Microbiologist

The magazine of the Society for Applied Microbiology ■ June 2011 ■ Vol 12 No 2 ISSN 1479-2699

Food safety
...at home and away

INSIDE

Prolisa™

Enzyme Immunoassay System

C. difficile GDH EIA KIT

PRODUCT FEATURES

- Highly Sensitive*
- Highly Specific*
- Detection limit - 0.2ng/ml in sample diluent, 0.2ng/ml in faecal samples
- Easy to perform and read
- Available in 96-well test size with detachable wells
- Rapid results

*Data available in IFU and from Pro-Lab Diagnostics

EHEC EIA KIT

PRODUCT FEATURES

- 100% Sensitivity from broth culture
- 98.3% Specificity from broth culture
- Easy to perform and read
- Rapid results in 2 hours
- Available in 96-well test size with detachable wells
- Detects 100% of STEC serotypes commonly associated with human disease

Ordering Information		
PL.2002	Prolisa™ *C. difficile* GDH EIA Kit	96 Tests
PL.2001	Prolisa™ EHEC EIA Kit	96 Tests

Pro-Lab Diagnostics U.K.
7 Westwood Court
Neston, South Wirral, Cheshire
CH64 3UJ
United Kingdom
Tel: 0151 353 1613
Fax: 0151 353 1614
E-mail: uksupport@pro-lab.com

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

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

www.pro-lab.com

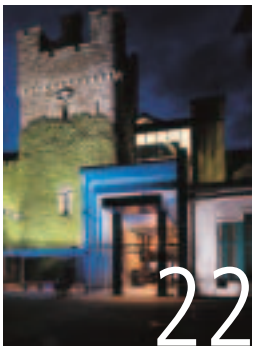
PRO-LAB DIAGNOSTICS

June 2011 ■ Vol 12 No 2 ■ ISSN 1479-2699

Microbiologist the magazine of the Society for Applied Microbiology

contents

Policy matters: Science and the Budget



Summer Conference — Have you booked yet?

information

Microbiologist is published quarterly by the Society for Applied Microbiology. ISSN 1479-2699. Registered in the UK as a charity and Company limited by guarantee. Registered in England and Wales: 6462427. Registered Charity: 1123044.

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: Lucy Harper. Tel: +44 (0)1234 326709. email: lucy@sfam.org.uk

Design and print: Pollard Creativity Limited. Tel: +44 (0)1933 664700. email: micro@pollardcreativity.co.uk

Society for Applied Microbiology, Bedford Heights, Brickhill Drive, Bedford MK41 7PH, UK. Tel: +44 (0)1234 326661. Fax: +44 (0)1234 326678.

www.sfam.org.uk

editorial

Lucy Harper talks about food safety

I'm writing this Editorial on the day the UK Government has recommended better clarity in the use of 'best before' and 'use by' dates on food packaging. This aims to reduce food wastage — something which we in the UK are responsible for to the tune of £680 per household each year. Whether these dates are there to protect consumers from harm, or to protect manufacturers and distributors from lawsuits, is a matter for another discussion, but suffice it to say this is an important issue.

Food is what sustains us and maintaining safety in the storage, handling and preparation of food is vital, especially in vulnerable groups. 'Use by' and 'best before' dates help people to decide whether to eat that last piece of mouldy cheese, or to risk having a nibble on a soft ginger nut biscuit. Of course we are all (especially this audience) able to use our own senses of sight and smell, as well as common sense, to make good judgements about whether or not something is safe to eat.

But misunderstandings about these two labels could be wasteful and dangerous. By law all food should contain a 'best before' date, after which food can remain perfectly safe to eat for a time. But the 'use by' date is different and after this date food is likely to be unsafe to eat and should be thrown away.

People are throwing away food which is edible because it's past the 'best before' date, or eating food which is unsafe because they're mistaking the 'use by' date for the 'best before' date. So any guidance which clarifies these and other food labelling terms to reduce misunderstanding is a move in the right direction.

The importance of Food Safety in the home is the subject of our first feature article in this issue of *Microbiologist* (page 26). Elizabeth Redmond and Christopher Griffith provide a fascinating overview of research in this area, stating that: "*The domestic kitchen has been described as the 'front line in the battle against foodborne disease' (CFIA, 1998). Foodborne illnesses most often arise from the handling and preparation of food and it is reported that a substantial number of cases of foodborne disease occur in the home (POST, 1997).*"

The global foodborne infectious disease burden is the subject of an interview with Dr Tanja Kuchenmüller of the World Health Organization (WHO), who tells us that: "*…the global impact of foodborne diseases that we are currently aware of, is just the tip of the iceberg.*" Turn to page 31 to read more about the WHO Initiative to estimate the global burden of foodborne diseases through their Foodborne Disease Burden Epidemiology Reference Group (FERG).

Finally, the topic of this year's Summer Conference is Food Safety. This conference has proved to be extremely popular — so for those of you who've booked a place we look forward to seeing you in Dublin. For more information see page 22, visit www.sfam.org.uk/summer_conference.php or email Sally Cryer at sally@sfam.org.uk.

contribute

We are always looking for enthusiastic writers who wish to contribute articles to the magazine on their chosen microbiological subject.

For further information please email the editor, Lucy Harper at: **lucy@sfam.org.uk**

Lucy Harper

Microbiologist is published quarterly by the Society for Applied Microbiology, a registered charity. ISSN 1479-2699.

Copy Dates:

Vol 12 No.3 Sept 2011
Friday 24 June 2011

Vol 12 No.4 Dec 2011
Friday 23 Sept 2011

Vol 13 No.1 March 2012
Friday 23 Dec 2011

Vol 13 No.2 June 2012
Friday 23 March 2012

Subscriptions:
A subscription to *Microbiologist* is included in the annual *Sf*AM membership fee. For further information about the many benefits of membership please see page 6.

Advertising:
Information about advertising in *Microbiologist* and how to submit advertisements can be found on the Society website.

Website: our website **(www.sfam.org.uk)** 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.

contact point

Society for Applied Microbiology
Bedford Heights, Brickhill Drive, Bedford MK41 7PH, UK.

tel: +44 (0)1234 326661
fax: +44 (0)1234 326678
email: communications@sfam.org.uk
www.sfam.org.uk

society office staff

CHIEF EXECUTIVE OFFICER: Philip Wheat
email: pfwheat@sfam.org.uk
tel: +44 (0)1234 326661

COMMUNICATIONS MANAGER: Lucy Harper
email: lucy@sfam.org.uk
tel: +44 (0)1234 326709

COMMUNICATIONS OFFICER: Clare Doggett
email: clare@sfam.org.uk
tel: +44 (0)1234 327679

MEMBERSHIP & FINANCE CO-ORDINATOR: Julie Wright
email: julie@sfam.org.uk
tel: +44 (0)1234 326846

EVENTS ORGANIZER: Sally Cryer
email: sally@sfam.org.uk
tel: +44 (0)1234 761752

ADMINISTRATOR: Julie Buchanan
email: julieb@sfam.org.uk
tel: +44(0)1234 326661

publications subcommittee

FEATURES EDITOR: Claire Cassar
email: c.cassar@vla.defra.gsi.gov.uk

FEATURES EDITOR: Louise Fielding
email: lfielding@uwic.ac.uk

FEATURES EDITOR: Clare Taylor
email: cl.taylor@napier.ac.uk

REGULAR CONTENT EDITOR: Alison Kelly
email: a.kelly@kingston.ac.uk

GRANTS EDITOR: Louise Hill-King
email: louise@hill-king.com

executive committee

COMMITTEE MEMBERS

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

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

HON GENERAL SECRETARY: Dr Mark Fielder, School of Life Sciences, Kingston University, Penrhyn Road, Kingston upon Thames, Surrey KT1 2EE
email: m.fielder@kingston.ac.uk

HON MEETINGS SECRETARY: Dr Andrew Sails, Health Protection Agency, Newcastle Laboratory, Institute of Pathology, Newcastle General Hospital, Westgate Road, Newcastle NE4 6BE
email: andrew.sails@hpa.org.uk

HON TREASURER: Mr Steve Davies, Microbiology Department, Northern General Hospital, Herries Road, Sheffield S7 5AU
email: steve.davies@sth.nhs.uk

ORDINARY COMMITTEE MEMBERS UNTIL JULY 2011

Professor Christine Dodd, Division of Food Sciences, School of Biosciences, University of Nottingham, Sutton Bonington Campus, Loughborough, Leicestershire LE12 5RD
email: christine.dodd@nottingham.ac.uk

Dr Clare Taylor, School of Life, Sport & Social Sciences, Edinburgh Napier University, Sighthill Campus, Sighthill Court, Edinburgh, EH11 4BN
email: cl.taylor@napier.ac.uk

ORDINARY COMMITTEE MEMBERS UNTIL JULY 2012

Mr Mark Reed, Pro-Lab Diagnostics, 7 Westwood Court, Neston Cheshire CH64 3UJ
email: mreed@pro-lab.com

Dr Sally J Cutler, School of Health and Biosciences, University of East London, Stratford Campus, Romford Road, London E15 4LZ
email: s.cutler@uel.ac.uk

Dr Samantha Law, NCIMB, Ferguson Building, Crabstone Estate, Bucksburn, Aberdeen AB21 9YA
email: s.law@ncimb.com

Dr Alison Kelly, School of Life Sciences, Kingston University, Penrhyn Road, Kingston upon Thames, Surrey KT1 2EE
email: a.kelly@kingston.ac.uk

ORDINARY COMMITTEE MEMBERS UNTIL JULY 2013

Dr Louise Fielding, Food Research and Consultancy Unit, Cardiff School of Health Sciences, University of Wales Institute Cardiff, Llandaff Campus, Western Avenue, Cardiff CF5 2YB
email: lfielding@uwic.ac.uk

Dr Irene Grant, Institute of Agri-Food and Land Use, School of Biological Sciences, Queen's University Belfast, Medical Biology Centre, 97 Lisburn Road, Belfast BT9 7BL
email: i.grant@qub.ac.uk

Dr Katie Laird, De Montfort University, The Leicester School of Pharmacy, Faculty of Health & Life Science, Hawthorn Building, Leicester, LE1 9BH
email: klaird@dmu.ac.uk

benefits

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

- The opportunity to apply for one of our many grants or funds.
- Eligibility to win any of our awards or nominate a candidate for the SfAM Communications Award.
- Access to our five peer–reviewed Journals: *Journal of Applied Microbiology*, *Letters in Applied Microbiology*, *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*.
- Free access to the entire collection of digitized back files for *JAM* and *LAM* dating back to 1938.
- A topical quarterly magazine, *Microbiologist*.
- Substantially reduced rates for attendance at SfAM meetings and conferences.
- Networking with worldwide professionals in over 80 countries.
- Access to private members' area of the SfAM website.
- Monthly email bulletins with the latest news from SfAM.
- Invitation to the annual *Environmental Microbiology* lecture.
- Fostering cross disciplinary research.
- A 25% discount on the extensive Wiley–Blackwell collection of titles.

Detailed information about all these benefits and more can be found on the Society website at: www.sfam.org.uk.

GRANTS & AWARDS: Many grants, 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 Lecture Grants 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 application forms.

JOURNALS: The Society publishes two monthly journals: *Journal of Applied Microbiology* and *Letters in Applied Microbiology*. We also produce this quarterly colour magazine, *Microbiologist*, which contains features, topical news stories and full details of our meetings. The Society is also a partner with Wiley–Blackwell in the monthly journals: *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*.

All Full and Student Members receive free access to the online versions of the Society's journals, and can also submit papers to our journals via an online submission service.

MEETINGS: We hold three annual meetings; the Winter Meeting is a one-day meeting with parallel sessions on topical subjects. The Spring Meeting is a one–day meeting tailored for personnel in clinical microbiology. The Summer Conference is held every July and comprises a main symposium, a poster session, the AGM and a lively social programme. All members are invited to our prestigious annual lecture held to commemorate the success of our *Environmental Microbiology* journal. We also hold joint ventures with other organizations on topics of mutual interest.

WEBSITE: The website is the best source of detailed information on the Society and its many activities. It has fully interactive membership areas where you can find archive issues of *Microbiologist*, exclusive SfAM documentation and much more.

membership options

■ **Full Ordinary Membership** gives access to our many grants and awards, online access to the *Journal of Applied Microbiology*, *Letters in Applied Microbiology*, *Environmental Microbiology*, *Environmental Microbiology Reports* and *Microbial Biotechnology*, copies of *Microbiologist*, preferential registration rates at Society meetings and access to the members' 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** is only open to those with an interest in applied microbiology without it being a prime aspect of their job. For example, school teachers and those taking a career break; on maternity leave, or working temporarily in other areas. It does not provide access to any journals or Society grants and awards.

