from a population is more likely to be normal than the individual measurements and therefore, inferences about means are less susceptible to this problem. Third, moderate departures from normality do not significantly affect the validity of parametric tests. Consideration of these points may lead to the conclusion that despite some reservations, the data may not depart radically enough from normality to question the validity of a parametric analysis. In other circumstances, however, it may be clear that the data depart significantly from normality and a different approach required.

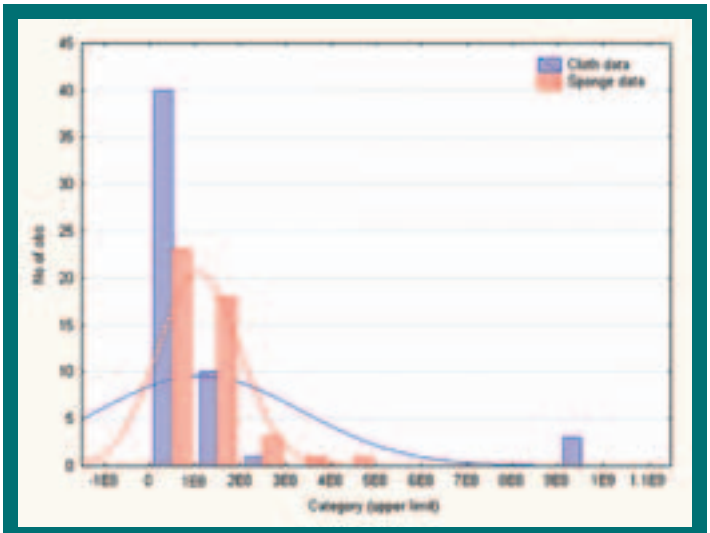


***Fig. 1**. Frequency distribution of the bacterial counts on cloths and sponges. Fitted curves are those of the normal distribution.*

Deviations from a normal distribution

The two most common ways in which a distribution may deviate from normality are called *skew* and *kurtosis*. Most statistical software will provide tests of these properties and tables of significance (Table A20) of the relevant statistics are given by Snedecor and Cochran (1980). It is important to note that some distributions may deviate from normal in more complex ways and therefore, absence of skew and kurtosis does not guarantee that a distribution is normal. A skewed distribution is asymmetrical and the mean is displaced either to the left (positive skew) or to the right (negative skew). By contrast, distributions that exhibit kurtosis are either more 'flat-topped' (negative kurtosis) or have longer tails than normal (positive kurtosis). Fig. 1 shows the frequency distribution of the bacterial counts on 54 sponges and 46 cloths introduced in Statnote 1 (*Microbiologist*, June 2005). In both cases the distributions are clearly asymmetrical with the means located to the left of the histogram and therefore exhibit a degree of positive skew. As a result, the arithmetic mean is no longer a good description of the *central tendency* of such a distribution. There are two additional statistics that can be used to describe the central tendency of a skewed distribution. First, is the *mode*, the value of the variable 'x' with the highest frequency, i.e., the maximum point of the curve. Second, is the *median*, the middle value of 'x', i.e., if all the values of 'x' were listed in ascending or descending order, the median would be the middle value of the array. Little progress has been made in devising statistical tests based on the mode but there are tests, to be described later, that essentially test the differences between the medians of two groups.

An important property of non-normal distributions is that the standard deviation (SD) is no longer an accurate descriptor of the spread of a distribution with a given mean. Hence, 'z' and 't' tables cannot be used to predict the proportion of observations that fall a given distance from the mean. On reporting frequency distributions from large samples that are not normally distributed, investigators often quote the *percentiles* of the distribution, e.g., the 90% percentile of a distribution is the score such that 90% of the observations fall short of and 10% exceed the score (Snedecor and Cochran, 1980).

What is data transformation?

One method of analysing non-normal data is to convert or *transform* the original measurements so that they are expressed on a new scale that is more likely to be normally distributed than the original. The usual parametric 't' tests can then be carried out on the transformed values. There are three common circumstances in which such a transformation should be considered. First, if the data are percentages and especially if the majority of the observations are close to zero or 100%. Percentage data can be transformed to an *angular* or *arcsin* scale defined as follows:

Angular measurement = $\sin^{-1}\sqrt{\%/100}$

Statistical software will often provide this transformation or see Table X in Fisher and Yates (1963). Percentage data can be significantly skewed when the mean is small or large and consequently, the effect of the transformation is that

percentages near 0% or 100% are spread out to a greater degree than those near the mean so as to increase their variance. A paired or unpaired 't' test can then be carried out using the transformed values as described previously (*Microbiologist*, December 2005). Second, data that comprise small whole numbers or quantities assessed using a score that has a limited scale, e.g., if bacterial abundance was scored from 0 to 5, are unlikely to be normally distributed. In this case, a transformation to $\sqrt{x}$ (or $\sqrt{x + 1}$ if many zeroes are present) may make the scores more normally distributed. Third, the 't' test described in Statnote 3 also assumes *homogeneity of variance*, i.e., that the degree of variability is similar for both groups of observations. It is not unusual, however, for results from a 'control' group to be more consistent than values from an experimentally treated group. In this case, a transformation of the original measurements to a logarithmic scale may equalise the variance and in addition, may also improve the degree of normality of the data.

How are non-parametric tests done?

An alternative approach to transformation in the analysis of non-normal data is to use a non-parametric test. As an illustration, we return to the scenario described in Statnote 1 (*Microbiologist*, June 2005). To recapitulate, given the intrinsic structural and compositional differences between cloths and sponges, a study was envisaged to investigate if one material provided a more favourable environment for bacterial survival than the other. A total of 54 'in-use' dishcloths and 46 sponges were collected from domestic kitchens and the aerobic colony count of each determined in the laboratory. The frequency distributions of the counts from both materials are shown in Fig. 1. In Statnote 1, these distributions were tested for normality and it was concluded that the cloth data exhibited a marked deviation from normal whereas the sponge data were closer to a normal distribution. However, it may be prudent to conclude that the data as a whole do not conform closely enough to a normal distribution to use the parametric 't' tests described in Statnote 3. An alternative approach is to use a *distribution-free or non-parametric test*. These tests can be used regardless of the shape of the underlying distribution as long as the samples being compared can be assumed to come from distributions of the same general shape.

Table 1. Comparison of the number of bacteria on 10 cloths and sponges (two independent groups, Mann-Whitney test)

Clothes (A)		Sponges (B)	
Count	Rank	Count	Rank
1.8×10^6	4	1.1×10^8	13
1.8×10^7	6	2.2×10^8	20
2.0×10^7	7	4.6×10^6	5
5.9×10^7	10	9.8×10^7	11.5
1.6×10^8	19	1.3×10^8	15.5
2.0×10^5	2	1.3×10^8	15.5
9.8×10^7	11.5	1.5×10^8	18
1.1×10^6	3	4.7×10^7	9
6.9×10^4	1	1.4×10^8	17
3.0×10^7	8	1.2×10^8	14

1. Add up the ranks for each group: $R_A = 71.5$, $R_B = 138.5$
2. $U_A = \{n_A(n_A + 1)/2 + (n_An_B)\} - R_A = 83.5$ where n_A and n_B are the number of observations in each group
3. $U_B = \{n_B(n_B + 1)/2 + (n_An_B)\} - R_B = 16.5$
4. The smaller U (in this case 16.5) is the test statistic
5. Lesser U must be ≤ Wilcoxon's tabulated U for significant difference
6. For larger samples: $Z = (\phi\mu - T\phi - 1/2)\sigma$ where $\sigma = \sqrt{n_B}\,\mu/6$ and $\mu = n_A(n_A + n_B + 1)/2$

The Mann-Whitney U-Test (for unpaired data)

To illustrate this test and to simplify the calculations we will use data from a sample of 10 cloths and 10 sponges only. The Mann-Whitney U-test can be carried out on two independent groups of data (A,B) and is the non-parametric equivalent of the unpaired 't' test (Statnote 3). Although most statistical software will carry out this test, it is still useful to understand its 'mechanics' (Table 1). First, ranks 1, 2, 3, ... are assigned to the whole set of observations, regardless of group. A rank of 1 is given to the lowest count, 2 to the next lowest etc. with repeated values, called 'ties', given the mean of the ranks within that run. The ranks of each group are then added together separately (R_A, R_B). The quantities U_A and U_B are then calculated as shown in Table 1. Whichever is the smaller of U_A and U_B, is taken to the table of Wilcoxon's U to judge the significance of the difference between cloths and sponges (Snedecor and Cochran, 1980; Table A10). The lesser U has to be equal to or *less* than the tabulated value for significance, i.e., low values of U indicate a significant difference between the groups. In the present example, a value of U = 16.5 was obtained which is less than the value tabulated at P = 0.05. Hence, there is evidence that the sponges harbour considerably more bacteria than the cloths. For larger samples, outside the range of the statistical table, the data may approach a normal distribution more closely and a value of Z can be calculated (Table 1), the statistic being referred to tables of the normal distribution.

The Wilcoxon signed rank test (for paired data)

If the data in the two groups are paired (*Microbiologist*, December 2005), then the appropriate non-parametric test is the Wilcoxon signed rank test. To illustrate this test (Table 2), we collected data on the number of bacteria on a single pair of cloths and sponges on 10 separate occasions. Hence, we do not have two independent samples as in the previous example. In this case, there is a link between a particular cloth and sponge in that the data for each pair were collected on a specific occasion. Essentially, the data are subtracted for each pair of observations (A - B). Omitting zero differences, ranks (r) are applied to all of the remaining values of A - B regardless of whether the difference is positive or negative. If ties occur between positive and negative columns, the ranks are amended in any such run of ties to the mean rank within the run. The positive and negative signs are restored to the ranks and the positive and negative ranks added up. R is the smaller of the two sums of ranks and is taken to the table of the Wilcoxon signed rank statistic T to obtain a P-value (Snedecor and Cochran 1980;

Table A9). The value of R has to be equal to or LESS than the value of T in the P = 0.05 column to demonstrate a significant difference between the two groups. In this case, our value of R = 1 was less than the tabulated value indicating that sponges harbour more bacteria than the cloths. With larger numbers of observations, a value of Z can be calculated and referred to tables of the normal distribution.

Comparison of the parametric and non-parametric tests

It is reasonable to ask what is the relative sensitivity of parametric and non-parametric tests and what happens if they are used incorrectly? If a t-test is used on non-normal data, the significance probabilities are changed and the sensitivity or power of the test is altered and this can result in erroneous conclusions especially if treatment effects are of borderline significance. With non-parametric tests, the significance levels remain the same for any continuous distribution with the exception that they are affected by the number of zeros and tied values in the Wilcoxon signed rank test (Snedecor and Cochran 1980). With large normal samples, the efficiency of the non-parametric tests is about 95% compared with the t-test. With non-normal data from a continuous distribution, however, the efficiency of the non-parametric tests relative to 't' never falls below 86% in large samples and may be greater than 100% for distributions that are highly skewed.