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

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

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

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

JOIN US!

You can apply for membership on, or offline. To apply offline, please contact the Membership & Finance Co-ordinator, Julie Wright on **+44 (0)1234 326846**, or email **julie@sfam.org.uk.** Alternatively, write to her at:

The Society for Applied Microbiology, Bedford Heights, Brickhill Drive, Bedford MK41 7PH, UK.

www.sfam.org.uk

Environmental Microbiology Lecture 2011

The 2011 *Environmental Microbiology* lecture will be presented by **Professor Willem M. de Vos**, distinguished professor of Helsinki University, Finland and professor of microbiology of Wageningen University, the Netherlands. The title of his presentation will be "***Microbes Inside***". Professor de Vos is a very distinguished worker in the field of environmental microbiology and he acts as an Editor for the journal *Microbial Biotechnology*. He has co-authored over 400 peer-reviewed papers and his outstanding work has been recognized by numerous international awards. For members unable to attend, the lecture will be available online immediately after the event.

Membership changes

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.

Australia

A. Fulurija

Belgium

J. Mahillon

China

X. H. Zhang

Finland

C. Simoes

India

S. Shilpee

Ireland

A. Barczynska

Japan

T. Narihiro

Malaysia

O. A. Odeyemi

New Zealand

A. Naila

Nigeria

C. Anyakorah; A. W. Ashiru; O. Atanda; H. Obueh; E. Odion-Owase; A. M. Omemu; I. Osuolale

South Africa

A. Strydom

Spain

S. Bover-Cid

Thailand

N. Nakaew

Turkey

M. Uvey

UK

W. Abdelrahman; A. Abid; J. Al-Attwani; R. Arevalo; R. Arroyo Dans; T. J. Aspray; R. Bayliss; S. J. Benton; N. L. Blackwell; A. R. Buck; Carter; K. S. Dixon; A. Edwards; J. Ekprasert; M. El Khawand; M. Emery; I. Freire Martin; N. Goodawardane; L. Hoyles; K. S. Hussein; W. Joseph; A. Langarica Fuentes; K. S. Lomas; P. Lovatt; G. L. Marsden; J. Miller; A. Murch; R. Noad; R. A. Owen; G. K. Paterson; P. Prokopovich; L. Ryall; K. Samineni; A. Sattar; B. Sealy; G. Staite; N. Tahir; V. Taylor; D. Tosin; P. Varghese; N. A. Wali; L. K. Wareham; H. D. Williams

USA

P. Hexley

Losses

We were saddened to learn of the death of the following member of the Society:

Souzana Sotiracopoulos — Retired member since 1979 — died January 2011

president's column

Geoff Hanlon looks back over his presidency and reviews the many benefits now available to members

There must be some mistake…I can't possibly have come to the end of my term as President of the Society already. It seems as if I have only just begun and there is so much left to do. I'm sure that most outgoing Presidents feel the same way; however, it is the nature of the post that just as you are getting into your stride it is time to step aside and let someone else take over. It was with a feeling of immense pride but also some trepidation that I embarked on the role of President in July 2008. Thankfully I had the support of a great Committee and team of Officers who helped me into the role. During the last three years I've learned an awful lot, met a whole host of interesting and influential people who I wouldn't normally have encountered and generally had a great time.

My period of office didn't get off to a particularly good start. I was supposed to take over from Margaret Patterson at the AGM in Belfast, but at the time she was in hospital and so was I. Shortly afterwards the world was hit by the biggest financial crisis in living memory and there was real concern as to the possible effect this might have on the stability of the Society. Fortunately, we seem to have steered our way through both of these obstacles and come through relatively unscathed.

I am very conscious that the role of President has changed dramatically over the years, as indeed the Society has changed, and I have sometimes felt a bit of a fraud especially in the company of some illustrious past Presidents. It is they who laid the foundations for the modern Society we have today and we owe them a tremendous debt of gratitude. Many of these people were involved with running the Society in the days when it was organized by small bands of dedicated, unpaid enthusiasts who were responsible for absolutely everything. My job has been so much easier than theirs, because now we have a team of highly professional office staff, who have taken on all those roles, headed up by our CEO Phil Wheat. This effort is augmented by Sally Cryer and her team who are responsible for organizing all our meetings and do so with immense skill and dedication. My personal thanks go to all of them for their help and support throughout my period of office.

When the Society was formed back in the early 1930s it had just 34 members paying an annual subscription of 10 shillings each and that subscription income was the Society's only source of revenue. If we work out the value of that 10 shillings today, based on average earnings, it turns out that we would today be paying a membership fee equivalent to around £96 instead of our current fee which is just about half that. When one looks back to see what those pioneer members got for their money you will see that it amounted to virtually nothing. Compare that to the myriad of benefits available to our members today in the way of three main scientific meetings plus the *Environmental Microbiology* Lecture, over £150000 worth of grants available and five free journals together with the *Microbiologist* magazine, and it's evident that we've come a very long way.

Today, of course we have about 1,700 members worldwide and it is encouraging that the number of members is increasing despite the gloomy economic outlook. Our annual income has increased from £17 in the 1930s to around £1 million, of which only about 7% comes from membership fees. What has changed dramatically is income from journals, which thanks to an excellent relationship with Wiley-Blackwell and the outstanding work of our Chief Editors and editorial boards, has increased by more than 10-fold in the last 15 years. This has enabled us to start to look outwards to see how we as a learned society can contribute to the international capacity building agenda. We are in an ideal position to make a real difference in developing countries and to help them address issues of concern to them. We are looking to do this by making grants available to those who want to get involved in this sort of activity. Another approach is the introduction of an e-Affiliate Membership for microbiologists in the poorest countries of the world. This is free of charge; they can access the *Microbiologist* electronically, and will be able to apply for grants to attend our own meetings in the UK.

It may be that the people who were involved in the formation of our Society could have foreseen these changes; after all they must have been people of considerable vision. Change happens whether you want it to or not because the world is changing around us and the more successful you are the more you are going to change. It's how you manage change that's important, and that seems to be something we have done pretty well over the years.

Society Members at the Summer Conference in Leeds in 1932

It has been a real privilege to be involved with one small step on the S*f*AM's journey and I would like to say thank you to all those who put their trust in me at the outset. Sincere thanks also go to all those people who have sat on the Main Committee and held Officer posts during my period of office — your immense efforts have made my job so much easier. Finally, I would like to welcome Professor Martin Adams as your new President. Martin has been involved with the Society for many years and brings a wealth of experience to the role. I'm sure you will offer him the same support that you gave to me and I know the Society is in safe hands as we face the changes that lie ahead.

Professor Geoff Hanlon
President of the Society

ceo's column

Philip Wheat reports on the latest developments within the Society

I have previously mentioned on a number of occasions what terrific benefits are provided by membership of the Society. One such benefit is access to five peer-reviewed journals and this on its own is probably worth the membership fee. However, I am pleased to announce yet another membership benefit related to journals. As you are aware, we publish the journals in partnership with Wiley-Blackwell. On the 1 February 2011 they announced the launch of an additional new service — Wiley Open Access which they have developed to increase author choice. Wiley have initially launched this new service in the life and biochemical sciences, including neuroscience, microbiology, ecology and evolution. When they launched the service Wiley used a quote from our Honorary President as part of their worldwide press release. Professor Geoff Hanlon was quoted as saying:

"*The new Wiley Open Access journal in microbiology will deliver something of real value, with in-depth peer review, fast publishing times and availability to the worldwide research community. We are looking forward to partnering Wiley to support this new high-quality open access journal for the microbiology community*".

Wiley will introduce a range of new payment schemes to enable academic and research institutions, funders, societies and corporations to actively support their researchers and members who wish to publish in Wiley Open Access journals. More information is available at www.wileyopenaccess.com.

The benefit to Society Members of this new initiative is that should you wish to submit your research to Wiley Open Access you get a 10% discount on author fees (please contact me for further details: pfwheat@sfam.org.uk). I am also pleased to announce the details of this year's annual *Environmental Microbiology* Lecture. Once again the venue will be the Royal Society of Medicine in London, 10 October 2011 starting at 6.30 pm. The lecture will be given by Professor Willem M. de Vos from Helsinki University, Finland and Wageningen University, the Netherlands. The title of his presentation is "*Microbes Inside*". Professor de Vos is a very distinguished worker in the field of environmental microbiology and he acts as an Editor for the journal Microbial Biotechnology. He has co-authored over 400 peer-reviewed papers and his outstanding work has been recognized by numerous international awards. All members of the Society will receive an invitation to this event in this issue of the *Microbiologist*. So that we can finalize arrangements can I request that if you wish to attend please reply as soon as possible.

If you would like to attend the lecture but want some help with the cost of travel or maybe overnight stay why not apply for assistance by applying for a **Scientific Meeting Attendance Grant** (discussed in the *Microbiologist* March 2011)?

If you are unable to attend but would like to hear the lecture, it will be made available online within 48 to 72 hours of the end of the event. We have enabled this online provision in previous years and it has proved to be very popular, with over 3,000 hits for last years' lecture to date. So make sure you log on and don't miss out.

Philip Wheat
Chief Executive Officer

SfAM AGM AGENDA 2011

The 80th Annual General Meeting of the Society for Applied Microbiology will be held on Wednesday 6 July at 4.45 pm at the Clontarf Castle Hotel, Dublin.

1. Apologies for absence

2. Approval of minutes

Approval of minutes published in the September 2010 issue of *Microbiologist* of the 79th Annual Meeting held in Brighton, 2010.

3. Matters arising from the previous minutes

4. Report of the Trustees of the Society 2010

(i) Report of the Honorary President.

(ii) Report of the Honorary General Secretary.

(iii) Report of the Honorary Meetings Secretary.

(iv) Report of the Honorary Treasurer.

5. Adoption of the 2010 Annual Report

6. Election of new Members

(including Honorary Members), deaths and resignations.

7. Election of the new President

Professor Martin Adams.

8. Result of ballot and election of new Committee Members

9. Any other business

membership matters

Twitter Competition

We are delighted to announce the winner of our **micro**break Twitter competition — **Samantha Price** — a Student Member and regular tweeter from De Montfort University, Leicester, who sent in this informative tweet:

"World Health Day — Let's be aware of antibiotic resistance! Remember to complete the course and that no antibiotic will cure a cold ;-)".

Introducing a new member of the Publications Subcommittee

Clare Taylor has joined the Publications Subcommittee in the role of Features Editor. Here she introduces herself.

I have been reading the Society's quarterly magazine for almost 14 years and in that time I have read some great articles and learnt one or two things about statistics (thank you StatNotes!). I have also been the beneficiary of financial support from the SfAM over the years and have enjoyed contributing articles based on the experiences that those funds supported. Given the huge interest in microbiology and the vast area our fascinating subject covers, I commend past and present contributors to the *Microbiologist* for their ability to keep the magazine interesting and relevant. Looking to the future, as the Society expands in membership and reaches a more diverse audience, it is crucial that the *Microbiologist* continues to be a means of communication with our members and colleagues, offering articles and digests of recent news, as well as highlighting the good work of the Society. I am delighted to have joined the Publications Subcommittee as a Features Editor for the *Microbiologist* and I look forward to being involved in generating ideas, and commissioning articles that I hope others will enjoy reading.

Clare Taylor

Welcome to the S*f*AM's new administrator

The SfAM have a new member of staff at the Society Office. Julie Buchanan joined the team at the beginning of January as the Office Administrator. Here she tells us a little about herself.

I moved from Basingstoke to Bedford with my husband in November 2010, and joined the SfAM permanently at the beginning of January 2011 after temping here throughout December. Previous to this I worked in the finance sector for a French bank called BNP Paribas.

The SfAM is a great place to work and is totally different from my previous job; it is a really varied and interesting role, which allows me to use all my various administration skills. I look forward to continuing to develop in this role and learning more about the Society.

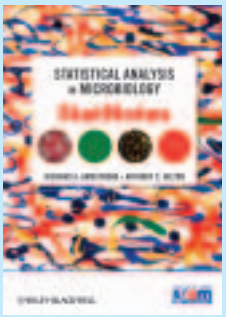
To contact Julie, email julieb@sfam.org.uk.