Conclusions

When testing the difference between two groups, if previous data indicate non-normality, then either transform the data if they comprise percentages, integers or scores or use a non-parametric test. If there is uncertainty whether the data are normally distributed, then deviations from normality are likely to be small if the data are measurements to three significant figures. Unless there is clear evidence that the distribution is non-normal, it is more efficient to use the conventional t-tests. It is poor statistical practice to carry out both the parametric and non-parametric tests on a set of data and then choose the result that is most convenient to the investigator!

Table 2. Comparison of bacteria on pairs of cloths and sponges sampled on 10 occasions (two dependent groups, Wilcoxon signed rank test)

Occasion	Cloth (A)	Sponge (B)	A - B	Rank
1	1×10^4	4.6×10^6	-4.5×10^6	-2
2	3.3×10^7	9.8×10^7	-6.5×10^7	-6
3	5.7×10^7	1.3×10^8	-7.3×10^7	-7
4	1.9×10^7	1.3×10^8	1.11×10^8	-9
5	1.2×10^4	6.0×10^2	$+1.1 \times 10^4$	+1
6	8.8×10^2	4.7×10^7	-4.7×10^7	-5
7	2.6×10^6	1.4×10^8	-1.14×10^7	-3
8	3.3×10^7	1.2×10^8	-8.7×10^7	-8
9	8.7×10^6	2.1×10^8	-2.0×10^8	-10
10	7.6×10^7	1.1×10^8	-3.4×10^7	-4

1. Subtract each pair of counts A - B
2. Assign ranks (r) to differences ignoring the sign of the difference
3. Restore the signs and add up the positive and negative ranks
4. Compare the lesser R (in this case +R = 1) with the tabulated Wilcoxon's signed rank statistic T, $R \leq T$ for significance
5. For larger samples $Z = (\mu - T - 1/2)\sigma$ where T is the smaller rank sum and $\sigma = \sqrt{(2n + 1)\mu/6}$ where n = number of pairs and $\mu = n(n + 1)/4$

References

- Fisher RA and Yates F (1963) Statistical tables. Longman, London.
- Hilton A & Armstrong RA (2005a) Are the data normal? *Microbiologist* June 2005. **6:** 2, pp34-35
- Hilton A & Armstrong RA (2005b) Describing the normal. *Microbiologist* September 2005. **6:** 3, pp30-33.
- Hilton A & Armstrong RA (2005c) Testing the difference between two groups. *Microbiologist* December 2005. **6:** 4, pp30-33.
- Snedecor GW and Cochran WG (1980) Statistical methods, 7th Ed. Iowa State University Press, Ames Iowa. Chapters **5,6.**

Dr Anthony* Hilton and Dr Richard Armstrong**
*Pharmaceutical Sciences and **Vision Sciences, Aston University, Birmingham, UK

a one day meeting on

Epidemiology and vaccines

The Royal Society, Carlton House Terrace, London
Thursday 5th January 2006

This years Society Winter meeting was held on the 5 January 2006 at the prestigious Royal Society, Carlton house Terrace, London. It had the topical theme of Epidemiology and Vaccines with many of the presentations on relevant issues such as pandemic influenza and climate change. Three of the speakers kindly agreed to take part in a press briefing organised by the Science Media Centre on the previous day (see page 6). The venue was impressive, both in its grandeur and history, but also in the hospitality of the staff who were kind and courteous.

Professor Sattar and David Russell

A D Russell Memorial Lecture 2006

This was given by Prof S A Sattar (Faculty of Medicine, University of Ottawa, Canada), at the Royal Society in London on 5 January 2006. This Memorial Lecture was instituted in 2005 to commemorate the life and works of the late A. Denver Russell (1936-2004), Professor of Pharmaceutical Microbiology and a long-time member of the Society. Prof. Russell was a leading world authority on biocide usage and its possible association with antibiotic resistance. This first Memorial Lecture represented his field of work with a presentation on the use of biocide in environmental control.

Prof. Sattar was particularly suited to give this lecture because of his research achievements and international expertise in the world of biocides (microbiocides). His expertise as an orator (he has given over 225 invited lectures to date) and scientist (he has written over 120 peer-reviewed paper and numerous book chapters), was reflected in this very topical lecture entitled *'the use of microbiocides in infection control: a critical look at safety, testing and applications.'* During his lecture, several issues were addressed; notably the need for microbiocides, their safety, concerns with their testing and label claims, and their use in infection control. In addition the traits of an ideal microbiocide were discussed.

The continuous threat of infectious diseases and their economic and health impacts, the *failure* of antibiotic chemotherapy, the slow development of effective vaccines, lifestyle and population changes (e.g. increase travel, relocation of population, aging population) contribute to a re-discovery of the role of microbiocides for the control of infectious diseases. Indeed these agents are used in many fields/industries (e.g. medical, consumer, food, water, etc.) with the exception of the *routine* treatment of air. Microbiocides are particularly indicated for the treatment of surfaces to eliminate and/or decrease the spread of those pathogens that can survive in the environment. However, their use is associated with several problems which were described with appropriate examples: toxicological (e.g. skin sensitisation), microbiological (e.g. microbial resistance and cross-resistance), chemical (e.g. storage, corrosiveness), environmental (e.g. interference with hormone functions) concerns, in addition to product label (e.g. confusing label), purchasing (e.g. based on cost only), training (often inadequate) matters.

Prof. Sattar also pointed out that efficacy testing protocols of microbiocides are sometimes inappropriate. Among several concerns are the usually recommended contact time (e.g. 10 minutes) which does not reflect usage in practice, but also the lack of reproducibility and the poor choice of surrogates. Through the judicious use of examples, Prof. Sattar demonstrated the consequence of choosing an inappropriate testing protocol. This is particularly important since the effectiveness of microbiocides to prevent/control infections in practice remain mainly circumstantial and difficult to evidence with field studies. Overall, to improve the use of microbiocides several issues should be considered, such as the improvement and harmonization of efficacy test protocols, the development of safer and better microbiocides, the simplification of products label, and updating and streamlining regulatory processes. Prof. Sattar provided us with an excellent and topical lecture on the use of microbiocides for infection control and gave us a clear insight of the future for these agents.

Dr Jean-Yves Maillard
Cardiff University

Plenary Session: Combating the inevitable: pandemic influenza

After the superb A D Russell Memorial lecture, Dr James Robertson gave an overview of reverse genetics technology and its use in research into influenza virus and vaccines. This technique has been used to generate candidate vaccine strains including that for the recent outbreak of H5 avian influenza in Asia (and more recently, Europe). He went on to say that the H5N1 strain was far too pathogenic to use as a candidate vaccine strain, but reverse genetic technology has allowed the pathogenic trait to be engineered out of this strain—generating a non-pathogenic reference strain. The robustness of the technique was demonstrated by the fact that this reference strain was generated within three weeks of receipt of the wild type pathogenic virus. It is now being used world-wide for the manufacture and clinical trials of a human H5 vaccine.


Professor Martin Maiden

How Epidemiology informs Vaccine Design

The Plenary session concluded with a presentation from Professor Martin Maiden who began with an introduction to vaccine design. This area of work was initiated shortly after the realisation that specific microbes cause particular diseases. This knowledge, coupled with the techniques to isolate these organisms, lead to a 'golden age' of vaccine development, the results of which are, in some cases, still in use today.

Despite many advances in vaccine development technology, some organisms remain unsuitable for vaccine development. In a lot of these cases, this is due to antigenic diversity – a property which can be lost in conventional studies that rely on isolation of single pathogen strains. Martin then went on to explain how such problems can be addressed using modern epidemiological studies. He highlighted the case of *Neisseria meningitidis*, for which such approaches have been crucial in identifying pathogenic variants and potential vaccine components. Professor Maiden then went on to discuss the efficacy of a vaccine—for example those against encapsulated bacteria such as meningococcus, which rely on population effects such as herd immunity. He concluded his talk by stating that epidemiological studies can make a major contribution at all stages of vaccine design.

Session A: Postcodes to pandemics: new perspectives in global disease epidemiology

Appending neighbourhood codes to names and addresses: lessons microbiology can learn from health promotion practitioners. *Prof. Richard Webber*

Microbiologists often have access to information on the geographical location of the subjects of their research—if by no other means but their postcodes! Professor Webber illustrated the amount of information that can be gleaned form a person's name and address, and this was illustrated using that of the prime minister, Tony Blair. For example, a persons gender, ethnicity and geographical location can all be assessed

and using the postcode, companies can find out the type of neighbourhood in which a person lives. Health authorities are also increasingly using this information to analyse hospital admission data in order to understand the relationship between the type of neighbourhood and risk of a specific diagnosis. Prof. Webber then went on to describe how profiling cases, clients and customers by the type of neighbourhood in which they live could be used to enhance microbiological research. This was illustrated by the epidemiology of *Campylobacter jejuni* cases in the Morecombe area. He concluded his talk, saying that evaluation of the relevance of this type of study to current research issues is required. It is important in measuring health needs at the local level, such as the planning of strategies for specific diagnoses and the evaluation of local delivery units.

Julie Wright, Rachel Dowdy and Sally Cryer

Epidemiology of TB in Asian and UK communities

Professor Peter Hawkey described a rapid typing method for *M. tuberculosis* using a molecular method known as Mycobacterial Interspersed Repetitive Units containing variable number tandem repeats (MIRU-VNTR). This technique has been made possible by the sequencing of the entire genome of Mycobacteria, and the exploitation of the variability in repeat number of VNTRs loci. This method has been shown to produce results comparable with the current IS6110 Restriction Fragment Length Polymorphism (RFLP) technique, but in a fraction of the time. It can also be performed direct from archived isolates/positive liquid culture. He then went on to describe a study which took place in the Midlands, UK between 2003 and 2005 where MIRU-VNTR was used prospectively to type strains of TB. This illustrated that typing, combined with geographical information systems gives a powerful tool for early outbreak identification and management. Such a technique can enhance the surveillance and control of TB in the community.

Epidemiologyof gastrointestinal (GI) pathogens in the Grampian region, Scotland

Dr Norval Strachan gave an overview of GI pathogens including *E. Coli* O157, *Campylobacter*, *Cryptosporidium* and *Salmonella* in the Grampian region, Scotland. This is an ideal area for the study of such pathogens as it covers a diverse landscape from wide rural areas with large numbers of cattle and sheep, to the highly populated city of Aberdeen. Human epidemiological data was presented showing seasonality and distribution of GI infections. This included a discussion of the 'Rise and Fall of *Campylobacter*'—a phenomenon which was not restricted to the Grampian region, Scotland.

Dr Strachan concluded by saying that the farming environment is an important source of these zoonotic pathogens and disease mapping can be helpful but it is important to integrate epidemiological and typing data.

Unfortunately, Professor Peter Diggle was unable to attend the meeting and so his session on *'Spatio-temporal statistics for infectious disease data'* was not presented.