Don Whitley awarded Honorary Membership

Dr Don Whitley has been awarded and accepted Honorary Membership of the Society. Don has been a member of the Society since 1968 and has been awarded this honour for his outstanding long term commitment and involvement in the work of the Society. Congratulations Don.

Statistical Analysis in Microbiology: StatNotes

By Richard A Armstrong and Anthony C Hilton. Published by Wiley-Blackwell / SfAM, 2010



Statistical Analysis in Microbiology: StatNotes has been designed specifically for microbiologists who are involved in experimental research and need to draw accurate conclusions from their findings. It features 28 StatNotes that together enable you to understand the basic principles of statistics, choose the correct statistical methods to analyze your experimental data, and work with a variety of commercially available statistical software packages. Written specifically for microbiologists, the highly acclaimed and popular StatNotes enable you to choose which statistical methods should be applied to analyze and draw correct conclusions from your experimental data.

journalWatch

News about the Society's journals

Journal of Applied Microbiology

The following articles published in 2009 were the most cited articles from the *Journal of Applied Microbiology* in 2010.

Surrounded by mycobacteria: nontuberculous mycobacteria in the human environment. Falkinham, J.O. III, **Vol. 107**, No 2.

Microbial nitrilases: versatile, spiral forming, industrial enzymes. Thuku, R.N., Brady, D., Benedik, M.J. and Sewell, B.T. **Vol. 106**, No 3.

Fe(III) oxide reduction and carbon tetrachloride dechlorination by a newly isolated *Klebsiella pneumoniae* strain L17. Li, X.M., Zhou, S.G., Li, F.B., Wu, C.Y., Zhuang, L., Xu, W. and Liu, L. **Vol. 106**, No 1.

The role of biofilms and protozoa in *Legionella* pathogenesis: implications for drinking water. Lau, H.Y. and Ashbolt, N.J. **Vol. 107**, No 2.

Role of the alternative sigma factor sigma(B) on *Staphylococcus aureus* resistance to stresses of relevance to food preservation. Cebrián, G., Sagarzazu, N., Aertsen, A., Pagán, R., Condón, S. and Mañas, P. **Vol. 107**, No 1.

Letters in Applied Microbiology

The following articles published in 2009 were the most cited articles from *Letters in Applied Microbiology* in 2010.

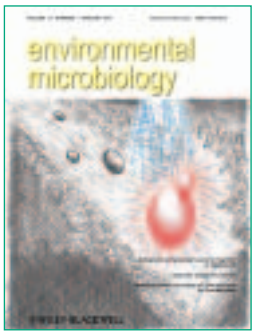
Occurrence of *Cryptosporidium* and *Giardia* genotypes and subtypes in raw and treated water in Portugal. Lobo, M.L., Xiao, L., Antunes, F. and. Matos, O. **Vol. 48**, No 6.

Auxin production by plant associated bacteria: impact on endogenous IAA content and growth of *Triticum aestivum* Ali, L.B., Sabri, A.N., Ljung, K. and Hasnain, S. **Vol. 48**, No 5.

The antimicrobial activity of four commercial essential oils in combination with conventional antimicrobials. Van Vuuren, S.F., Suliman, S. and Viljoen, A.M. **Vol. 48**, No 4.

Fabrication of silver nanoparticles by Phoma glomerata and its combined effect against *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Birla, S.S., Tiwari, V.V., Gade, A.K., Ingle, A.P., Yadav, A.P. and Rai, M.K. **Vol. 48**, No 2.

The benefits of silver in hygiene, personal care and healthcare. Edwards-Jones, V. **Vol. 49**, No 2.



Environmental Microbiology

The following articles published in 2009 were the most cited articles from *Environmental Microbiology* in 2010.

Wrinkles in the rare biosphere: pyrosequencing errors can lead to artificial inflation of diversity estimates. Kunin, V., Engelbrektson, A., Ochman, H. and Hugenholtz, P. **Vol. 12**, No 1.

Towards the human intestinal microbiota phylogenetic core. Tap, J., Mondot, S., Levenez, F., Pelletier, E., Caron, C., Furet, J.P., Ugarte, E., Muñoz-Tamayo, R., Paslier, D.L.E., Nalin, R., Dore, J. and Leclerc, M. **Vol. 11**, No 10.

Bacteria rather than archaea dominate microbial ammonia oxidation in an agricultural soil. Jia, Z. and Conrad, R. **Vol. 11**, No 7.

Dynamics and functional relevance of ammonia-oxidizing archaea in two agricultural soils. Schauss, K., Focks, A., Leininger, S., Kotzerke, A., Heuer, H., Thiele-Bruhn, S., Sharma, S., Wilke, B.M., Matthies, M., Smalla, K., Munch, J.C., Amelung, W., Kaupenjohann, M., Schloter M. and Schleper, C. **Vol. 11**, No 2.

Clostridium difficile PCR ribotype 078 toxinotype V found in diarrhoeal pigs identical to isolates from affected humans. Debast, S.B., Van Leengoed, L. A. M. G., Goorhuis, A., Harmanus, C., Kuijper, E.J. and Bergwerff, A.A. **Vol. 11**, No 2.

Environmental Microbiology Reports

The following articles published in 2009 were the most cited articles from *Environmental Microbiology Reports* in 2010.

Honeybee colony collapse due to *Nosema ceranae* in professional apiaries. Higes, M., Martín-Hernández, R., Garrido-Bailón, E., González-Porto, A.V., Garcia.-Palencia, P., Meana, A., Del Nozal, M.J., Mayo, R. and Bernal, J.L. **Vol. 1**, No 2.

Climate change: a catalyst for global expansion of harmful cyanobacterial blooms. Paerl, H.W. and Huisman, J. **Vol. 1**, No 1.

South American native bumblebees (*Hymenoptera: Apidae*) infected by *Nosema ceranae* (Microsporidia), an emerging pathogen of honeybees (*Apis mellifera*). Plischuk, S., Martín-Hernández, R., Prieto, L., Lucía, M., Botías, C., Meana, A., Abrahamovich, A.H., Lange, C. and Higes, M. **Vol. 1**, No 2.

Environmental, genomic and taxonomic perspectives on methanotrophic *Verrucomicrobia*. Op den Camp, H.J.M., Islam, T., Stott, M.B., Harhangi, H.R., Hynes, A., Schouten, S., Jetten, M.S.M., Birkeland, N.K., Pol, A. and Dunfield, P.F. **Vol. 1**, No 5.

Denitrification capabilities of two biological phosphorus removal sludges dominated by different '*Candidatus Accumulibacter*' clades. Flowers, J.J., He, S., Yilmaz, S., Noguera, D.R. and McMahon, K.D. **Vol. 1**, No 6.

Felicity Howlett
Wiley-Blackwell

bioFocus

Mark Downs reports on Science policy in Government

The Society of Biology is a single unified voice for biology:

- advising Government and influencing policy.
- advancing education and professional development.
- supporting our members.
- engaging and encouraging public interest in the life sciences.

For further information visit:

www.societyofbiology.org

Sound science really must underpin public policy. The Government has been quick to reassure on this point but the proof of the pudding is in the eating: their attachment to evidence-based policy has yet to be truly challenged. But the early signs are indeed encouraging. Clear statements on pseudoscience and homoeopathy support the Government's desire for evidence-based policy and the network of Chief Scientists in all Government departments, apart from the Treasury, provides a strong route to embedding science within the policy development process. The Council on Science and Technology, staffed by external experts and chaired by the Chief Scientist, provides an important advisory forum for the Prime Minister. This, together with the increasing willingness to use independent expert advisers in times of crisis, can surely only help to create a more open environment and improve trust.

Civil servants sometimes get bad press. But, like any other professional body, the reality is that there is a range of personalities and capabilities. Those working in science policy are no different, although my own experience is that they are by and large very able and committed public servants. Yet their role is often underestimated. The truth is that officials working in science policy are absolutely critical to the UK science agenda. The roles are often diverse and challenging and the issues dealt with can have major implications for the economy, health care, the environment, food supply and the ethical framework in which we all operate. Ministers and Governments come and go but the "corporate memory" is retained by officials and the advice they offer differs little between Governments of varying hue. It is the use to which the information is put through political imperative which changes.

Against this backdrop, any significant reduction in staffing within central Government would be a real concern. If the numbers of civil servants with science backgrounds or science policy portfolios are significantly or disproportionately reduced, however unintentionally, the ability of Governments to deliver not only on the science agenda but on the broader growth and innovation agenda will be severely restricted. With this in mind, the Society of Biology wrote to the Chief Scientific Adviser and Head of the Profession in the Civil Service, Sir John Beddington, to ensure senior officials and ministers take account of this as restructuring proceeds. He has committed to ensuring this concern is not lost amongst the rush to change and has positively welcomed continuing dialogue to help inform the policy agenda.

The Fukushima earthquake in Japan with its terrible impact on human life and the environment is sadly one of the first opportunities in 2011 to see how well scientific advice fits into Government. On the surface it appears to have been effective. Despite the rapidly changing and poor information that emerged over the first few hours and days of this tragedy, the advice from Government remained clear and informed by expert opinion. This has not always been the case and a successful response in one area of policy is no guarantee of equal success in another. Reviews of the response to pandemic flu certainly suggest that it could have been improved. It is an unfortunate fact that bad advice takes much longer to dissipate its negative effects, while news stories of positive outcomes are often hardly noticed. The learned societies can surely play a very positive role in ensuring that the Government has access to the best qualified and most reliable experts available in any particular field. But the scientists who help Government must not only have strong scientific credentials, they must have equally strong communication capabilities. They must be able to explain to non-experts the critical issues in a way they understand and feel comfortable acting upon. This may be 'motherhood and apple pie' but it is so easy, and so damaging, to get it wrong. It is critical at a time of emergency but similarly important as part of day-to-day policy development, and indeed the ability to respond to emergencies depends critically upon the pre-existence of networks of trust. There are a lot of 'black swans' issues and events to anticipate and pre-empt.

Critical, high-profile ethical issues such as gene therapy, embryonic stem cells and economic restrictions on the availability of drugs are just a few examples of the medical-based applications of biology where it is essential that officials in Government are able to understand the detail of the science and, together with the experts, communicate effectively to ministers and the media. The same is of course true for food security and production processes, antibiotic resistance, climate change, biodiversity and micro-biodiversity, green technology, waste management or any of a host of issues facing society where biology plays a role, either as a problem or solution. The Society of Biology both independently and through our members is keen to facilitate greater public engagement with all areas of biology and to help facilitate dialogue between policymakers and scientists. During 2011 we will continue to reply to Government and parliamentary consultations; exploring partnering the Cambridge Centre for Science Policy to support exchanges and secondments between policy officials and practising scientists; working with the Royal Society of Chemistry and Institute of Physics to run joint events in Westminster and the devolved administrations, and we are seeking to engage parliamentarians through the party conference process and beyond. The opportunities are endless and this is a modest start. But if we all contribute it is certain that we can make a difference.

Dr Mark Downs, PhD, FSB
Chief Executive, Society of Biology

policyMatters

Beck Smith reports on science policy

Science and the Budget

In the first in a series of articles on science policy, **Beck Smith**, Head of Policy for the Biochemical Society, reflects on the outcomes of the 2011 budget and how this will affect science funding.

(Article reprinted from The Biochemist 33 (3) © The Biochemical Society 2011)

The 2011 budget brought good news for UK science with the Chancellor announcing £100 million of capital investment in science (HM Treasury, 23 March 2011). Whilst widely welcomed by the scientific community, this news is set against a backdrop of the 43% reduction in capital spending at the Department of Business, Innovation and Skills (BIS) over four years as set out under the terms of the Comprehensive Spending Review (CaSE, 20 December 2010), and arrives amidst what has been a challenging start to 2011 for the life sciences sector.

On 1 February 2011, Pfizer announced that it was to close its research and development (R&D) facility in Sandwich, Kent. This announcement follows the decision by Pfizer in 2007 to close its manufacturing operations in Sandwich. Although it was hinted that recent changes in Pfizer's global strategy which include significant cuts in R&D ($9.1 to $9.6 billion in 2010, falling to $8 to $8.5 billion by 2012 — Wall Street Journal blog, 3 February 2011) may have such an impact, the decision to close the site, which employs 2,400 people still surprised many. It has since been announced that they hope to expand their operation in Cambridge, transferring 150 employees from Sandwich (BBC News, 28 February 2011), however, in the face of a large number of redundancies this does little to offset the effect this decision will have on the majority of Pfizer staff. Pfizer's decision to close this site follows a global trend by major pharmaceutical companies, many of whom are shifting to a 'centres of excellence' model. Some of these decisions are being made as the result of loss of patents on blockbuster drugs. In the case of Pfizer, Lipitor (the biggest selling drug of all time) will come off patent on 30 November 2011, and thus face generic competition. This is predicted to result in a $10 billion decrease a year in revenue (Wall Street Journal blog, 18 June 2008) for Pfizer.

Despite the knowledge of changes in Pfizer's global strategy, reduction in R&D budgets and protestations from Pfizer to the contrary, the decision has left many questioning both Britain's reputation as a good place to do science and the Government's belief that the private sector will be able to compensate for public sector cuts. John Denham, Labour's shadow business secretary, has called the news a "*deeply worrying development*" adding, "*we cannot afford to lose global industries as easily as this*."

The UK's pharmaceutical sector received another blow on 16 March 2011 with Novartis announcing that they would be closing their manufacturing site and therefore reducing the workforce at their Horsham site in West Sussex from 950 to 550. In response, the Rt Hon. David Willetts, Minister for Universities and Science said, "*This announcement from Novartis is disappointing news, which arises from their global restructuring. The life sciences sector is key to our future economic growth*" (Research Fortnight blog, 16 March 2011). The decisions of Novartis and Pfizer to downsize their UK operations present two key challenges. The first relates to staff and the other to the future use of the sites, particularly in the case of Pfizer and the Sandwich site. David Willetts has visited the site and said the Government would "*try to ensure a really valuable and prosperous future for all the activities on this site.*" Whilst both the previous and current Governments have shown a commitment to addressing skills gaps and increasing and retaining science, technology, engineering and mathematics (STEM) graduates, ensuring that the highly qualified and experienced scientists now facing unemployment are not lost from the sector must be a priority.

The Budget and the Plan for Growth

Alongside the Budget, the Government published 'The Plan for Growth' (henceforth referred to as the Growth Plan) which they termed "*an urgent call for action*." This document opens with some stark facts. Britain has fallen from 4th (1998) to 12th (2010) in the World Economic Forum's Global Competitiveness Index. In the OECD's PISA international rankings of excellence in maths between 2000 and 2009, Britain has fallen from 8th to 28th and in science, from 4th to 16th (HM Treasury, 24 March 2011). Despite these figures, the Growth Plan reiterates the oft made point that, "*The UK has a world-class research base, with more top-ranking universities, and more Nobel prize-winners, than any country except the US. If these and other strengths are harnessed, more successful British companies can compete in global markets, develop innovative products and services; and so create new jobs and rising prosperity*."

The Growth Plan outlines four broad ambitions:

1. To create the most competitive tax system in the G20.
2. To make the UK one of the best places in Europe to start, finance and grow a business.
3. To encourage investment and exports as a route to a more balanced economy.
4. To create a more educated workforce that is the most flexible in Europe.

Within these broad ambitions, the document contains a stated focus on the scientific sector, including the need to

increase the level of UK R&D being commercialized. In this aim, specific measures in the Growth Plan to make business investment innovation easier in this area, include:

- The introduction of a Patent Box in 2013, which will give a reduced 10 per cent corporation tax on profits from patents. It is hoped this will encourage companies to locate the high-value jobs and activity associated with the development, manufacture and exploitation of patents in the UK.
- The Higher Education Innovation Fund (HEIF) for university-collaboration with the private sector has been maintained and reformed.
- SME R&D tax relief will be increased to 200 per cent in 2011 and 225 per cent in 2012 (subject to state approval).
- The additional £100m in 2011-2012 in science capital development (HM Treasury, 24 March 2011) consisting of: £80 million to develop the national research campuses at Daresbury, Norwich and the Babraham Institute at Cambridge, £10 million for three further testing facilities at the ISIS neutron source in Harwell and £10 million to start a National Space Technology Programme to be match-funded by industry.

The Growth Plan provided information about how the money allocated to the national research campuses would be spent, with the £10 million investment at Daresbury building on existing expertise in accelerator, detector and imaging technologies. The £26 million Norwich allocation will be used for infrastructure, incubator space, provision of facilities for an anchor tenant (a relatively substantial company that intends to be on the park for some years, employing significant numbers of staff). Finally, the £44 million Babraham allocation will be used for developing a building for an anchor tenant and variety of incubator spaces and buildings, provision of 'researchers' residences' and further infrastructure improvements.

Following the announcement of this additional £100 million for science capital development, David Willetts said: "*This new investment recognizes the value of our excellent research base and proves the UK science industry is very much open for business. The extra spending will help drive innovation and growth and reflects our commitment to cutting-edge research.*"

Imran Khan, Director of the Campaign for Science and Engineering welcomed the announcement but warned that this boost to the capital expenditure "*comes in the wake of a £1.4 billion cut in capital spending and two weeks after China's new budget confirmed that funding for their equivalent of the Research Councils will have doubled in the two years since 2009*" (CaSE, 23 March 2011). Imran adds that "*George Osbourne must build on today's good news by working with academia and industry to develop a clear, well-financed, and long-term strategy to put science and engineering at the heart of this Government's growth agenda.*"

Whilst perhaps not quite at the heart of the growth agenda, life sciences do appear central to the Government's Growth Plan, placed alongside health care as a key sector for growth. In the Growth Plan the Government has outlined what it considers to be the barriers preventing UK science delivering to its full potential and measures to remove those barriers. Last year's Comprehensive Spending Review protected the science budget in cash terms over the next four years (excluding capital expenditure) and the Growth Plan builds on from that point by putting in place measures it feels will ensure the effective exploitation of UK science.

Three key aims and initiatives directly related to the UK life science sector can be identified within the Growth Plan:

1. Increasing the skills base

The Government's Growth Plan recognizes that an effective skills base will be needed to underpin its aims for the science sector. The plan states that "*businesses regularly report difficulties in recruiting graduates with suitable skills*", then with a reference to the recommendations of the Browne Review goes on to say that "*reform is necessary to make the system more responsive to students and employers that it is financially sustainable in the long term*" (HM Treasury, 24 March 2011). In the life sciences, despite some 30,000 graduates in 2008-2009 (almost 10 per cent of all first degree graduates), life sciences employers are still reliant on workers from overseas "*with a third of the sector's workforce sourced from abroad.*" The explanation offered for this level of overseas recruitment is that, in part, UK graduates are inadequately skilled and this is coupled with shortages in critical areas such as *in vivo* subjects. In addition, the Growth Plan states that, "*employers have consistently reported that the poor practical and numerical ability of UK bioscience graduates reduces employability*" (HM Treasury, 24 March 2011).

In addressing these skills shortfalls in the life sciences, the Government is bringing together employers through Cogent (the UK's industry skills body for chemicals, pharmaceuticals, nuclear, oil and gas, petroleum and polymer businesses) to indentify and shape the skills agenda, with initiatives such as the Society of Biology's new accreditation scheme to ensure that one feeds into the other. In directly addressing the shortages of *in vivo* skills, this has been singled out as one of two key areas that the accreditation scheme will focus on — the other being biochemistry.

2. Promoting STEM careers

With direct reference to the STEM sector, the Government plans to strengthen its strategy for promoting STEM skills. It is hoped that by supporting the Careers Profession Alliance, the provision of careers advice will be improved. The quality of STEM-related careers advice is often discussed, with a clear need for career advisors to have a greater understanding of the wide breadth of careers available to STEM graduates in addition to a sound understanding of the scientific career pipeline.

In addition to improved careers advice, the Government has recognized the need for early action at the school level in order to improve STEM teaching and promote careers in STEM. There is the aim to increase the number of industry-school visits e.g. by Apprenticeship Ambassadors and remove the "*excessive bureaucracy and other barriers to these visits*." It is hoped that by raising the quality of new entrants to the teaching profession, the teaching of STEM skills will be improved. Whilst the bursaries for trainee teachers of science and maths will be protected, the 'golden hello' scheme which saw science and maths teachers receive a one-off payment of £5000 when they began teaching is to be scrapped (Gove, M. 31 January 2011). STEMNET is singled out as a mechanism for promoting STEM through its range of activities between business and schools, including a STEM Ambassadors programme.

3. Facilitating innovation

The Growth Plan announced the launch of a competition to form a Technology and Innovation Centre (TIC) focusing on cell therapies and advanced therapeutics. This is the second TIC to be announced by the Government, and follows information released less than a fortnight previously about how the High Value Manufacturing TIC was to be structured. TICs, based loosely on the successful German Fraunhofer model, aim to accelerate the commercialization of UK research by forming networks between academia and industry. The new Cell Therapy TIC is seen as the next step in the Government's goal to help the UK's health care and life sciences industry fulfil its potential by exploiting promising discoveries and supporting their development.

The Cell Therapy TIC, "*will support the development and commercialization of therapeutics as well as the underpinning technologies for manufacturing, quality control and addressing safety and efficacy challenges for these new treatments*" (HM Treasury, 24 March 2011). If the Cell Therapy TIC is to be formed in a similar model to the High Value Manufacturing TIC, then a hub and spoke model in which a 'centre of excellence' is formally networked to a number of other research and technology facilities from across the UK can be expected.

There is some scepticism around the potential effectiveness of TICs as part of the Government's wider innovation strategy. Although based broadly on the German Fraunhofer model, the comparable funds available to each organization in each Centre are likely to be very small — surely this will limit their impact? This multi-organization model is in direct contrast to the German model in which there is a single Fraunhofer Institute in each area. With no funds available for new buildings, there are concerns that how the funds allocated to developing Technology and Innovation Centres will be used. The perceived disconnect between universities and businesses is seen as a key barrier to increasing the commercial exploitation of UK R&D — are TICs the best model to rectify this? Whilst the Fraunhofer model has seen significant success, this is a model which has been in place in its current form for over 20 years and therefore expectations of UK TICs to deliver need to be placed in an appropriate timeframe.

Challenges for the sector

The Government's challenge remains for UK science to deliver on the claims made in the run up to the Comprehensive Spending Review — which is that an investment in science equates to an investment in a country's long term economic and social well-being. It is clear that the Government sees an important role for itself in this aim and that it is hoped the measures outlined in the Growth Plan will help UK science to deliver on its claims.

references

- BBC News 'Pfizer bosses tell MPs why they decided to close Kent site' 28 February 2011. http://.www.bbc.co.uk/blogs/louisestewart/2011/02/pfizer_bosses_tell_mps_why_the.html
- Campaign for Science and Engineering — 'Capital spending — a closer look' 20 December 2010 http://sciencecampaign.org.uk/ ?p=2606
- Campaign for Science and Engineering — 'CaSE responds to the 2011 Budget' 23 March 2011 http://sciencecampaign.org.uk/?p=4242
- Gove (2011). Letter from Rt Hon. Michael Gove MP to Graham Holley Chief Executive Training and Development Agency for Schools, 31 January 2011 http://media.education.gov.uk/assets/files/pdf/l/letter%20from%20michael%20gove%20to%20tda%20on%20teacher%20training%20places.pdf
- HM Treasury 'Budget 2011' 23 March 2011 http://cdn.hm-treasury.gov.uk/2011budget_complete.pdf
- HM Treasury 'The Plan for Growth' 24 March 2011 http://cdn.hm-treasury.gov.uk/2011budget_growth.pdf
- Research Fortnight blog — 'Novartis closes factory and reduces R&D at Horsham, Sussex. Government promises new pharma action plan' 16 March 2011 http://exquisitelife.researchresearch.com/exquisite_life/2011/03/novartis-set-to-close-rd-site-in-horsham-sussex-with-loss-of-500-scientist-jobs.html
- The Wall Street Journal Blog — 'Pfizer plans to cut billions in annual R&D spending' 3 February 2011 http://blogs.wsj.com/health/2010/02/03/pfizer-plans-to-cut-billions-in-annual-rd-spending/
- The Wall Street Journal Blog — 'Countdown to expiry: Lipitor goes generic on 11/30/11' 18 June 2008 http://blogs.wsj.com/health/2008/06/18/countdown-to-expiry-lipitor-goes-generic-on-113011/

Beck Smith
Head of Policy, Biochemical Society

Campaign for Science & Engineering in the UK

We are delighted to announce that S*f*AM is now an organizational member of the Campaign for Science and Engineering (CaSE). Here, Director, **Imran Khan** describes their work.