Impact of global climate change on infectious disease epidemiology

Prof. Paul Hunter's talk focussed on the effects of climate change on foodborne, waterborne and vector-transmitted disease. He put forward scenarios and their possible effects on infectious disease. For example, increases in summertime temperature may increase the risk of foodborne disease by allowing faster bacterial growth. Decreasing rainfall in some localities may impact on water available for consumption and agricultural use. This may lead to the increased use of waste water and its associated contamination of food and drinking water. He then went on to talk about the effect of extreme weather conditions—one of the predicted effects of climate change—on infectious disease. For example, storm events could impact on vulnerable water supplies and recreational areas, increasing risk from enteric pathogens. Changing climate may have an impact on the ecology of host species, leading to a change in distribution of vector-borne diseases. He concluded by saying that climate, in particluar rainfall and temperature have an effect on the epidemiology of a range of infectious diseases in the UK and elsewhere. The mechanisms involved in this change are varied and some may be secondary to behavioural change. However, in the UK, climate is rarely the main driving force behind infection but infectious disease impact of climate change is most likely to be felt in the world's poorer countries. Professor Hunter was required immediately after his talk for a live radio interview about his presentation (see page 6 for information about the press briefing which triggered this interview.

Lucy Harper

Session B: Current Vaccine Issues

Conjugate Vaccines in the infant immunization programme

Dr Andrew Pollard began his talk by stating that there are 3.5million deaths per annum due to respiratory infections, many of these in the under fives. He focussed his talk on encapsulated bacteria, namely *meningococcus*, *haemophilus* influenza b vaccine (HIB) and *pneumococcus*. He described the problems for young children when their maternal antibodies reduce the incidence of disease rise because of an immature

immune system. Conjugated vaccines introduced in the early 1980s have helped address some of these problems with vaccines associated with polysaccharides. HIB vaccine, a conjugated vaccine radically reduced disease in the mid 1990s and continues to do so. A similar effect has been seen up to now with the Group C meningococcal vaccine. Group B strains are a problem in the UK predominantly in the very young, whereas Group C strains are also a problem in teenage years. His talk then focussed on longevity of antibody protection of conjugated vaccines and looked at the programme of vaccination highlighting differences associated with age. How to maintain effective levels of antibodies was then described for conjugate vaccines. Booster vaccines of HIB and Group C meningococcal vaccine are hopefully the way forward probably introduced at the same time as MMR!

Measles Mumps and Rubella (MMR)

Dr Mary Ramsay gave an overview of the epidemiology of measles, mumps and rubella in the UK pre- and post-vaccination. After 1988, when the vaccine was introduced, a massive reduction of cases was seen, with a coverage of 92%. There were a group of susceptible individuals who have not had protection and these were at risk of infection with older populations. In 1994 a new campaign was introduced to 'catch' these individuals but there was a shortage of MMR vaccine and MR was given. Surveillance of General Practitioners data have shown that not all diseases of 'measles' diagnosed by GPs were confirmed by serology. In 1988 an unsubstantiated link between MMR and autism was reported and subsequently the vaccination programme was reduced, although further research has not substantiated the claim.

Coverage at two years of age since then has fallen from 92% to approximately 80% and this can be seen in areas within the UK, especially London and the South East. There has been some evidence of reversal of this trend since 2003. A major outbreak of mumps is currently happening and this is presumed to be due to the 'timing of the introduction of the vaccine'. Mathematical modelling is used to predict outbreaks and this was described briefly at the end of the talk.

Bioterrorism Vaccines

Professor Richard Titball described the possible agents that could be used as biological agents of terrorism. He described the problems of development of preventative treatments including vaccines. Vaccines would have to be licensed and be able to protect against airbourne disease, especially as a single dose. Two approaches to plague were described explaining the use of live attenuated mutants and the subunit vaccines. The resistance to using live attenuated strains lead to the further development of subunit vaccines focussing on describing studies of the F1 antigen into recombinant strains e.g. *E.coli* and the antigen pair of the type III system. Mice studies where both subunits are put together and used were shown to be very effective with both injected and inhaled challenges. Guinnea pigs and Macaque monkeys also show an excellent response.

Human Papilloma Virus Vaccine

Professor Margaret Stanley eloquently described the history and disease processes of human papilloma virus (HPV), showing some sinister associations with cancer and pre-cursor lesions. Examples of the effects of papilloma viral infection were described, including Laryngeal papilloma caused by HPV6 + 11, which can cause major problems in children. Also, genital warts caused by HPV6 +11 cost the NHS £50million/yr for removal! Neoplastic disease, cervical vulval and urogenital cancers are increasing and are associated with particular serotypes. HPV 16 +18 are associated with 50-70% of cervical cancers. Professor Stanley then went on to explain that a subunit vaccine (L1) is being used in clinical trials and vaccines of HPV16 and HPV18 virus-like-particles (VLPs) are immunogenic and safe. Two commercially available vaccines quadvalent and bivalent vaccines are available showing excellent efficacy and prevent persistent infection (90%) and disease(100%).

Latest Developments in Tubercolusis (TB) Vaccines

Dr Doug Lowrie began by stating that over two billion people are infected with TB and there are two million deaths per year caused by TB infection. HIV infection is worsening the situation. The World Health Organisation (WHO) declared TB a global problem in 2000 and current BCG vaccines have had little effect outside developing countries. New vaccines are urgently required and are currently being developed, these include recombinant BCG, recombinant virus vectors, subunit plus adjuvant and DNA / RNA modified vaccines. Application of post-infection vaccines may help with treatment of these difficult to treat infections.

Dr Valerie Edwards-Jones
Manchester Metropolitan University

Conclusion

The Winter meeting was highly interesting and informative and judging by the feedback we've received from many of the delegates, you all agree! We thank Dr Jean-Yves Maillard and Dr Valerie Edwards-Jones for their contributions to the meeting report. We also thank Philip Wheat, Julie Wright, Rachel Dowdy and particularly Sally Cryer for their efforts in making the meeting such a resounding success.

Am I eligible - can I apply?

Grants can be made available to ANY FULL member who is able to offer a suitable undergraduate student a work placement for a period of up to 10 weeks during summer. The grant is £160 per week for the student for a maximum of 10 weeks and up to £50 per week for lab costs for a maximum of 10 weeks. To apply, visit **www.sfam.org.uk/members/prizes.php**

GUIDELINES

1. Any full member of the Society who can offer an undergraduate student, or a recent graduate (within 6 months of graduation) a work placement is eligible to apply for this grant. The placement can last up to a maximum of 10 weeks, normally during the summer vacation.

2. The Grant will normally provide support at the rate of £160 per week for the student and up to £50 per week for lab costs. The monies will usually be paid to the Department in which the student/graduate works unless a specific request is made for an alternative method of payment.

3. Applications should be made by the supervisor using the PDF form provided on the website or the paper form obtainable from the Society Office.

4. Successful applicants and their students/graduate must write a report on the placement within 4 weeks of completing their placement which will be published in *Microbiologist*. Photographs of the applicant and/or the work done during the placement are desirable. These should be supplied as (a) digital images at a size of not less than 4 inches square at a resolution of not less than 300 pixels per inch, or (b) original photographic prints which will be scanned and promptly returned.

5. Normally a member may not apply for a further grant until a period of two years has elapsed.

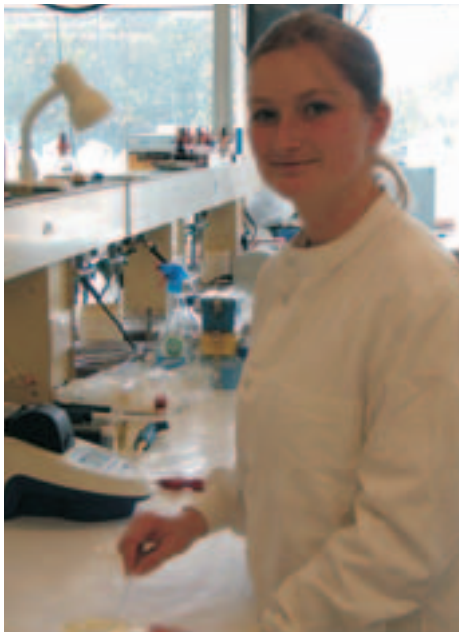
6.There is no closing date for this Grant and applications can be made any time during the year. Applicants must apply at least 6 weeks before the proposed start date.

www.sfam.org.uk/members/prizes.php

The Effect of Bioluminescence on DNA repair in Bacteria.

Kerry Cutter reports on her project

DURING MY FINAL YEAR OF study in Applied Microbiology at the University of the West of England, Bristol I undertook a small research project investigating the effect of bioluminescence on DNA repair in bacteria. This yielded some interesting preliminary results but was stopped in its tracks due to time restrictions. I was then fortunate enough to secure an SfAM 'Students into Work' Grant allowing me the opportunity to extend not only my research project but also my laboratory experience and ultimately ascertain which career path to follow.



The evolution of early low efficiency bacterial bioluminescence to become the efficient system that it is today was most likely subject to a positive environmental pressure since as much as several percent of the bacterial cell energy is consumed by this process. Both the biochemical and genetic basis of bioluminescence have been investigated extensively but the biological role of bacterial luminescence has remained obscure.

The aim of this project was to quantify the effect of bioluminescence on DNA repair in bacteria and thus identify whether a possible biological function of bioluminescence might be to provide light for DNA repair. The most likely repair mechanism being photoreactivation which, with the help of the enzyme photolyase, utilizes the energy of visible light to directly reverse UV-induced mutagenic and cytotoxic DNA lesions.

The genetic system required for luminescence in bacteria incorporates the *lux* genes. The *luxA* and *luxB* genes code for bacterial luciferase which catalyses the reaction. In addition to these the lux operon typically contains three further structural genes *luxC*, *luxD* and *luxE* that encode the subunits of a fatty acid reductase. The remaining *lux* genes, *luxR* and *luxI* are involved in the regulation of *lux* expression.

A number of *lux* gene constructs have been used successfully in a variety of bacterial species as highly sensitive real-time reporters of metabolic activity. The assembly of such constructs by introduction of a modified *luxCDABE* cassette isolated from a naturally bioluminescent organism may provide insight into the evolutionary drive behind bacterial bioluminescence.

The first objective of this project was to transform a strain of *Escherichia coli* DH5α with two plasmids, namely pAL1 and pAL2. pAL1 contains only the *luxAB* genes creating transformants which yield low level bioluminescence upon addition of a substrate such as dodecanal. By replacing the *luxAB* genes in pAL1 with a *luxCDABE* cassette isolated from *Photorhabdus luminescens* that has been rearranged to become *luxABCDE*, pAL2 was constructed. It was demonstrated that pAL2 transformants yielded higher levels of bioluminescence without the addition of substrate.

The second objective of this study was to compare the UV sensitivity of *Escherichia coli* DH5α transformed with the plasmids pAL1 and pAL2 with wild-type *E.coli* DH5α to assess the significance of bioluminescence in DNA repair. This was achieved by growing a culture of bacteria to a pre-defined optical density and spreading a known amount onto agar plates. These plates were then exposed to a range of doses of UV irradiation in the dark and incubated overnight wrapped in blackout material to prevent exposure to visible light. This was carried out for *E.coli* transformed with pAL1 and pAL2 as well as the wild-type.

Following overnight incubation the number of colony forming units on each plate was counted and survival calculated using an unirradiated control plate to represent 100% survival. This method was also repeated for wild-type *E.coli* that was incubated in visible light.