CaSE is the UK's leading independent advocate for the science and engineering sectors, and focuses on arguing for more research funding, better science and maths education, a more innovative economy, and greater use of science and evidence by Government. S*f*AM is an organizational member of CaSE. If you'd like to join as an individual member, please go to http://sciencecampaign.org.uk/?page_id=3315.

Science and policy: is the future online?

Science and engineering are crucial to the UK's future, so safeguarding that future means we must continue to campaign for the health of our sector. But has the way in which we campaign for science in policy seen a fundamental change? The last year may come to be seen as a landmark for political activism in the science community, when power and activism was effectively channelled through online avenues.

2010 had the potential to be a watershed for UK science and engineering. In the run up to October's Spending Review we heard that the science budget could see cuts of anything up to a third. Spending reductions on that scale would have been catastrophic. Tomorrow's historians of science might have looked back and judged it to be the year when this nation took an irreversible fall from the top table of global research.

Instead, we won a reprieve. The national science budget was frozen in cash terms, which equates to roughly a 10% cut over four years, once inflation is taken into account. It's not ideal, but much better than had been feared.

Going online

Part of the reason that science fared relatively well, compared to other types of public spending, was the campaign mounted by the sector. As well as the highly visible actions of CaSE, there were others. As well as directly

lobbying politicians with our members and supporters, and seeding stories about science funding in the mainstream media, we also helped get the Science is Vital (SiV) movement off the ground, after it was kick-started by UCL researcher Dr Jenny Rohn on her blog.

Science is Vital saw us bring over 100 scientists into Parliament to lobby their MPs, 2,000 protestors onto the streets outside HM Treasury, and 36,000 signatories to an online petition calling on the Government to safeguard science spending. Much of the campaign was 'viral' — it relied on email cascades trying to reach scientists up and down the country, people blogging to share their perspectives on the cuts and the importance of the campaign — and of course having the likes Professor Brian Cox spreading the word to his nearly 200,000 Twitter followers didn't hurt either.

The campaign would have been far harder to run 25 years ago, when CaSE was initially founded. In 1986 it took months of phone calls to organize a letter of 1,500 people to *The Times*, calling on the Government to 'Save British Science'. Does this mean we should spend more time and energy focusing on the online element of campaigns, in future?

General Elections are all about getting key messages across to as large an audience of voters as possible. Alongside CaSE's established election work — including briefings and letters to the leaders of the parties — we used online media to engage as many people as possible. We blogged on our own site and others, often at the New Scientist, used Twitter to keep up interest and commentary, and even organized a webcast science policy debate.

There were 55,000 hits to our blog in April 2010, when the letters to CaSE from each of the main party leaders detailing their science and engineering policies were posted. The fact that the blog was well advertised and accessible also meant that prospective parliamentary candidates were happy to write for it. As a first foray into using online tools to boost our reach it was pretty successful.

Traditional campaigns

However, other recent campaigns have followed a more conventional curve. For instance, CaSE was one of the first organizations to raise the alarm about the Government's proposals to cap non-EU economic migrants, just after the Queen's Speech. The move could have inflicted enormous damage on our research base and international standing, but thanks to loud and vocal protests from the science community, we look set to escape its worst effects.

Key to this campaign was the succession of stories in the press highlighting just how absurd the restrictions were in practice, and the high-level lobbying of ministers — including David Cameron himself — by figures including university vice-chancellors and industry chiefs. The day after Cameron's first speech at the Conservative Party conference as Prime Minister, his party woke up to the front page of The Times carrying news of eight Nobel prize-winning scientists criticizing his plans in a letter organized by CaSE.

Twitter and blogs, while used, played nowhere near the same role as they did in the anti-cuts campaign. Yet, arguably, the anti-migrant cap campaign was even more successful than the funding one. We are still set for a research funding cut, whereas scientists and engineers look set to get unprecedented recognition in new immigration rules. So perhaps the success of Science is Vital was a one-off?

What are the lessons?

As with all things the answer lies somewhere between the two extremes. Even with the Science is Vital movement, the online aspect of the campaign formed a small part of the overall picture. As well as the tweets, blogs, and the petition, an enormous amount of work was done on the ground — from organizing the logistics for the Whitehall rally and lobby of Parliament, to fundraising and getting high-profile backers for the campaign.

In addition to Science is Vital, the summer and autumn of 2010 saw ordinary members of the public, researchers, businesspeople, journalists, learned societies, civil servants, and politicians all, in their own way, making the case for continued spending on research. CaSE and others continued with our traditional lobbying and evidence-based advocacy to highlight the danger to politicians. We can't run the 'controlled experiment' to see what made the difference, but we do know that we barely left a stone unturned — and that was key.

The impending demise of Britain as a scientific nation is something that caught people's imaginations. Issues like the migrant cap and specific instances of evidence-based policy-making might not be able to catch the public mood in the same way. We need to make sure that the community knows what the mechanisms for influencing politicians are, even when it seems like nobody else cares.

However, there will be issues where lots of people care. The influence of Twitter and blogs for Science is Vital was crucial. It allowed us to rapidly bring together an unprecedented number of people, and allowed those people to get their voice heard by Government. We were told that getting scientists out of their labs and into the streets was impossible, and yet people came from all over the country on their day off to show their support. In the aftermath of the rally we heard that Danny Alexander, Chief Secretary to the Treasury, had asked the Science Minister whether it was he who had sent the protestors to George Osborne's department instead of Vince Cable's.

We can be sure of two things. First, with every passing month and year, the influence of online media will grow. Second, there will be lots of challenges for science over the next four years. It's crucial that we're alert to the power of online tools and mass movements, and are able to identify those issues and campaigns where they can add the most value. Ultimately, British science and engineering may depend on it.

Imran Khan
Director, Campaign for Science and Engineering

about the author

■ After initial training as a biologist, **Imran** worked in science communication and policy with a range of organizations, ranging from the World Health Organization to the BBC and the House of Commons.

Winter Meeting 2011 report

Royal Society, London, UK, Wednesday 12 January 2011

Probiotics
Anaerobic Microbiology

This year's S*f*AM Winter Meeting was once again held in the grand surroundings of the Royal Society, London.

Jean-Yves Maillard, presenting Peter Lambert with a framed piece of Celtic artwork

Plenary session

The plenary session began with the **5th Denver Russell Memorial Lecture** given by Peter Lambert, Aston University. Denver Russell (1936 – 2004) was a Professor in the Welsh School of Pharmacy at Cardiff University and a world authority on antibiotic and biocide mechanisms of action and the development of resistance. Peter expressed his personal gratitude for encouragement given to him by Denver 40 years ago.

In his lecture, ***Propionibacterium acnes*: emerging pathogen?** Peter presented findings which tentatively support the hypothesis that this bacterium causes infections and should not be so readily dismissed as a contaminant. He talked about disease processes which are known to involve *P. acnes*, including acne, endocarditis and orthopaedic prosthesis infections, before concentrating on its possible association with SAPHO (synovitis, acne, pustulosis, hyperostosis, osteitis) syndrome, sarcoidosis, prostate cancer and low back pain. Randomized controlled trials are currently being undertaken in Denmark to further investigate these associations.

To commemorate the occasion of the memorial lecture, the Chief Editor of *Letters in Applied Microbiology*, Jean-Yves Maillard, presented Peter with a framed piece of Celtic artwork.

There then followed two taster lectures to introduce the topics of the parallel afternoon sessions. George MacFarlane, University of Dundee, gave an overview of **The gut flora and probiotics**. After describing aspects of microbial colonization of the digestive tract, George explained how this microbiota can be manipulated using functional foods such as probiotics. Some of the health claims made for these products are supported by good evidence but others are not. Likewise, there are several proposed mechanisms of action, some of which are more plausible than others. He concluded by saying that for functional foods to gain widespread acceptance by public, legislative and scientific communities, cause and effect relationships need to be substantiated on a robust scientific basis. Additionally, inadequate terminology such as "*healthy balance of bacteria in the gut*" will not be acceptable.

The second taster lecture, **An overview of the past 40 years in anaerobic microbiology**, was given by Mike Wren, HPA Collaborating Centre, University College London Hospitals. Mike has worked extensively in clinical anaerobic microbiology throughout his career and relayed his memories of isolation methods which have now been superseded by safer alternatives. As well as mentioning established anaerobic pathogens such as *Clostridium difficile* and *Clostridium tetani*, he talked about anaerobes which have more recently emerged as causative agents of human disease. *Fusobacterium necrophorum* is now associated with eye infections as well as persistent sore throats; *P. acnes* was mentioned in relation to neurosurgical wounds which are slow to heal; *Bilophila wadsworthia* has been implicated in liver abscesses and appendix and biliary tract infections; *Anaerobiospirillum* spp. have previously been linked to

ileocolitis in cats and diarrhoea in puppies but are now also associated with diarrhoea and bacteraemia in humans. Mike concluded his lecture with a summary of further work that is needed to advance anaerobic microbiology. This includes the development of more affordable, reliable methods of antibiotic susceptibility testing than the currently available gradient tests.

Louise Hill-King

Session A — Probiotics

Delegates who attended the afternoon session on Probiotics were treated to five excellent presentations summarizing the current state-of-play on this topic. Ian Rowland, University of Reading, began his presentation on **Probiotics and the elderly** by informing us that healthy life expectancy is not increasing as fast as life expectancy *per se* — the population may be living longer but there is more illness, probably due to immunosenescence with ageing. He then reviewed outcomes of probiotic administration to older people, which indicate that there is potential benefit in the use of probiotics to relieve constipation (laxative effect, improved transit time), to protect against antibiotic-associated diarrhoea, to prevent colorectal polyps, and to improve immune function more generally.

The second speaker, Bob Rastall, also from the University of Reading, brought us up-to-date on **Prebiotics** starting with the current thinking on what prebiotics are — i.e. food ingredients, supplements or components that escape digestion in the small intestine to reach the colon, where they serve as fermentation substrates for resident 'good bacteria'. He described some exciting research currently being undertaken at the University of Reading using model gut systems to study changes in the microbiota associated with different prebiotics, and the use of human volunteers (students) to study the effects of administration of prebiotics to real people.

Christine Edwards, University of Glasgow, reviewed studies considering the effects of **Probiotics, prebiotics and neonates** to encourage colonization of the gut with beneficial bacteria from birth. She set the scene by reviewing differences in the microbiota of infants, as influenced by delivery method (vaginal vs caesarean), breast fed vs formula fed and north vs south Europe. Her main conclusions were that there isn't a huge amount of evidence for many beneficial effects at the present time and that much more research (particularly long term, >12 month, studies) is needed before science-based recommendations regarding probiotics or prebiotics in relation to infant feeding can be made.

Veterinary use of probiotics has increased over recent years. Roberto La Ragione, from the Veterinary Laboratories Agency (VLA), summarized how probiotics are being used for both food-producing and companion animals. Administration to animals presents significant challenges in terms of cost, how to apply, providing adequate quantities, stability and safety of preparations, and timing of application. His presentation outlined current research approaches to characterize probiotic strain capabilities — fluorescence *in situ* hybridization (FISH), FlowFISH, 3D cell culture and confocal microscopy, cell crown *in vitro* organ culture (IVOC) technology (biopsy model) — and included some recent results of animal model and *in vivo* studies at the former VLA.

The final speaker, Kevin Whelan, King's College London, provided delegates with a comprehensive review of the **Safety of probiotics** in use. Acknowledging that there are a number of potential safety issues with probiotic use, he emphasized that the safety record of probiotics is very good, dating back many decades, and only a few adverse opportunistic probiotic-associated events have been documented. These have generally been associated with administration of probiotics to already ill/non-healthy people, particularly those that are hospitalized and being artificially fed. The need for clinical safety trials in patient populations that are the intended targets for probiotics use, rather than healthy individuals, was emphasized.

Irene Grant

Session B Anaerobic Microbiology

The afternoon session on anaerobic microbiology was opened by Ian Poxton (University of Edinburgh) who gave the audience **An update on pathogenic clostridia.** In recent years the emergence of a hypervirulent strain of *Clostridium difficile* has caused concern; the 027 ribotype has now been isolated from North America and a number of countries in Europe and is reported to cause more severe disease and produces higher levels of toxin. In addition this strain also produces binary toxin and a significant problem is the prevalence of increasing antibiotic resistance. New control strategies are under investigation including neutralizing the toxins, preventing attachment and modulating the inflammatory response. Interestingly, although official Department of Health figures suggest that there has been a decline followed by a plateau in the number of cases arising in England and Wales, there is an apparent increase in paediatric cases, suggesting that susceptibility to *C. difficile* infection is across a broader spectrum than previously thought. Ian then continued to reveal some insights into the rising prevalence of 'forgotten' clostridial infections such as wound botulism which has re-emerged particularly amongst injecting drug users who practice skin and/or muscle popping. Ian finished his talk by focussing on infections in animals including Blacks disease (*C. novyi*), pulpy kidney (*C. perfringens*) and braxy (*C. speticum*) in sheep and noted that due to the removal of antibiotics from feed, *C. perfringens* infection in poultry was also more widespread.

In contrast to the pathogenic clostridia, Nigel Minton (University of Nottingham) described the latest advances in **The exploitation of beneficial clostridia** and, in particular,

focussed on the use of *Clostridium* spp. for the production of second generation biofuels. Bioethanol has been widely talked about, however, biobutanol is considered a more attractive alternative to fossil fuels because its properties are more favourable and it can be used directly in engines without any mechanical conversion. Widely available and renewable non-food biomass containing lignocellulose is a raw material for the production of biobutanol, but there are major hurdles in developing the technology for bioconversion, such as low product yield coupled to solvent toxicity, substrate conversion and the cost of downstream processing. Butanol can be produced biologically by the anaerobic ABE (acetone-butanol-ethanol) fermentation of solventogenic clostridia, but they are inefficient and importantly are unable to use lignocellulose directly as a feedstock. Strain improvement, therefore, is a key goal for this area of research. However, there has been a lack of tools available for the genetic manipulation of clostridia and this has hampered development. Nigel continued to describe some of the synthetic biology approaches employed in his group that have resulted in the development of the ClosTron which has enabled the construction of specific mutants (some 200 to date). He also described metabolic engineering approaches due to allele coupled exchange (ACE) technology that are important for strain improvement, such as inserting the genes for cellulose-degrading enzymes into *C. acetobutylicum*. Nigel concluded his talk by describing work to develop *Clostridium*-directed enzyme prodrug therapy (CDEPT) as an approach for the treatment of cancer. This exciting area uses *Clostridium* spores that localize exclusively to hypoxic solid tumours and strains are being constructed that can deliver prodrug-converting enzymes. Strain improvement, coupled with prodrug development, make this a genuine prospect for anti-cancer drug delivery.

Following a short break for coffee the afternoon resumed with Martin Woodward (Veterinary Laboratories Agency) who discussed **Anaerobes in complex polymicrobial diseases** affecting animals. These polymicrobial infections are so called because the clinical and pathological symptoms are due to the presence of multiple microorganisms. Infections such as these can be difficult to diagnose and treat due to their complex nature and include a range of syndromes or 'complexes' such as bovine respiratory disease complex, porcine respiratory disease complex and avian intestinal spirochaetosis (AIS). Martin described the effects of a range of infections such as foot rot, a common disease in sheep and cattle, and the increasing prevalence of spirochaetes identified in this and other diseases. Molecular approaches have identified important virulence determinants and have enabled comparisons of strains in terms of fitness and disease-causing ability. Currently, there is much focus on the development of diagnostic tools against novel targets of the organisms responsible for AIS which is endemic worldwide amongst poultry flocks and thought to cost the UK up to £18 million a year. Interestingly, it was noted here also that the removal of antibiotics from animal feed is thought to be responsible for the re-emergence of this disease which certainly left me with an uneasy feeling. To finish, Martin described the use of 454 sequencing approaches as well as investigations using probiotics to produce inhibitors of spirochaete growth.

Val Hall (Public Health Wales Microbiology) was the penultimate speaker in the session and described **Modern methods for the identification of anaerobes** and the challenges faced in identifying anaerobic isolates in the pressured environment found in many diagnostic labs. As a base to compare from, Val described some of the conventional techniques that rely on experience, highlighting issues with commercial phenotyping and poorly maintained databases, as well as the problems with polymicrobial diseases where mixed populations of anaerobes are present. Modern techniques for identification include sequencing (16S rRNA), PCR-RFLP and FISH approaches as well as DNA-DNA hybridizations. However, many of these approaches have inherent problems such as the requirement for specialist equipment, time required and suitability for a wide range of organisms. One area that shows promise is the use of MALDI-TOF mass spectrometry for bacterial identification. This powerful approach has a number of advantages and in many cases can be done using whole organisms, negating the need for extraction. However, caution is recommended as this approach relies on up-to-date curated database information which isn't guaranteed to be reliable.

Finishing off the session (and the day) Peter Mullany (Eastman Dental Institute) presented an overview of **The influence of mobile genetic elements on oral anaerobes**. Oral anaerobes are responsible for a range of conditions in the oral cavity including dental caries and periodontal disease and play an important role in the polymicrobial biofilm commonly referred to as plaque. Given the association of the biofilm phenotype and increased antibiotic resistance, this begs the question is the oral cavity a niche for antibiotic resistance? Describing a metagenomic study carried out on oral samples of healthy volunteers, Peter highlighted the prevalence of tetracycline resistance genes including *tetM* and *tetW* in the oral environment. As these genes are often associated with mobile genetic elements such as transposons, these data suggest that the oral microbiome is a rich environment for horizontal gene transfer. Peter described recent work funded by the EU to examine the transfer of antibiotic resistance in humans and detailed the molecular approaches used including TRACA (transposon-aided capture) that enables the recovery of plasmids resident in the human oral metagenome.

Together all the speakers contributed to a scintillating session that sparked a number of discussions and revealed some insights into a fascinating area of microbiology.

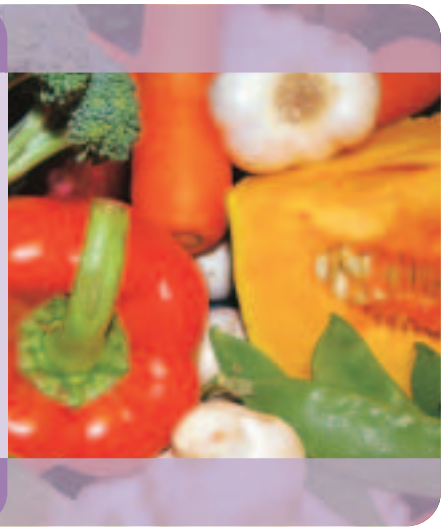
Clare Taylor

4 - 7 July 2011

Summer Conference

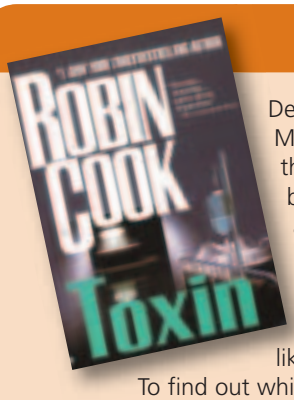
Food microbiology

- Including the Lewis B Perry Memorial Lecture, followed by drinks, buffet and tour of the Guinness Storehouse
- Conference dinner with Irish entertainment and tutored whisky tasting session at the Jameson Distillery



Clontarf Castle, Dublin, Ireland

BAD BUGS BOOK CLUB



Delegates at this years' Summer Conference in Dublin are invited to join Professor Joanna Verran of Manchester Metropolitan University in a critical discussion of the book '*Toxin*' by Robin Cook, a thriller tracing the cause of a fatal case of *E.coli* poisoning. On Tuesday evening, we will discuss the book over a glass of wine and buffet, looking at its scientific accuracy, relationship with current aspects of food microbiology, and relevance to the public understanding of science. If you'd like to join in the discussion, but don't yet have a copy of the book, you can buy it at Amazon: **http://amzn.to/eUgwDU**

Please contact Sally Cryer if you're a registered delegate at the Summer Conference and would like to come along.

To find out which other books Jo has discussed at previous book clubs, visit:
http://www.hsri.mmu.ac.uk/microbiology/education_and_communication/bad_bugs_book_club.asp

For more information about this event please contact Sally Cryer. Email sally@sfam.org.uk. Tel: +44 (0)1234 761752

To register online for the Summer Conference please visit www.sfam.org.uk/summer_conference.php or contact Sally Cryer ■ Email: sally@sfam.org.uk. Telephone: +44 (0)1234 761752

SUMMER CONFERENCE 2011 BOOKING FORM and INVOICE

SfAM SUMMER CONFERENCE 4 — 7 July 2011

CLOSING DATE FOR REGISTRATIONS: Monday 20 June 2011. EARLY BIRD DISCOUNT of £50.00 is applied to all bookings made before 6 June 2011

PLEASE NOTE: We are no longer accepting bookings with accommodation included. Delegates can still book for the meeting but will have to make their own accommodation arrangements.

Cancellation policy: Up to 30 days prior to the event all cancellations will be subject to a 10% cancellation fee, up to 14 days prior to the event there will be a 50% cancellation fee, and no refunds will be given on cancellations made within 7 days of the event.

FEES BEFORE 6 JUNE 2011	Full Member	Student, Honorary, Associate & Retired Member	Student Non–Member	Non–Member
Conference Rate: (no accommodation)	£100.00 ☐	£50.00 ☐	£100.00 ☐	£200.00 ☐
Conference Day Rate:	£50.00 ☐	£25.00 ☐	£50.00 ☐	£100.00 ☐

FEES BETWEEN 7 JUNE and 20 JUNE 2011	Full Member	Student, Honorary, Associate & Retired Member	Student Non–Member	Non–Member
Conference Rate: (no accommodation)	£150.00 ☐	£100.00 ☐	£150.00 ☐	£250.00 ☐
Conference Day Rate:	£100.00 ☐	£75.00 ☐	£100.00 ☐	£150.00 ☐

Conference Day Rate delegates please tick the day you wish to attend: Mon 4th ☐ Tue 5th ☐ Wed 6th ☐ Thur 7th ☐

RISK ASSESSMENT WORKSHOP: please tick this box if you would like to attend the workshop taking place on Monday 4 July 11.00 – 17.00 ☐

LEWIS B PERRY MEMORIAL LECTURE: please tick this box if you would like to attend the lecture and social event at the Guinness Storehouse on Monday 4 July ☐

QUIZ NIGHT with wine and buffet: please tick this box if you would like to attend at Clontarf Castle on Tuesday 5 July ☐

CONFERENCE DINNER: please tick this box if you would like to attend the dinner at the Jameson Distillery on Wednesday 6 July (extra fee applies) **£50.00** ☐

***Non–Members please note: You can add 1 year's membership to your event booking using this form, then register at the member rate and spend the same amount of money or less!**

*ADD MEMBERSHIP TO YOUR BOOKING

Add Student membership (£25.00): ☐ **Add Full membership (£50.00):** ☐

YOUR DETAILS

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

Address:_____

Postcode:_____ **Tel No:**_____ **Email:**_____

Special dietary or other requirements:_____

YOUR NAME BADGE

Please enter the information below in **BLOCK CAPITALS** as you would like it to appear on your name badge

First Name:_____ **Family name:**_____

Organization/Affiliation:_____

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.** We accept payment **ONLY** by the following credit and debit cards: 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 charged: £_____

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

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

Security Code (last 3 digits on reverse of card): ☐☐☐ Cardholder's address to which credit card statement is sent:

Signature:_____ Date:_____

Please return the completed form by fax (post if you are enclosing a cheque) to: **The Society for Applied Microbiology, Bedford Heights, Brickhill Drive, Bedford MK41 7PH, UK. Tel: 01234 761752 Fax: 01234 328330. Email: meetings@sfam.org.uk**

Summer Conference 2011 Programme

Monday 4 July 2011

11.00-17.00 **Risk assessment workshop in the Great Hall, Clontarf Castle**

17.30 **Coaches leave Clontarf Castle to travel to the Guinness Storehouse**

18.00-19.00 **Tour of the Guinness Storehouse**

19.00-20.00 **Lewis B Perry Memorial Lecture in the Arrol Suite, Guinness Storehouse**

Nowhere to hide: food safety in a global environment
Alan Reilly, Chief Executive, Food Safety Authority of Ireland

20.00-21.00 **Drinks reception and buffet in the Guinness Storehouse**

Tuesday 5 July 2011

Session 1: Pathogen updates, The Great Hall, Clontarf Castle

09.00-09.35 **Verotoxigenic *Escherichia coli***
Chris Low, Scottish Agricultural College, UK

09.35-10.10 ***Campylobacter***
Simon Park, University of Surrey, UK

10.10-10.45 **Foodborne viruses**
Marion Koopmans, National Institute for Public Health and the Environment (RIVM), The Netherlands