In order to assess the level of photoreactivation in non-luminescent wild-type bacteria, the survival of UV irradiated wild-type *E.coli* DH5α following recovery either with or without exposure to visible light was evaluated. The survival of transformants was then compared to wild-type survival in the light and dark to see if there was any evidence of bioluminescence acting as an internal light source to stimulate photoreactivation.

The final objective was to investigate the effect of UV irradiation on light output by comparing irradiated and unirradiated cultures of pAL2 transformants.

This Grant has not only enhanced my practical experience but also allowed me the opportunity to plan and execute my own experimental work. This has given the confidence to undertake a microbiology PhD studentship which I am due to start in October.

Many thanks to my project supervisor, Vyv Salisbury, and the entire Microbiology staff for their support and also to SfAM for their sponsorship.

Kerry Cutter
University of the West of England, Bristol

Analysis and exploitation of new bacteriophages of enteric pathogens.

Robin Macintosh reports on his project

FOR SEVERAL YEARS, THE Salmond laboratory in Cambridge has been isolating, characterising and exploiting phages of various enteric bacteria (both animal and plant pathogens) for functional genomics and the study of bacterial cell surfaces.

In my project I decided to tackle a murine pathogen, *Citrobacter*, as part of an exciting new venture in this lab. *Citrobacter rodentium* is a host-restricted mouse pathogen. It is a

member of the Enterobacteriaceae and is a useful model for studying the pathogenesis of enteropathogenic and enterohaemorrhagic *E. coli*. The genome has been sequenced, but not yet annotated, at the Wellcome Trust Sanger Institute. However, there are still rather limited genetic tools currently available for this pathogen and so my project was to isolate and characterise some bacteriophages for the sequenced strain. In the future, some of these phages could be useful for genetic analysis of the host and should have utility in phage therapy trials. The main aims of my project were to isolate new phages and within the limited time available, try to characterise the cell surface receptors of some of the phages. The project proved very successful.

Firstly, I set about the unglamorous task of collecting samples from the local sewage works and enriching for *C. rodentium* phages. Multiple previous studies in the research group had identified the optimum "locations" for phage isolation for a variety of enteric and non-enteric bacterial hosts and so I was able to save time on such screening. I set up several enrichments by inoculating LB with an overnight culture of *C. rodentium* (using a marked host containing a kanamycin resistance [Kan^r] gene) and chloroform-treated environmental samples followed by incubation in an orbital shaker. Enrichments were carried out at various temperatures and for different times of incubation. Based on previous experience in the group, there was some mild concern that, due to a recent dry spell, phage populations may have been too low to detect, casting doubt over the future of this part of the project! After incubation of the enrichments, I centrifuged samples to pellet bacteria and made serial dilutions of chloroform-treated supernatants. 200 μl of an overnight *C. rodentium* culture were then inoculated with 10 μl of the serial dilutions, and plated immediately in 4 ml of top agar LBA and incubated overnight. Multiple enrichments, under different conditions of temperature of time of incubation, yielded phage plaques—and in one particular 'jackpot' case 8.9×10^8 plaque forming units per ml (pfu/ml) was achieved! There were several different plaque morphologies on each plate and I picked eight, clearly morphologically distinct plaques into phage buffer, made serial dilutions and inoculated 200 ml of *C. rodentium*, as before. The phages were 'bulked up' by harvesting phage lysate from the top agar of plates, the plaques of which were just becoming confluent. These eight new plaque purified phages were assigned letters ϕA, ϕB, ϕC, ϕD, ϕE, ϕF, ϕG, ϕH. By varying growth conditions – including different temperatures and multiplicities of infection - the titres of lysates of each phage were boosted to ~1010 pfu/ml and, with phage samples at such high titre, I was then able to perform the next part of my project.

The next part of the project was to try to identify genes in *C. rodentium* that were necessary for susceptibility to specific phage. By doing this I would be able to identify the putative target receptor for that phage. The first choice phage for this part of the work was another phage (ϕX) that had been isolated prior to my arrival in the group and which had been partially characterised, was almost certainly virulent, and had been shown to grow to high titre.

I performed a mutagenesis of the *C. rodentium* strain in order to generate a heterogeneous culture containing cells with random transposon insertions. I assumed that there would be some transposon-containing mutants in the culture that would be phage resistant due to insertions in a gene(s) encoding the phage receptor, or a regulatory gene affecting the latter. As the transposon (Tn) contained a chloramphenicol resistance (Cm^r) marker it was possible to identify phage resistant bacteria that also contained the transposon. The genomic DNA around the Tn insertion was then sequenced by random primed PCR and the sequence used to perform BLAST searches to ascertain the probable function of the corresponding gene.

The Tn mutagenesis was done by patch mating the *Citrobacter* strain with an *E. coli* containing a plasmid carrying the Cm resistance Tn. The patch matings were suspended in 1 ml LB. 200 μl of this were added to 200 μl of ϕX ($2.5x10^{10}$) and plated in 4 ml top agar with Kan and Cm. The 23 colonies that arose after overnight incubation at 37° C were picked onto a Kan, Cm LBA plate for storage. Each of these was streaked out to single colonies to reduce the risk of phage contamination. In order to confirm that the mutants were indeed phage resistant a spot test was performed. Top agar lawns consisting of 200 μl overnight culture of the mutants were made and 20 μl of ϕX was spotted onto each plate before they were incubated overnight at 37° C. A control consisting of a lawn of unmutagenised *Citrobacter* showed a clear spot test, 1 cm in diameter, where the phage had been spotted. The phage failed to make plaques on any of the mutant lawns confirming that all the mutants were indeed resistant.

Next, the genomic DNA from the mutants was extracted using a Qiagen DNeasy Tissue Culture Kit the subjected to random primed PCR amplification (Jacobs *et al.*, 2003). This method involved amplifying some of the Tn DNA along with a section of flanking genomic DNA by way of two PCRs. The first PCR used one primer that annealed to a site inside the Tn DNA and a set of 'random' primers that were designed to bind at numerous unknown points throughout the genome. The "random" primers had a semi-degenerate section and an adaptor tail of known sequence for use in the second PCR. The first reaction produced a number of products, many of which were unwanted. The second reaction was designed to selectively amplify the desired product from the first. It used a nested primer that annealed to the Tn DNA at a point close to the edge of the Tn DNA along with a primer that annealed to the adaptor tail of the "random" primers. Primer Tn IS2-OUT and "random" primers PF106 – PF108 were used in the first PCR. 5 μl of product from this PCR were used as the template for the second reaction. For this PCR amplification, nested primer TBOL 58 and adaptor tail primer PF109 were used. The products from the second PCR were purified using a Qiagen Gel Extraction Kit and sequenced by the DNA Sequencing Facility of the Department of Biochemistry, University of Cambridge using the nested primer, TBOL 58.

From the sequence, the section that did not correspond to Tn or primer sequence was selected and used to search the Sanger Institute's *Citrobacter rodentium* genomic database. I then selected a larger section of sequence (~500bp) from the database and entered this into the NCBI BLAST search. Using the translated query versus protein database, I was able to identify the probable function of genes into which the Tn had inserted.

Out of the 23 phage resistant mutants that I isolated, reliable sequence was obtained for six. All these six had the Tn insertion in genes most likely involved in lipopolysaccharide (LPS) production. This strongly suggested that ϕX infects via LPS.

Having identified six putative LPS assembly mutants I decided to investigate if the other phages that I had isolated were able to infect these mutants. I made a top agar lawn of three of the mutants and spotted on 20 μl of each phage, ϕA –H, using ϕX as a negative control. Phages A, B, C and H produced a clear spot test on the lawn after overnight incubation at 37° C whereas phages D, E, F, G and the negative control did not. This suggests that my 'new' phages A, B, C and H are LPS-independent phages and that D, E, F, and G, like ϕX, use LPS as their receptor.

In summary, I identified the receptor of ϕX as being LPS through identification of Tn insertions that resulted in resistance to the phage. I isolated eight new *Citrobacter rodentium* phages and obtained evidence suggesting that four of these were LPS-dependent phages and four were not. A detailed molecular biological characterisation of these phages including (electronmicroscopy, capsid protein analysis, and restriction enzyme analysis) and their exploitation in the genetic analysis of the host pathogen, is now actively in progress in this lab.

I am grateful to the members of the Salmond laboratory for their invaluable guidance and advice and particularly grateful to SfAM for funding this short project which provided an excellent opportunity to acquire new skills. This experience has certainly stimulated a strong interest in bacteria and phages that has encouraged me to pursue further studies in molecular microbiology.

Robin Macintosh
Cambridge University

The Influence of GFP Incorporation on Bacterial Physiology.

Mary Sattenstall reports on her project

AFTER COMPLETING TWO years of my Master's degree in Pharmacy, I still felt very uncertain about which career path I wished to follow. Therefore I was delighted when provided with an opportunity to undertake a microbiology based research project during the summer vacation under the supervision of Dr David Allison at the University of Manchester. The aim of the project was to investigate the effects of green fluorescent protein (GFP) incorporation on the physiology of bacteria.

GFP is a bioluminescent protein produced by the jellyfish Aqeuorea victoria. This protein is particularly useful as a gene marker as well as being used for protein targeting. It has been used for a range of diverse applications such as host pathogen interactions, as a reporter for spatial and temporal gene expression both within individual cells and biofilm populations, for protein localization studies and as a molecular marker. Different colours of fluorescent proteins have also been used in order to label different types of bacteria and observe their activity within a biofilm.

For many years it had been assumed that GFP incorporation had very little effect on the physiology of bacteria and the aim of my project was to establish whether this was true. During the first

few weeks of the project I was trained in basic microbial physiology techniques as well as health and safety aspects to ensure that I was competent in the necessary techniques. The main technique that I would be using was viable cell counting. As such, incorporated within these preliminary tasks were a series of laboratory based exercises to demonstrate statistical reproducibility of this technique.

For the main part of the study three different bacterial species of isogenic non-GFP and GFP-containing transformants were used. These included both chromosomal and plasmid-borne GFP. Initially growth curves were performed in both nutrient broth and a simple salts media in order to determine whether GFP incorporation affected growth rate. However, after a few preliminary studies it became apparent that there would be insufficient time to complete the full program using simple salts, so they were abandoned. As a measure of physiological differences, the response of each culture pairing to a range of antimicrobial agents was assessed. Hence, disc diffusion assays were performed using standardised preparations of mid-exponential phase cells. Thereafter, IC_{50} determinations were made by exposing standardised cultures to tetracycline, ciprofloxacin and cetrimide at a range of different concentrations for 1h. Survivors were determined by plate counts and the concentration of antimicrobial required to reduce the population by 50% was noted as the IC_{50}.

Preliminary analyses of the results suggest that significant differences in physiology exist between non-GFP and GFP-containing strains. In all instances doubling times in nutrient broth were not significantly different (student t-test analysis), indicating that growth rate was not affected by GFP incorporation. However, significant differences in susceptibility (noted as IC_{50} values) to all three classes of antimicrobial agent were observed. Given the widespread use of GFP as a marker for both whole cells and specific genes and proteins, our results would suggest that caution be applied when interpreting data generated using GFP containing strains, particularly if the GFP is being used in a cell-physiological context. Despite being a very quiet period in the lab due to many of the postgraduate students writing continuation reports or theses, I found the nature of the work kept me interested throughout. Indeed, I found the SfAM work placement to be an extremely enjoyable and valuable experience. During the 10 week period I experienced both the lows, when hours of laboratory time did not yield meaningful results, and the highs when a coherent set of results were obtained. In my opinion the highs far outweighed the lows. I am sure the whole experience will not only be very useful for my final year project, but also for any subsequent research that I undertake.

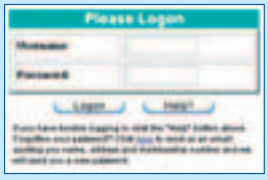
My sincere thanks to the Society for Applied Microbiology for providing me with such an opportunity, to my supervisor Dr Allison for all his continual support throughout the project and to all members of the microbiology lab for their help, friendship and encouragement.

Mary A. Sattenstall
University of Manchester

SfAM WEBSITE www.sfam.org.uk

Have you visited the SfAM website lately? As well as keeping you up-to-date with SfAM news and activities, it offers full SfAM members many other services. If you are a Full Member or Full Student Member, log on, using your SfAM username and password, to:

- advertise microbiology job opportunities (free!)
- post your CV (free!)
- advertise your microbiological skills or consultancy (a small annual fee is required)



Have you forgotten your username and password? Go to the website and click on 'Services' - 'Member Log on' and then follow the instructions on that page to have your username and a new password emailed to you.

Don't miss out on our wide range of grants, including our newest grant, the SfAM Fellowship. Details and application forms can be found at:

www.sfam.org.uk/members/prizes.php

Coming soon – online booking for the 2006 January Meeting. You'll find the complete programme online and on page 21 in this issue of *Microbiologist*.

the voice of applied microbiology on the world wide web!

Am I eligible - can I apply?

The President's Fund provides limited grants to ALL members to assist them to attend scientific meetings or workshops related to their area of work. Awards are made at the sole discretion of the Honorary President. Please note that this Fund is open to members of all ages! Why not apply to the Fund? The maximum grant available is normally £1,000.

To apply, visit **www.sfam.org.uk/members/prizes.php**

TERMS & CONDITIONS

1. The applicant must have been a member for at least a full subscription year before the event to be attended and must be a fully paid-up member at the time of application.

2. A successful applicant cannot re-apply to the Fund for three years from the date of the award.

3. Preference will be given to applicants who are contributing to the meeting they wish to attend and/or are unable to obtain funds elsewhere.

4. Completed applications must include an abstract of any intended contribution to be made at the meeting and must be received by the Society Office not less than six weeks before the date of the event.

5. Student member applications must be supported by their supervisor and include the contact telephone number(s) and email address(es) of the supervisor or head of department who is supporting their application.

6. The maximum grant available is normally £1,000.

7. Under exceptional circumstances this maximum may be exceeded.

9. The award of this grant is at the sole discretion of the Hon President of the Society.

10. The applicant must write a short article of between 400 - 600 words within 4 weeks of the meeting, the content of which will be agreed with the Editor of sfam *Microbiologist* and will be published in the magazine. Photographs of the applicant and/or the subject of the article are desirable. These should be supplied as (a) digital files in TIFF or JPEG format at a size of not less than 4 inches square at a resolution of not less than 300 pixels per inch, or (b) original photographic prints which will be scanned and promptly returned to the applicant.

Tracing the transmission of tuberculosis

A MAJOR CAUSE OF morbidity and mortality in the UK is *mycobacterium tuberculosis*. The second half of the twentieth century saw a steady decline in both cases and deaths from tuberculosis in England and Wales, with notifications reaching an all time low of 5,087 in 1987. However, since the early 1990s this trend has been reversed with a total of 6,837 cases being recorded in England, Wales and Northern Ireland in 2003. In October 2004 the Chief Medical Officer (CMO) published an action plan entitled 'Stopping Tuberculosis in England' in which he made several recommendations including improving surveillance (Anon 2004). In particular he advocated the development and implementation of laboratory techniques such as molecular typing or fingerprinting to aid the identification and investigation of tuberculosis transmission.

For many years IS6110 restriction fragment length polymorphism analysis (IS6110 RFLP) was considered to be the 'gold standard' for the epidemiological analysis of *M. tuberculosis*. Although this method was very successful for investigating potential epidemiological links between patients with tuberculosis it does have some disadvantages. In particular it is labour intensive and slow therefore limiting its usefulness for investigating ongoing transmission events such as during an outbreak. In addition the method provides poor discrimination for isolates with low IS6110 copy numbers and because it is a gel-based technique pattern comparison can be problematic.

The sequencing of the entire genome of a number of bacterial pathogens has revealed the presence of variable number tandem repeats (VNTR) in bacterial genomes which appear analogous to human microsatelites. The variability in repeat number of VNTRs loci can be exploited as a method of fingerprinting these pathogens. Twelve of these VNTR loci specific to Mycobacteria termed mycobacterial interspersed repetitive units (MIRU) are targeted in the VNTR typing method of Mazars et al. (2001) known as MIRU-VNTR typing. Isolates are fingerprinted based on the numbers of repeats at the 12 MIRU loci located throughout the genome. These units are 52 to 77 nucleotides long with the number of repeats being determined by sizing the fragment produced by amplifying the entire locus by PCR (Figure 1). These amplified fragments can be analyzed by agarose gel electrophoresis to determine their sequence lengths (Figure 2) which then can be interpreted to determine the number of repeats present at each locus. Alternatively the fragment sizes can be analysed by dHPLC or capillary electrophoresis on an automated DNA sequencer. Results are recorded as single

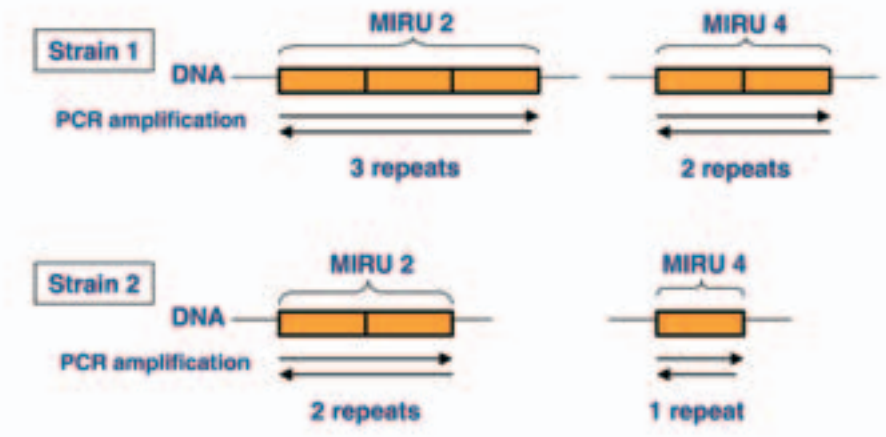


Figure 1. PCR amplification of MIRU-VNTR loci

multi-digit numbers therefore facilitating inter-laboratory comparisons and the creation of national or international databases of fingerprinting data.

The Regional Reference Centre for Mycobacteriology (RCM) at the HPA North East Laboratory provides reference services for the North of England and therefore receives isolates for identification, antibiotic susceptibility testing and epidemiological fingerprinting from three NHS regions. We recently began investigating MIRU-VNTR for fingerprinting *M. tuberculosis* isolates. In order to assess the utility of this method for identifying previously unrecognised clusters of related infections we have been performing a number of both retrospective and prospective typing studies. In collaboration with Dr Marko Petrovic, Consultant in Communicable Disease Control at Greater Manchester Health Protection Unit, we have used MIRU-VNTR to fingerprint 214 isolates of *M. tuberculosis* isolated from patients within the Greater Manchester region of the United Kingdom during 2002. The 212 isolates were differentiated into 139 distinct MIRU-VNTR profiles with 108 profiles only occurring once in the data set. MIRU-VNTR fingerprinting identified thirty one groups containing between two and thirteen strains which were indistinguishable from each other at all 12 MIRU loci. The geographical distribution of strains within clusters was assessed by comparing the postcodes of the home addresses of the individual patients. Within fifteen of the clusters geographical proximity of patient home addresses was demonstrated for some of the strains within the cluster indicating that the patient infections may be epidemiologically linked. Further investigations based on a review of patient case notes are underway to determine if these clusters have previously unrecognised epidemiological links.

MIRU-VNTR fingerprinting analysis has also proved useful for investigating potential incidents of laboratory cross contamination with *M. tuberculosis*. In the clinical microbiology laboratory, cross-contamination between specimens being tested for *M. tuberculosis* can lead to misdiagnosis which has important implications for patient care and management. In a recent study we used laboratory audit procedures to identify potential cross-contamination events using the following criteria: If smear negative samples were found to have been processed concurrently with other culture positive specimens became culture positive; if an inordinately high number of *M. tuberculosis* positive cultures were received from a submitting laboratory within a short time period; or if two or more multi-drug resistant (MDR) *M. tuberculosis* strains were submitted having been isolated from samples processed concurrently.

M. tuberculosis isolates from each of the incidences of suspected laboratory cross-contamination were fingerprinted by MIRU-VNTR. In all seven instances MIRU-VNTR fingerprinting proved extremely useful in helping to resolve suspicion of a laboratory cross-contamination event. DNA fingerprints of both 'truly positive' and 'falsely positive' samples were indistinguishable in five of the incidents strongly suggesting that laboratory cross-contamination had occurred in the submitting labs. Subsequent investigations demonstrated that these DNA fingerprinting results correlated with clinical evidence from the patients. In two instances in which the strains were isolated at the RCM in Newcastle, MIRU-VNTR fingerprinting results demonstrated that the suspected "falsely positive" samples were in fact genuine with isolates having MIRU-VNTR profiles distinct from one another. These two incidents demonstrate that MIRU-VNTR analysis can also offer validation of culture results. This study highlights the need for vigilance to identify possible laboratory cross-contamination and the usefulness of MIRU-VNTR for investigating such incidences.

I would like to thank The Society for Applied Microbiology for awarding me a Presidents Fund Grant which enabled me to attend the 7th International Meeting on Microbial Epidemiological Markers in Victoria, British Columbia where I presented data from some of the studies described above.