10.45-11.15 **Tea and coffee and trade show**

11.15-11.50 ***Salmonella***
John Threlfall, HPA, London, UK

11.50-12.25 ***Clostridium botulinum* and foodborne botulism**
Mike Peck, Institute of Food Research (IFR), Norwich, UK

12.25-13.25 **Lunch and trade show**

13.25-14.00 ***Cronobacter* spp.**
Seamus Fanning, University College Dublin, Ireland

14.00-14.35 ***Bacillus***
Niall Logan, Glasgow Caledonian University, UK

Session 2: Epidemiology of foodborne disease

14.35-15.10 **Current challenges to microbial food safety — estimating the global burden of foodborne diseases**
Danilo Lo-Fo-Wong, World Health Organization (WHO), Geneva, Switzerland

15.10-15.45 **Food safety in the European Union: ECDC's role in tracking the burden of disease and trends**
Andrea Ammon, European Centre for Disease Prevention and Control (ECDC), Sweden

15.45-16.00 **Tea and coffee and trade show**

16.00-16.35 **Climate Change and the challenge of new pathogens**
Marion Wooldridge, Veterinary Laboratories Agency, Weybridge, UK

16.35-17.10 **Food safety — the retailer's perspective**
Alec Kyriakides, Sainsbury's, UK

17.10-18.10 **Student session**

17.15-19.30 **Trade show with wine, buffet and a competition**

20.30 onwards **Quiz night in Indigo Lounge, Clontarf Castle**

Wednesday 6 July 2011

09.00 onwards **Posters**

These preliminary programme times and titles were correct at the time of going to press. For the latest programme please visit: ww.sfam.org.uk/summer_conference.php

Session 2: Epidemiology of foodborne disease (continued) The Great Hall, Clontarf Castle

09.00-09.35 **The threat of antibiotic resistance in the food chain for human health**
Hilde Kruse, WHO, Europe

Session 3: Microbiological risk assessment

09.35-10.10 **Recent global risk assessments and impact on Codex standard setting**
Sarah Cahill, Food and Agricultural Organization (FAO), Rome, Italy

10.10-10.45 **Recent developments in *Campylobacter* risk assessment**
Maarten Nauta, Technical University of Denmark

10.45-11.15 **Tea and coffee and posters**

11.00-12.00 **Attended poster viewing**

12.00-13.00 **Lunch**

13.00-13.35 ***Salmonella* risk assessment in Finland**
Pirkko Tuominen, Finnish Food Safety Authority, Finland

13.35-14.10 ***Listeria* risk in butter**
Phil Voysey, Campden, UK

14.10-15.10 **Student presentations**

15.10-15.30 **Tea and coffee and posters**

SfAM Award Lectures

Chair: President of the Society

15.30-15.35 **Introduction to New Lecturer Research Grant**

15.35-16.10 **S*f*AM New Lecturers Research Grant Lecture**
Speaker to be confirmed

16.10 -16.15 **Introduction to the WH Pierce Prize**
S*f*AM President

16.15-16.45 **W H Pierce Prize**

16.45-17.15 **Annual General Meeting**

18.00 **Coaches leave Clontarf Castle to travel to the Jameson Distillery**

19.00 **Delegates taken on a tour of the Jameson Distillery**

19.30 **Tutored whisky tasting session**

19.45-22.00 **Dinner in the Jameson Distillery with Irish entertainment — music and dancing**

22.30 **First coach arrives to take delegates back to Clontarf Castle**

23.00 **Last coach arrives to take delegates back to Clontarf Castle**

Thursday 7 July 2011

Novel technologies to control safety and stability

09.00-09.35 **Novel technologies — overview**
Bala Balasubramaniam, Ohio State University, USA

09.35-10.10 **Pulsed electric fields**
Stefan Toepfl, University of Applied Science, Osnabruck, Germany

10.10-10.45 **Tea and coffee and posters**

10.45-11.20 **Use of packaging for food preservation**
Frank Devlieghere, Ghent University Belgium

11.20-11.55 **High-pressure processing /pressure assisted thermal sterilization (HPP/PATS)**
Alejandro M. Amezquita, Unilever, UK

12.00-13.00 **Lunch and close**

The need for consumer food safety in the home

Foodborne disease incidence associated with the home

Sources of food contamination are diverse and foodborne pathogens associated with a range of raw foods are regularly brought into the domestic kitchen. Transmission of such pathogens to humans, due to implementation of unsafe food-handling behaviours within the household, is seen as inevitable. The domestic kitchen has been described as the "*front line in the battle against foodborne disease*" (CFIA, 1998). Foodborne illnesses most often arise from the handling and preparation of food and it is reported that a substantial number of cases of foodborne disease occur in the home (POST, 1997). Catering premises are subject to food legislation specifying design, layout, construction and size requirements, and food handlers go through food safety training. However, the domestic environment may have inadequate facilities for equivalently safe food preparation, as consumers have no formal training and no food safety regulations apply to the home unless it's being used for commercial processes. So it is possible to see how foodborne outbreaks may originate when food is prepared and served at home (Ryan *et al.*, 1996).

Reported incidence of foodborne disease associated with the domestic environment in the UK, Europe, USA, Canada, Australia and New Zealand is variable and is based upon reported outbreaks. Outbreaks of foodborne illness occurring in private homes are less likely to be reported than those in commercial and public premises (Scott, 2003). Given the substantial under-reporting of foodborne disease and the fact that the majority (more than 95%) of foodborne disease cases are thought to be sporadic (FSA, 2000) and less likely to be investigated by public health authorities, the actual proportion of foodborne disease cases that occur in the home is likely to be much greater than reported outbreak data suggests (Redmond & Griffith, 2003). Nevertheless, data from England, Wales, USA and Canada suggest between 12 and 20% reported foodborne outbreaks have been attributed to the home. Data from Australia and New Zealand suggest between 20 and 50% of foodborne illness has been attributed to the home and data for some European countries suggest that up to 95% of reported foodborne disease outbreaks have been associated with food prepared or consumed in the home. In Europe, FAO/WHO (2002) stated that the "*private home is the single location where most foodborne outbreaks occur.*" Throughout Europe the frequency distribution of the places where outbreaks occurred varies from country to country, depending on differences in eating habits. Summarized data from international and national studies reporting on the incidence of foodborne disease attributed to the home (1982 to 2003) can be found in Table 1.

Bacterial contamination and the domestic kitchen

Potential pathogens can enter the domestic kitchen via a variety of routes, for example, raw foods. Poultry is acknowledged as an important potential reservoir of foodborne pathogens, particularly *Campylobacter* and *Salmonella* species (ACMSF, 1996). Microbiological surveys of raw, retail poultry have identified high prevalence rates

(Harrison *et al.*, 2001) and it is clear that poultry meat continues to be a significant route for the transmission of *Campylobacter* and *Salmonella* — the leading causes of bacterial gastroenteritis in humans — in industrial, domestic and catering environments. *Campylobacter* is known to be a primary cause of sporadic cases of foodborne illness (Tam, 2001) and the annual number of reported cases exceeds reported *Salmonella* cases in many European countries (Takkinen & Annon, 2003). A study that evaluated the acute health effects and risks associated with different foods, showed that chicken was associated with relatively high levels of risk and accounted for more disease, health service usage and death than any other individual food type (Adak *et al.*, 2005). The largest proportions of reported foodborne disease outbreaks associated with the private home have been caused by *Salmonella* (Tirado & Schmidt, 2000). However, as the incidence of *Campylobacter* is mainly sporadic it is possible that more cases of *Campylobacter* infection may be attributed to the home than *Salmonella*. Food is not the only route or vehicle by which microorganisms can enter the kitchen. The presence of soiled laundry and pets is not uncommon and the domestic kitchen has been used for motor vehicle maintenance, gardening and even breeding chickens - each use bringing its own microbiological hazards (Worsfold & Griffith, 1997). So, the multifunctional nature of the modern kitchen directly impacts upon the need for better food safety in the home (Scott, 2003).

The importance of the home as a location for acquiring foodborne disease has prompted the assessment of levels of bacterial contamination within the domestic environment. Other studies have quantified bacterial pathogens in the home and determined the effectiveness of cleaning agents and methods. However, few surveys have evaluated microbial contamination in the domestic kitchen after food preparation. Most studies have concluded that the domestic environment is an important source of foodborne infections, and hygiene behaviour and/or cleaning practices need to be improved to reduce levels of contamination in the domestic environment.

Research results have shown that the majority of domestic environments were contaminated with pathogenic and non-pathogenic microorganisms. Interestingly, two studies found bacterial contamination levels in kitchens to be higher than in bathrooms (Ojima *et al.*, 2002). Finch *et al.*, (1978) reported that the normal domestic environment appears to support a fairly wide range of bacterial species and Josephson *et al.*, (1997) concluded that normal kitchens can be easily contaminated with a variety of bacterial contaminants including faecal coliforms, *Enterobacteriaceae* (such as *E. coli*), *Campylobacter* spp. and *Salmonella* spp. *Campylobacter* spp. have also been detected from commercial and domestic kitchens after food preparation (Dawkins *et al.*, 1984; Redmond *et al.*, 2004). *Listeria* spp. (including *Listeria monocytogenes*) has been isolated from 20% of domestic kitchens (Cox *et al.*, 1995), and from 47% of kitchens and bathrooms (Beumer & Kusumaningram, 2003) and both studies expressed concern for the implications of human exposure to these pathogens in the domestic environment. Other organisms that have been detected in the

Table 1. Global incidence of foodborne disease attributable to the home (1982-2003)

Country	Years of data collection	Incidence
England and Wales, UK	1992-2003	12% general foodborne outbreaks of infectious intestinal disease (IID) associated with food prepared in private house and served elsewhere
England and Wales, UK	1993-1998	12% general foodborne outbreaks of foodborne disease attributed to food consumed in a private house
Europe	1993-1998	42% foodborne disease outbreaks (microbiologically confirmed and suspected) associated to the private home (the place where food was eaten)
France	1993-1997	40% foodborne disease outbreaks (microbiologically confirmed and suspected) associated to the private home (the place where food was eaten)
Spain	1993-1998	49% foodborne disease outbreak associated with the private home (the place where food was eaten or acquired)
Australia	1999	Suggested between 20-40% of foodborne illness arise from private homes
New Zealand	1997	~50% cases of foodborne illness have been reported to be caused by poor handling techniques in the domestic kitchen
USA	1993-1997	20 reported bacterial foodborne disease outbreaks from place where food was eaten
'The Americas'	1998-2001	38.1% homes were implicated in foodborne outbreaks
Canada	1982	14% incidents (outbreaks and cases) caused by mishandling of foods in homes

Adapted from Redmond and Griffith, 2003

domestic environment include *Staphylococcus* spp. (Josephson *et al.*, 1997; Speirs *et al.*, 1995; Finch *et al.*, 1978), *Bacillus* spp. and *Micrococcus* spp. (Finch *et al.*, 1978; Scott *et al.*, 1982; Speirs *et al.*, 1995), and *Streptococcus* spp. (Scott *et al.*, 1982). It has also been reported that potentially pathogenic *E. coli*, *Klebseiella pnneumoniae*, and *Enterobacter cloacae* are the most frequently detected species in the home (Scott *et al.*, 1982).

Cronobacter spp. (formerly *Enterobacter sakazakii*) have also been isolated from the home environment (Kandhai *et al.*, 2004). These organisms are a relatively rare, but often fatal, cause of infection in neonates that has resulted from consumption of contaminated powdered formula milk. A review of cases and outbreaks of *Cronobacter* spp. infection has found that these bacteria were isolated from food/formula preparation items such as blenders, bottle cleaning brushes and spoons (Muytjens & Kollee, 1990).

The type and density of bacterial contamination is influenced by the physical nature of the site sampled (Gorman *et al.*, 2002). Contaminants detected from the majority of studies were more commonly isolated from wet or moist locations (Cox *et al.*, 1995; Josephson *et al.*, 1997; Scott *et al.*, 1982; Speirs *et al.*, 1995) where survival and proliferation of organisms is favoured. The most common locations of heavy contamination in the domestic kitchen are dishcloths, cleaning cloths, sponges, sink environments and towels (Beumer & Kusumaningram, 2003; Cox *et al.*, 1995; Finch *et al.*, 1978; Josephson *et al.*, 1997; Scott *et al.*, 1982; Speirs *et al.*, 1995). Kitchen sponges and dishcloths are considered to be particularly conducive for growth and survival of bacteria as they are continuously moist and supplied with nutrients in the form of food scraps and organic matter (Doyle *et al.*, 2000). Other contaminated locations include those frequently touched, such as taps and fridge handles. These findings suggest that these locations may not just harbour the bacteria, but also spread them around the kitchen during use (Doyle *et al.*, 2000; Scott *et al.*, 1982; Redmond & Griffith, 2005). So, it is suggested that consumers use disposable paper towels for cleaning surfaces in the kitchen, rather than dishcloths.