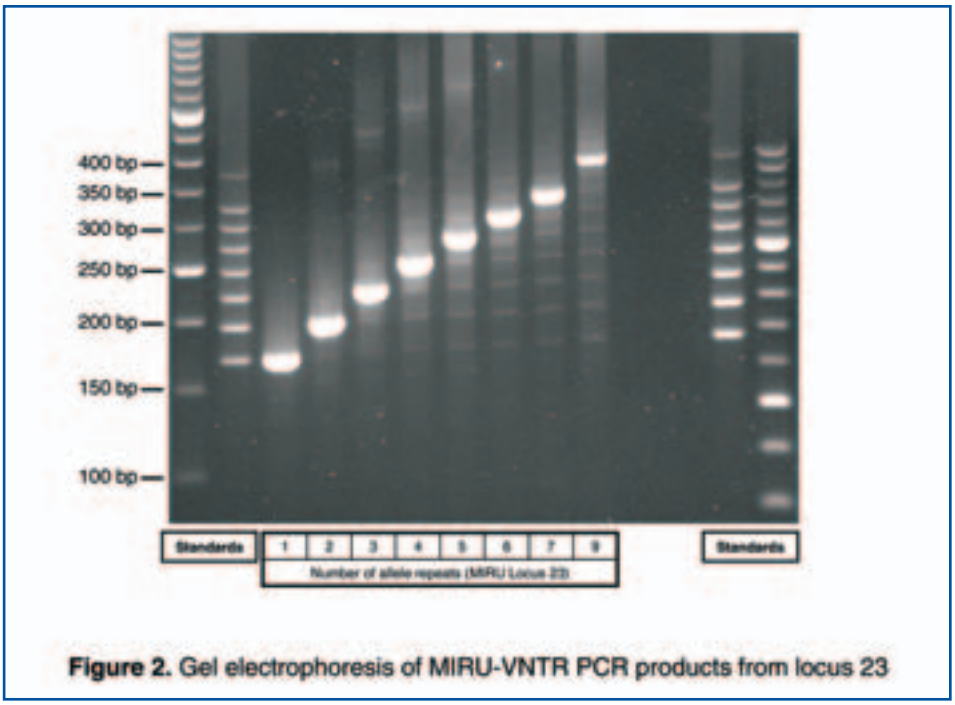


Figure 2. Gel electrophoresis of MIRU-VNTR PCR products from locus 23

References

- Anon. (2004) Stopping tuberculosis in England: An Action Plan from the Chief Medical Officer. DOH October 2004.
- Mazars E, Lesjean S, Banuls AL, Gilbert M, Vincent V, Gicquel B, Tibayrenc M, Locht C, Supply P. 2001. High-resolution minisatellite-based typing as a portable approach to global analysis of *Mycobacterium tuberculosis* molecular epidemiology. *Proceedings of the National Academy of Sciences* **98**, 1901-6.

Andrew Sails

Bacillus cereus in foodstuff

FOOD POISONING IS DEFINED as any disease of an infectious or toxic nature caused by the consumption of food or drink. The term is most often used to describe the illness, usually diarrhoea and/or vomiting caused by bacteria, viruses or parasites. Bacteria related food poisoning is the most common caused by fewer than 20 organisms. More than 90 percent of cases of food poisoning each year are caused by *Staphylococcus aureus*, *Salmonella* spp., *Clostridium perfringens*, *Campylobacter* spp., *Listeria monocytogenes*, *Vibrio parahaemolyticus*, *Bacillus cereus*, Entero-pathogenic *Escherichia coli*, and *Shigella* spp. Normally, a large number of food-poisoning bacteria must be present to cause illness.

Bacillus cereus has been recognized as an agent of food poisoning since 1955. It is an aerobic spore forming bacterium that is commonly found in soil, dust, vegetables, and many raw and processed foods. It may be spread when foods are prepared and held without sufficient refrigeration before serving, allowing them to germinate and multiply to the large numbers necessary to cause illness. Foods that may be contaminated are cereal products, herbs and spices, dried foods, milk and dairy products, meat and meat products. Consuming food that contains a bacterial cell number greater than 10^6 *B. cereus*/g may result in food poisoning. Two types of illness have been associated with the consumption of foods contaminated with *B. cereus*.

The symptoms of *B. cereus* diarrhoeal type food poisoning mimic those of *Clostridium perfringens* food poisoning. The onset of watery diarrhoea, abdominal cramps and pain occurs 6 -15 hours after consumption of contaminated food. Nausea may accompany diarrhoea but vomiting rarely occurs. Symptoms persist for 24 hours in most instances. The emetic type of food poisoning is characterised by nausea and vomiting within 0.5 to 6 hours after consumption of contaminated foods. Occasionally, abdominal cramps and/or diarrhoea may also occur. Duration of symptoms is generally less than 24 hours.

The symptoms of this type of food poisoning parallel those caused by *Staphylococcus aureus* foodborne intoxication. The emetic illness is mediated by a highly stable toxin that survives high temperatures and exposure to trypsin, pepsin and extreme pHs and the diarrhoeal illness is mediated by a heat- and acid-labile enterotoxin (Notermans & Batt 1998).

Psychrotolerant strains of *Bacillus cereus* have been in focus lately mainly due to their potential growth in chilled products such as milk and other diary products (Anderson Borge *et al.*, 2001). Psychrotrophic *B. cereus* is the limiting factor for the shelve-live of pasteurised milk and cream stored at >6 to 7°C (Griffiths 1992). The spore content of milk was strongly associated with the degree of contamination of the teats with soil (Davies and Wilkinson 1973). A study reported that high water content of soil, low evaporation of water and dirty access alleys were the most important factors correlating with high spore concentration. The spore content of soil was found to vary from <50 to 380,000/g depending of time and sampling site. The milking equipment did not contribute significantly to the contamination. The spore contents in air during milking (<100cfu/m3) and in feed (silage, fresh grass and concentrated) were too low to be of importance for contamination (Christiansson *et al.*, 1999). Further support that soil was the major contamination course was found by comparison of genetic fingerprints by random amplified polymorphic *B. cereus* from soil and milk and by teat cleansing experiments which resulted in reduced contamination levels in milk (Christiansson *et al.*, 1999).

Rice is the most common food associated with this food poisoning. It may be consumed in the form of grain rice, rice flour, noodles, rice cakes/crackers and breakfast cereals. It has often been associated with food poisoning outbreaks where *B. cereus* is the causative agent. Spores of *B. cereus* can survive well in dried rice products. Storage under cool, dry conditions resulted in no loss of viability of spores in rice-based cereal over 48 weeks of storage, although storage conditions of warm temperature (45°C) resulted in some loss of viability (Jaquette & Beuchat 1998).

An important characteristic of *Bacillus* is the ability of spores to survive the boiling of rice during cooking prior to their germination and toxin production. *B. cereus* has been shown to grow in rehydrated rice to numbers around 10^7/g within 24 hours of incubation at 26°C (Harmon & Kautter 1991), and 10^9/g at 32°C (Shelef & Liang 1982). At 8°C *B. cereus* grew from around 10^4/g to 10^8/g in 10 days (Ultee *et al.*, 2000).

Since *B. cereus bacteria* are common and widespread, preventing and contamination of food with spores is virtually impossible. Consequently, effective prevention and control measures depend on inhibiting spores germination and preventing the growth of vegetative cells in cooked, ready-to-eat foods. Freshly cooked food should be eaten immediately after cooking or kept above 63°C and eaten within 2 hours after cooking or cooled within one and a half hours of cooking and then kept at 8°C or below until eaten (within 3 days). This food should only be reheated once after cooking and it must be thoroughly reheated to a minimum temperature of 70°C for at least two minutes (Ultee *at el.*, 2000).

There are many different methods to detect microorganisms in food. Traditional culture based approach for the analysis of microorganisms in food can

only detect high quantities of bacteria. A period of incubation is usually required as the procedure requires a time period measured in days. Since the target organism may be a minority of the total microflora, recovery stages may be incorporated prior to selective procedures. It is fundamental that methods for detecting microorganisms are quick and efficient so patients can be treated as soon as possible.

A quick and efficient DNA extraction method using magnetic media coupled with PCR is one of the fastest ways to detect relatively small amounts of DNA. PCR is rapid, each cycle takes only about one to three minutes so repeating the process for 45 minutes can generate millions of copies of the specific DNA strand (Chui *et al.*, 2004). PCR can achieve in a week the results collected in a year by conventional microbiological methods.

Bee Ann Yeap
University of Brighton

References

- Christiansson A., Bertilsson J., and. Svensson B (1999) Bacillus cereus Spores in Raw Milk: Factors Affecting the Contamination of Milk During the Grazing Period. *J Dairy Sci*, **82**: 305–314
- Chui Linda W, K. R., Lu Patricia, Manninen Ken, Sim Jeong (2004). "Evaluation of four DNA extraction methods for the detection of *Mycobacterium avium* subsp. paratuberculosis by polymerase chain reaction." *Diagnostic Microbiology and Infectious Disease* **48**(1): 39-45.
- Davies, F. L., and G. Wilkinson. 1973. Bacillus in milk and dairy products. Pages 57–67 *in* The Microbiological Safety of Food. B. C. Hobbs and J.H.B. Christian, ed. Acad. Press, London, United Kingdom.
- Grethe I. Andersen Borge, Marianne Skeie, Terje Sørhaug, Thor Langsrud, Per Einar Granum (2001) Growth and toxin profiles of *Bacillus cereus* isolated from different food sources *International Journal of Food Microbiology*, **69**: 237–246
- Griffiths, M. W. 1992. *Bacillus cereus* in liquid milk and other milk products. Pages 36–39 in IDF Bull. 275. Int. Dairy Fed., Brussels, Belgium.
- Harmon SM, Kautter DA. (1991) Incidence and growth potential of *Bacillus cereus* in ready-to-serve foods. *Journal of Food Protection*; **54**: 372-374.
- Jacquette CB, Beuchat LR. (1998) Survival and growth of psychrotrophic *Bacillus cereus* in dry and reconstituted infant rice cereal. *Journal of Food Protection*; **61**: 1629-1635.
- Notermans S and Batt CA (1998) A risk assessment approach for food-borne *Bacillus cereus* and its toxins. *Journal of Applied Microbiology Symposium Supplement*, **84**: 51S-61S.
- Shelef LA, Liang P. (1982) Antibacterial effects of butylated hydroanisole (BHA) against *Bacillus* spp. *Journal of Food Science*; **47**: 796-799.
- Ultee A, Slump RA, Steging G, Smid EJ. (2000) Antimicrobial activity of cavacrol toward *Bacillus cereus* on rice. *Journal of Food Protection*; **63**: 620-624.

Bioluminescent Bacteria as Biosensors

A BIOSENSOR DETECTS, transmits and records information depending on a physiological or biochemical change. A good biosensor generally needs to be specific, sensitive, reliable, simple and gives real time results (D'Souza, 2001). Microbes have been frequently used as biosensors because of their ubiquitous nature their ability to rapidly metabolise a wide range of chemical compounds and the ease with which they can be genetically modified.

Naturally bioluminescent bacteria are found in the environment in a variety of habitats from the marine organisms *Vibrio fischeri* to the terrestrial *Photorhabdus luminescens*. Light is produced in a reaction catalysed by the enzyme luciferase (coded for by *luxAB* genes) which oxidises $FMNH_2$ and an aldehyde (produced by the fatty acid reductase enzyme encoded by *luxCDE*) in the presence of oxygen (See figure 1). As the expression of the *lux* operon depends on the metabolism of the cell, then any change in this will result in a change in the expression of the *lux* genes and therefore *lux* reporter technology can provide a non-invasive, accurate, real time and sensitive measurement of bacterial viability. Light emission is therefore an excellent candidate for incorporation into a microbial based biosensor. The *luxCDABE* operon from *Photorhabdus luminescens* has been cloned into a variety of plasmid vectors which have then been used to transform previously non bioluminescent bacteria into light emitting biosensors.

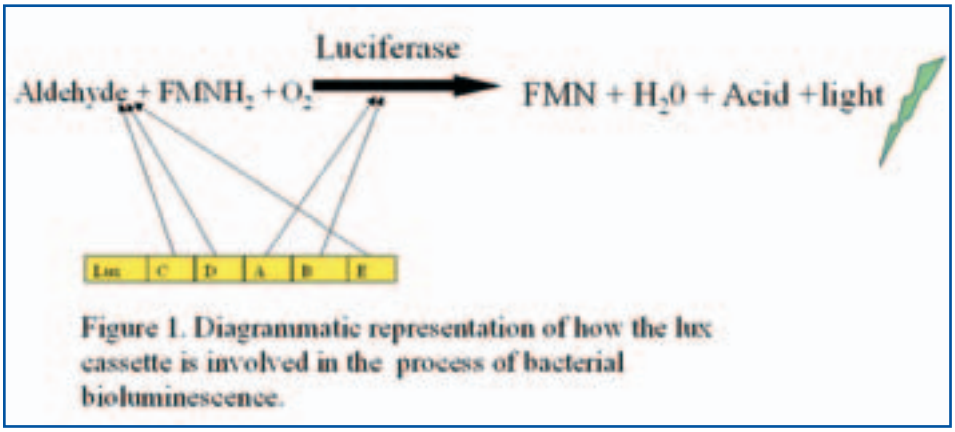


Figure 1. Diagrammatic representation of how the lux cassette is involved in the process of bacterial bioluminescence.

Examples of the successful use of bacterial *lux* reporters in this area are numerous. Our group, headed by Dr Vyv Salisbury, recognised the strengths of bioluminescent bacteria as biosensors of the post antibiotic effect (PAE) and control-related effective regrowth time (CERT) of novel antibiotics. A bioluminescent clinical strain of *E.coli* was constructed to study the activity of moxifloxacin and showed that whilst this antibiotic produced concentration dependant killing on viable counts, bioluminescent output was not concentration dependant. This provided relevant information for the treatment of established infections. Whilst Beard *et al.*, (2002), expressed *lux* genes in a

clinical isolate of *Streptococcus pneumoniae* to monitor gemifloxacin activity. Pharmacodynamics of antimicrobial agents had been previously monitored using viable counts for *S. pneumoniae* but this study demonstrated that bioluminescence provides an additional parameter to OD and viable counts for these interactions and provided support for the potential use of bioluminescent constructs of Gram positive pathogens. This was extended to examine the pharmacodynamics of linezolid in *S. pneumoniae* , indicating that whilst linezolid had little bactericidal effect it had a much greater influence on the PAE (Alloush *et al.*, 2003).

The use of bacterial *lux* reporters as pharmacodynamic indicators was further developed using bioluminescent bacteria as intracellular biosensors of antimicrobial activity (Angell *et al.*, 2002). A system was developed using a bioluminescent clinical isolate of *E.coli* inside a monocytic like cell line and the effects of ciprofloxacin and imipenem on the internalised bacteria were monitored in real-time. The results indicated that ciprofloxacin was capable of penetrating macrophages and exerting a killing effect on the internalised organisms. In contrast to this imipenem was not able to penetrate macrophages, or if it did, it was not able to exert a killing effect on the internalised cells.

This data correlated well with previous data that had used the more traditional method of viable counts. In another study (Qazi *et al.*, 2004) a high throughput system was developed to quickly assess replication of intracellular *Staphylococcus aureus* transformed with a dual *gfp-luxABCDE* reporter operon. The assay was used to monitor the efficacy of antimicrobials that are commonly used to treat staphylococcal infections. As bioluminescence and fluorescence were monitored, effects on both metabolism and protein synthesis could be assessed and gave information of the penetration of compounds into eukaryotic cells thus providing an approach to antibiotic selection in the clinical environment.

Cytosine arabinoside (Ara-C), a nucleoside analogue, is the agent of choice for the treatment of acute myeloid leukaemia (AML) a malignancy affecting the myeloid cell type. We have extended the research of the effect of antimicrobials on intracellular organisms to look at the effects of anti cancer drugs on bacteria within eukaryotic cells and thus gain more information on the fate of anticancer drugs *in vivo*. Although still in the developmental stages the initial results have been promising and suggest that there is potential for the development of a rapid, real-time and sensitive assay to monitor the response of leukaemic cells to anticancer drugs using bioluminescent bacterial reporters.

An award from the Presidents Fund was used to aid travel to present the initial work with Ara-C as a poster presentation at IUMS 2005, San Francisco, USA. I am very grateful to the Society for Applied Microbiology for this generous assistance.

References

- Alloush, H.M., Salisbury, V., Lewis, R., and MacGowan, A.P., (2003). Pharmacodynamics of linezolid in a clinical isolate of *Streptococcus pneumoniae* modified to express lux genes. *Journal of Antimicrobial Chemotherapy*. **53** (3): 511-13.
- Angell, J., McCleod, J.D., Lewis, R.J., and Salisbury, V.C., (2002). Use of a bioluminescent *Escherichia coli* within a monocytic cell line to assess antimicrobial efficacy. *Presented at the 42nd Interscience Conference on Antimicrobial Agents and Chemotherapy*, San Diego, USA, September 2002.
- Beard, S.J., Salisbury, V., Lewis, R.J., Sharpe, J.A., and MacGowan, A.P., (2002). Expression of lux genes in a clinical isolate of *Streptococcus pneumoniae*: using bioluminescence to monitor gemifloxacin activity. *Antimicrobial Agents and Chemotherapy*, **46** (2): 538-42.
- D'Souza, S.F., (2001). Microbial Biosensors. *Biosensors and Bioelectronics*. **16** (6): 337-53.
- Qazi, S.N., Harrison, S.E., Self, T., Williams, P. and Hill, P.J., (2004). Real-time monitoring of intracellular *Staphylococcus aureus* replication. *Journal of Bacteriology*. **186** (4): 1065-1077.

Johanna Angell

Could you benefit from a President's Fund Grant? See page 46 for details of this award or visit the website.

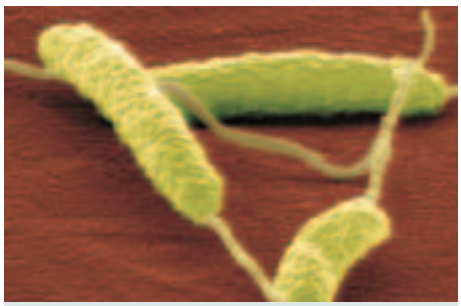
Francis Mégraud reports on the award of the 2005 Nobel Prize in Medicine

H. Pylori saga ends with Nobel Prize

THE 3rd SEPTEMBER 2005 WAS a great day for Bacteriology and Infectious Diseases. Indeed, for the third time only in the history of the Nobel Prize in Medicine, this prestigious award was given for the discovery of a bacterium. The previous prizes were awarded to Robert Koch in 1905 for his discovery of *Mycobacterium tuberculosis* and in 1928 to Charles Nicolle for his work on Rickettsia. But the discovery of *Helicobacter pylori* occurred at the end of the 20th century. How was it possible that a bacterium of such medical importance could have been ignored for so long? One reason may relate to the difficulty of accessing the stomach. Indeed, it was only in the 1970s that flexible endoscopes were developed following the principal work of B. Hirkowitz. Before then, using rigid endoscopes, it was quite difficult to explore most parts of the stomach *in vivo*. In contrast, this technological achievement allowed the endoscopist to take biopsies from all parts of the stomach. Also in the 1970s, the culture of microaerobic bacteria became popular after the discovery of the role of Campylobacters in diarrhoeal diseases. The tools were there, but it still took a few years before the culture of these 'new.'

microaerobic bacteria was possible. The paradigm at this time was that the stomach was sterile. Everyone accepted this theory because it was logical that no bacteria could live in such an acidic environment as that of the stomach. Thousands of pathologists had observed millions of gastric histological preparations and probably some happened to see bacteria on the surface of the mucosa. But they were discarded as contaminants. It is the merit of Robin Warren to have been open-minded enough to take the presence of these bacteria seriously, go further in observing them with an appropriate staining: Warthin Starry, and try to obtain a culture of them. Barry Marshall was in charge of this challenging task. After several attempts, at Easter 1982 the miracle finally happened: the bacterium now called *Helicobacter pylori* grew for the first time in culture. In fact, it was a rediscovery, because many researchers had observed this bacterium on anatomical specimens from the stomach at the beginning of the 20th century, or had indirect evidence that a bacterium could be the cause of peptic ulcer disease. However, at this time, bacteriologists were too busy working on the bacteria that grew well under aerobic conditions neglecting those which need special culture requirements. Eventually these more challenging organisms were forgotten. Marshall explored the old scientific literature and was then convinced of the importance of the new findings. It was a time of intense work in western Australia to unravel the mysteries of this new bacterium. After establishing a treatment regimen and in order to fulfill one of the strongest arguments for causality according to Sir Bradford Hill's criteria, they designed an intervention study where they showed that indeed eradication of *H. pylori* led to the cure of peptic ulcer disease.

B. Marshall went around the world, inexhaustible, to convince his peers of the new theory. The new paradigm was received with much skepticism. Barry Marshall was even courageous enough to ingest the bug himself and show that it could cause gastritis. We can compare the atmosphere at this time to the emergence of a new faith. Groups of "believers" were established around the world, especially in Europe where the European *Helicobacter pylori* Study Group was formed in 1987 (and later affiliated with ESCMID), and then, through its yearly workshop became an important forum for those involved in the field. Finally, the new paradigm emerged. The theory of 'No *Helicobacter*, no ulcer' replaced the theory of 'No acid, no ulcer' in the understanding of peptic ulcer disease. Another domain is now concerned, i.e.gastric cancer. In their first paper, the Nobel Prize winners already mentioned that *H. pylori* could be at the root of this terrible disease. Data accumulated since this time have proven that this is indeed the case. Except for very rare cases related to genetic abnormalities, all of the gastric carcinomas occur against a background of inflammation and *H. pylori* is the essential cause of this inflammation. The cascade of events already described by Correa in the 1970s has been completed by adding *H. pylori* infection at the origin. This is indeed the first cancer in humans known to be related to a bacterial infection! Already in 1994 this was acknowledged by the International Agency for Research on Cancer, a WHO agency, stating the carcinogenetic role of diverse substances or conditions. There is no doubt that the discovery of B. Marshall and R. Warren had a fantastic impact on medicine and public health. It was already recognised as one of the major discoveries of the 20th century, but it also had an important impact on the progress of science. The development of cell microbiology is indebted to this organism on which many studies were performed in order to explore the role of the *cag* pathogenicity island, the VacA cytotoxin, and adhesins. Phylogeography, which has the potential to trace human migrations through the study of the bacteria which inhabit humans, was also created following *H. pylori* studies. Also in the field of carcinogenesis, important new data emerged following the discovery of this unusual bacterium. The message to young investigators is that, even at a time of sophisticated scientific approaches, it is still possible to make important discoveries, provided you have an open mind to receive unexpected findings.



References

- Warren J R, Marshall B. Unidentified curved bacilli on gastric epithelium in active chronic gastritis. *Lancet* 1**983**;1: 1273-1275
- Marshall B J and Warren J R. Unidentified curved bacilli in the stomach of patients with gastritis and peptic ulceration. *Lancet* 1**984**; 1: 1311-1315
- Marshall B J, Armstrong J A, McGechie D B, Glancy R J. Attempt to fulfil Koch's postulates for pyloric *Campylobacter. Med J Aust* 1**985**; 142: 436-439

Francis Mégraud, M.D.
Secretary of the European Helicobacter Study Group

BOOKS

FREE BOOKS!

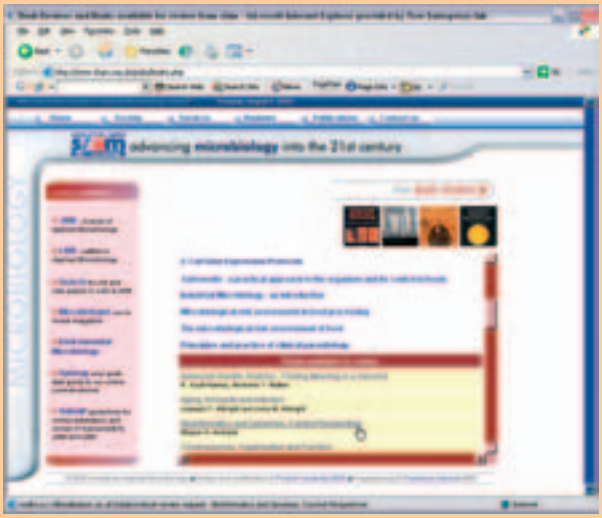
Would you like to review a book for ***Microbiologist*** and get to keep it? The Society receives several new books every week from publishers around the world and are always looking for enthusiastic additional reviewers who have an interest in the subjects covered.

There is an up-to-date list of titles available for review on the Society's website at:

www.sfam.org.uk/pubs/books.php.

To make an offer to review any book simply click its title. This will send an email request to the Editor of ***Microbiologist.*** In return for your efforts you get to keep the book!

You can also read online versions of book reviews published in ***Microbiologist*** on the same web page.



www.sfam.org.uk/pubs/books.php

Microbiology of Drinking Water

T2 Scientific, Lincoln.
www.t2scientific@ntlworld.com
CDRom £39.99 + £1.50 p&p
Reviewed by: Alan Godfree

Microbiologists working in the area of drinking water will be familiar with this publication that can trace its origin back to *Reports on Public Health and Medical Subjects No. 71*, published by the Ministry of Health in 1934. The publication that became known simply as 'Report 71', was intended to be a reference for those involved in the collection and bacteriological examination of water supplies. By publishing details of sampling and analysis, the committee responsible sought to introduce a measure of conformity such that the results from different laboratories could be compared. The scope of subsequent editions was widened to make the content more accessible to people without specialist bacteriological knowledge, particularly those concerned with the management of water supplies.

Report 71 was an essential source of reference and guidance for generations of water microbiologists, both in the UK and abroad. Over the years it has grown from a pamphlet numbering some 60 pages to a series of 12 individual booklets. The title has also changed to the *Microbiology of Drinking Water*, reflecting its wider scope. Responsibility for producing this book rests with the Standing Committee of Analysts (SCA) whose working groups prepare and publish guidance on methods of sampling and analysis for a range of environmental matrices. Analytical methods and guides are 'Blue Books' within the series *Methods for the Examination of Waters and Associated Materials.*

Available as an interactive CDrom or hard copy, this book remains an indispensable source of information for microbiologists in the water industry. Publishing the document as individual parts means that any amendments to existing sections or the addition of new chapters obviates the need for a complete reprint. On the downside, dividing the document up makes it more difficult for the user to cross reference information and it takes up more space on the shelf!

The CDRom version of the complete publication is very welcome. Clicking the document link from the welcome page opens the user's default browser to reveal the main index listing the individual sections (see screenshot 1). There are also links to a tutorial and what the developers term an Active Index (see screenshot 2). This is a list of keywords arranged alphabetically that link directly to the relevant section of text.

From the reviewer's perspective, the CD version offers enhanced readability on screen compared with the standard file that can be downloaded from the SCA website. The content of the individual SCA booklets has been included verbatim, but the typeface has been changed to improve legibility on a computer monitor (see screenshot 3) and there is the facility to print out sections of text if desired. Hyperlinks have been added to references or to other sections of the document. (see screenshot 4). The ability to navigate around the 12 individual parts within a virtual document is one of the major strengths of this product.

I would like to have seen the inclusion of photographs illustrating the sections dealing with analytical methods, particularly the appearance of colonies on chromogenic media. This would be valuable for users unfamiliar with the techniques and improve the functionality of the CDrom as a learning aid. This however, is a minor gripe and does not detract from what is an excellent and innovative product.

Screenshot 1

Screenshot 2

Screenshot 3

Screenshot 4

Immunology, Infection, and Immunity

Editors: Gerald B. Pier, Jeffrey B. Lyczak and Lee M. Wetzler. ASM Press
Reviewed by: Georgina Hold

The intention of this book is to bring together basic molecular and cellular components of the immune system with the pathogenesis and prevention of infectious diseases. In addition, it focuses on areas where the immune system does not act as it should i.e. immunodeficiencies and cancer control failure and also on areas where overactivity or dysregulation of the immune system cause problems including hypersensitivity. More than 30 scientists describe in detail traditional scientific views and doctrines about immunology, which are coupled with cutting edge scientific approaches and experimental data.

The book is divided into six sections: Section 1 describes the function and composition of the immune response. This section is further divided into five chapters, which nicely cover aspects of innate immunity, cells of the immune system, organs and tissues of the immune system and complement. If I had to criticise anything about the book, it would be the limited information provided on the crossover between innate and adaptive immunity. This is such an important aspect of immunology, which sadly often remains under-explained. Section 2 deals with antibodies and is again sub-divided into five chapters that deal specifically with genetics of antibody diversity, immunogenicity, antibody-antigen interactions, B cell activation and antibody production. Section 3 discusses cellular immunity in-depth including MHC, antigen processing/presentation, T cells and cellular communication. I was particularly impressed with the cellular communication chapter, which provided an excellent review on cytokines and their signalling. Section 4 describes immunologic effector systems and immunity to infections including CMI, mucosal immunity, immunity to various microorganisms and finally vaccines. I particularly appreciated the explanation presented in the chapter on vaccines on what makes a good vaccine and the difficulties that are involved during development. This type of information is fundamental and often difficult to locate. The final two sections deal with immune system dysfunctions, both deficiencies (Section 5) and overactivity (Section 6). Section 5 has extensive sections on immune defects in HIV infection and also immune defects within cancer. Some of the illustrations and schematics within this section were first-class, providing an excellent addition to the text. In particular the chapter on 'Cancer and the immune system', gives an extensive account of genetic changes, classes of tumour antigens and cell types important in anti-tumour immunity. Finally, Section 6 concentrates on three aspects of dysfunction: overactivity, namely hypersensitivity, autoimmunity and finally transplantation immunology.

The book is extremely well written and enriched with excellently presented illustrations, tables and schematics. The clear and concise summaries and 'suggested' reading list included at the end of each section are especially useful. In the majority of instances, the list directs you to excellent current reviews and key scientific papers. Another useful aspect of the book is the inclusion of several lengthy appendices, which tabulate (amongst other things) CD antigens, antigen names with CD designations, cytokines, chemokines and their receptors and cell types. These all provide an excellent point of reference for students to use.

society for applied sfam microbiology

For more information about the Society, Society meetings, the benefits of membership, *Microbiologist*, or to join us please visit the Society website at www sfam.org.uk

Benefits of sfam membership

The Society for Applied Microbiology was founded in 1931 and is dedicated to advancing the study of microbiology. Society members play a leading role in shaping the future of applied microbiology, and enjoy many benefits, including:

- **Reduced rates at Society meetings**
- **Access to the members areas of the Society website**
- **Generous grants and awards**
- **FREE access to three acclaimed journals**

Detailed information about all these benefits and more can be found on the Society website.

WEBSITE:

www.sfam.org.uk

The website is the best source of detailed information on the Society and it's many activities. It has a lively discussion forum and fully interactive membership areas where you can book your place at Society meetings find and advertise jobs, display your CV and much more.

CONTACT:

Society for Applied Microbiology, The Blore Tower, The Harpur Centre, Bedford MK40 1TQ, UK
Tel: 01234 326661
Fax: 01234 326678
email: info@sfam.org.uk
www.sfam.org.uk

membership options

- **Full membership** gives online access to the ***Journal of Applied Microbiology***, ***Letters in Applied Microbiology*** and ***Environmental Microbiology***, copies of ***Microbiologist***, preferential registration rates at Society meetings and access to the members areas of the website.

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

- **Associate membership** this class of membership is open to all current and new Society members including existing Associate Student Members and Retired members and gives quarterly copies of ***Microbiologist*** and preferential registration rates at all Society meetings.

- **Honorary Membership** of the Society is by election only and this honour is conferred on persons of distinction in the field of applied microbiology.

- **Corporate membership** is open to all companies with an interest in microbiology. Corporate members benefits include:

  - Half page advertisement in each quarterly issue of ***Microbiologist*** (which can be upgraded to a larger size at very attractive discounted rates).
  - Full page advertisement in the Members' Handbook.
  - FREE banner advert on the Society Website with a direct link to your company site.
  - Up to three members of company staff attending Society meetings at members' rate. (This means a 50% discount on non member registration rate).

- **Retirement Mambership**
Full Members can apply to go on the 'Retired Members List' once they have retired from their employment and have completed at least 20 years membership of the Society. Retired members are entitled to all the benefits of Full Membership except access to ***Journal of Applied Microbiology***, ***Letters in Applied Microbiology*** and ***Environmental Microbiology.***

Publications

The Society publishes two monthly journals: ***Journal of Applied Microbiology*** and ***Letters in Applied Microbiology.*** We also produce our own quarterly in-house colour magazine: ***Microbiologist***, which contains features, reports topical news stories and full details of our meetings. The Society is also a partner with Blackwell Publishing in the monthly journal ***Environmental Microbiology.***

Online journals

Synergy is an online service provided by Blackwell Publishing that gives Full and Student Members **FREE** access to the online versions of the Society's three journals: ***Journal of Applied Microbiology***, ***Letters in Applied Microbiology*** and ***Environmental Microbiology***. Members can register for this service at http://www.blackwell-science.com. Members can also submit papers directly to our journals via an online submission service.

For more information about Synergy or online manuscript submission, please visit the website.

Grants & awards

Many awards and prizes are available to members including the **W H Pierce Memorial Prize** and Prizes for Student Oral Presentations and Posters at the Summer Conference. In addition to these substantial awards, the Society has funds to assist members in their careers as microbiologists. These include **The President's Fund**, Conference Studentships, Sponsored Lectures and the popular **Students into Work** Scheme.

Full details of all the Society's grants and awards can be found on the website together with easy-to-use online application forms.

Meetings

We hold two annual meetings. The January Meeting comprises discussion sessions with the opportunity to display posters on related work. The Summer Conference is held every July and comprises a main symposium, a poster session, the AGM and a lively social programme. We also hold occasional joint ventures with other organisations on topics of mutual interest.