A summary of potential pathogens isolated from specific environmental sites within food preparation areas is shown in Table 2. These data indicate the range of microorganisms present, and the numbers isolated (Ojima *et al.*, 2002; Sharp & Walker, 2003) with counts for some sites in excess of 10^8cfu/ml (Hilton & Austin, 2000).

Table 2. Reported isolations of potential pathogens from specific environmental sites within food preparation areas

Environmental site	*Campylobacter* spp.	*Salmonella* spp.	*Y. enterocolitica*	*S. aureus*	*E. coli*	*Bacillus* spp.	*B. cereus*	*L. monocytogenes*	*Listeria* spp.
Dish cloth	●			●	●	●		●	●
Cleaning cloth	●	●		●	●		●		●
Wash-up sponge	●	●		●	●				●
Wash-up brush					●			●	●
Wash cloth		●						●	
Floor mop					●	●			●
Tea / hand towel				●	●	●			
Sink		●	●	●	●		●	●	●
Taps				●	●		●		
Refrigerator / door	●			●	●		●	●	●
Waste / Pedal bin	●			●	●	●			
Chopping boards	●			●	●				
Work surfaces	●				●	●			
Floors	●				●				

Adapted from Redmond and Griffith, 2000

There are inherent problems with these types of study, which may underestimate the presence of pathogens, including the random nature of the sampling, irrespective of the types of foods prepared. This may be compounded by relatively low numbers of pathogens in relation to non-pathogens, coupled with overgrowth of the latter. Other studies (Haysom & Sharp, 2005) have attempted to monitor trends in kitchen site microbial contamination over time, where contamination was seen to peak after meal preparation (although other non-food preparation activities also contributed). Research studies starting with an uncontaminated kitchen, showed how contamination of specific sites with food pathogens was found to occur during food preparation (Redmond *et al.*, 2004). Contamination and recontamination of sites in the domestic kitchen is constantly changing and coupled with poor general design, construction, maintenance and cleaning when compared to food processing plants, it is easy to see how the domestic kitchen could be a factor in domestic foodborne disease.

During food preparation, pathogens such as *Campylobacter*, *Salmonella*, *E. coli* and *Staphylococcus aureus* are spread from infected foods such as raw chicken to contact surfaces in the domestic kitchen (Gorman *et al.*, 2002), increasing the potential risk for foodborne disease. Laboratory experiments have shown that both *Campylobacter* and *Salmonella* can be easily transferred from raw chicken products to kitchen surfaces and hands (De Boer & Hahne, 1990) and dissemination of such pathogens to hands, cloths and hand- and food-contact surfaces during preparation of a chicken meal has previously been demonstrated (Redmond *et al.*, 2004). *Campylobacter* and *Salmonella* can persist on surfaces and this may lead to an increased risk of cross-contamination between food handlers, ready-to-eat (RTE) foods and other food contact surfaces. This not only presents contamination risks within the preparation of one meal (intra-meal contamination), but also between different meals (inter-meal contamination).

Consumer food safety

Consumers are the important final link in the food chain to assure safe food consumption and prevent subsequent illness (The Pennington Group, 1997). Consumers have responsibilities as purchasers, storers, providers and processors of food and need to be conscious of the nature and safety of food products. Food-handling practices employed by consumers in the domestic kitchen influence the risk of pathogen survival and multiplication, as well as cross-contamination to other products. Using observation and microbiological risk assessment, consumer food safety is needed to inform risk communication strategies to increase consumer implementation of risk-related practices and reduce the risk of foodborne disease.

Elizabeth C. Redmond and Christopher J. Griffith

references

- Advisory Committee on the Microbiological Safety of Food (ACMSF). (1996) Report on Poultry Meat. HMSO. London.
- Adak, G.K., Meakins, S.M., Yip, H., Lopman, B.A. and O'Brien, S. (2005) Disease risks from foods, England and Wales, 1996-2000. *Emerging Infectious Diseases*. **Vol. 11**,(3), pp365-372
- Beumer, R.R. and Kusumaningrum, H. (2003) Kitchen hygiene in daily life. *International Biodeterioration and Biodegradation*. **Vol. 51**, pp299-302
- Canadian Food Inspection Agency (CFIA). (1998) 1998 Safe Food Handling Study. A Report by Environics Research Group Ltd. PN4242. (June).
- Cox, J.M. (1995) *Salmonella enteritidis*: the egg and I. *Australian Veterinary Journal*. **Vol. 72**, (3), pp108-115.
- Dawkins, H.C., Bolton, F.J., Hutchinson, D.N. (1984) A study of the spread of *Campylobacter jejuni* in four large kitchens. *Journal of Hygiene* (Cambridge). **Vol. 92**, pp357-364.
- De Boer, E. and Hahne, M. (1990) Cross contamination with *Campylobacter jejuni* and *Salmonella* spp. from raw chicken products during food preparation. *Journal of Food Protection*. **Vol. 53**, (12), pp1067-1068
- Doyle, M.P., Ruoff, K.L., Pierson, M., Weinberg, W., Soule, B. and Michaels, B.S. (2000) Reducing transmission of infectious agents in the home. Part II: Control Points. *Dairy, Food and Environmental Sanitation*. **Vol. 20**, (6), pp418-425.
- Finch, J.E., Prince, J. and Hawksworth, M. (1978) A bacteriological survey of the domestic environment. *Journal of Applied Bacteriology*. **Vol. 45**, pp357-364.
- Food and Agriculture Organization of the United Nations (FAO) / World Health Organization (WHO). (2002) Statistical information on foodborne disease in Europe microbiological and chemical hazards. Conference Paper (Dec. 01/04. Agenda item 4b) presented at FAO / WHO Pan European Conference on food safety and quality. 25-28 February. Budapest, Hungary.
- Food Standards Agency (FSA). (2000) Foodborne Disease: Developing a Strategy to Deliver the Agency's Targets. Agenda item 4. Paper FSA 00-05-02. 12 October.
- Gorman, R., Bloomfield, S. and Adley, C.C. (2002) A study of cross contamination of foodborne pathogens in the domestic kitchen in Republic of Ireland. *International Journal of Food Microbiology*. **Vol. 76**, pp143-150.
- Griffith, C.J. (2000) Food safety in catering establishments. In Farber, J.M. and Todd, E.C. (eds.) *Safe Handling of Foods*. Marcel Dekker. New York.
- Harrison, W.A., Griffith, C.J., Tennant, D. and Peters, A.C. (2001) Incidence of *Campylobacter* and *Salmonella* isolated from retail chicken and associated packaging in South Wales. *Letters in Applied Microbiology*. **Vol. 33**, pp450-454.
- Haysom, I.W. and Sharp, A.K. (2005) Bacterial contamination of domestic kitchens over a 24 hour period. *British Food Journal*. **Vol. 107**, (7), p441.
- Hilton, A.C. and Austin, E. (2000) The kitchen dishcloth as a source of and vehicle for foodborne pathogens in a domestic setting. *International Journal of Environmental Health Research*. **Vol. 10**, pp257-261.
- Josephson, K.L., Rubino, J.R. and Pepper, I.L. (1997) Characterization and quantification of bacterial pathogens and indicator organisms in household kitchens with and without the use of a disinfectant cleaner. *Journal of Applied Microbiology*. **Vol. 83**, pp737-750.
- Kandhai, M.C., Reij, M.W., Gorris, L.G.M., Guillaume-Gentil, O., Van Schothorst, M. (2004) Occurrence of *Enterobacter sakazakii* in food production environments and households. *The Lancet*. **Vol. 363**, pp39-40.
- Muytjens, H.L. and Kollee, L.A.A. (1990) *Enterobacter sakazakii* meningitis in neonates: causative role of formula. *Pediatric Infectious Disease*. **Vol. 9**, pp372-373.
- Ojima, M., Toshima, Y., Kaja, E., Ara, K., Kauran, S. and Ueda, N. (2002) Bacterial contamination of Japanese households and related concern about sanitation. *International Journal of Environmental Health Research*. **Vol. 12**, pp41-52.
- Parliamentary Office of Science and Technology (POST). (1997) Safer Eating, Microbiological Food Poisoning and its Prevention. October.
- Redmond, E.C. and Griffith, C.J. (2003) Consumer food-handling in the home: a review of food safety studies. *Journal of Food Protection*. **Vol. 66**, (1), pp130-161.
- Redmond, E. C., Griffith, C. J., Slader, J. and Humphrey, T.J. (2004) Microbiological and observational analysis of cross contamination risks during domestic food preparation. *British Food Journal*. **Vol. 106**, (8), pp581-597.
- Redmond, E.C. and Griffith, C.J. (2005) Consumer use of cloth wipers: risk potential for cross contamination and recontamination in the domestic kitchen. Presented at IAFP Prague, October.
- Ryan, M.J., Wall, P.G., Gilbert, R.J., Griffin, M. and Rowe, B. (1996) Risk factors for outbreaks of infectious intestinal disease linked to domestic catering. *Communicable Disease Report* (Review). **Vol. 6**, (13), ppR179-R182.
- Scott, E. (2003) Food Safety and foodborne disease in 21st century homes. *The Canadian Journal of Infectious Diseases and Medical Microbiology*. Sept/Oct. **Vol. 14**, (5) pp277-280.
- Scott, E., Bloomfield, S.F. and Barlow, C.G. (1982) An investigation of microbial contamination in the home. *Journal of Hygiene* (*Cambridge*). **Vol. 89**, pp279-293.
- Sharp, K. and Walker, H. (2003) A microbiological survey of communal kitchens by undergraduate students. *International Journal of Consumer Studies*. **Vol. 27**, 1, pp11-16.
- Speirs, J.P., Anderton, A. and Anderson, J.G. (1995) A study of the microbial content of the domestic environment. *International Journal of Environmental Health Research*. **Vol. 5**, pp109-122.
- Takkinen, J. and Annon, A. (2003) The 11th international workshop on *Campylobacter*, *Helicobacter* and related organisms, 2001. *Eurosurveillance*, **Vol. 8**, (11), pp219-222.
- Tam, C.C. (2001) *Campylobacter* reporting at its peak of 1998: don't count your chickens yet. *Communicable Disease and Public Health*. **Vol. 4**, (3), pp194-199.
- The Pennington Group. (1997) Report on the circumstances leading to the 1996 outbreak of infection with *E. coli* 0157 in Central Scotland, the implications for food safety and the lessons to be learned. The Stationery Office. Edinburgh.
- Tirado, C. and Schmidt, K. (eds.) (2000) WHO Surveillance Programme for Control of Foodborne Infections and Intoxications in Europe. 7th Report, 1993-1998. BGVV-FAO/WHO Collaborating Centre for Research and Training in Food Hygiene and Zoonoses.
- Worsfold, D. and Griffith, C.J. (1997) Food Safety Behaviour in the Home. *British Food Journal*. **Vol. 99**, pp97-104.

WHO global burden of foodborne disease — Q&A

The real impact and cost of foodborne diseases globally is not known. So to fill this knowledge gap, the Department of Food Safety and Zoonoses (FOS) of the World Health Organization (WHO) launched: "*The Initiative to Estimate the Global Burden of Foodborne Diseases*" at an international consultation in September 2006. Here, Lucy Harper asks **Tanja Kuchenmüller** about this important initiative.

Q Why are foodborne diseases a growing problem globally?

A There are a number of aspects of global development which are increasingly challenging international health security. These developments include growing industrialization and trade of live animals and food products, growing trans national travel and migration, but also rapid urbanization which is associated with changes in food handling and food consumption. This includes more frequent preparation and consumption of food outside of the home, increased consumption of fresh and minimally-processed food as well as greater consumption of fish and seafood, meat and poultry around the world which increases the risk of foodborne diseases. There is also an emergence of new or antibiotic resistant pathogens, and finally we are also dealing with an increasing number of immunocompromised people who are particularly vulnerable to foodborne diseases, largely as a result of the HIV/AIDS pandemic.

Q Why are data derived from surveillance systems and sentinels only able to detect the tip of the global disease burden iceberg?

A While strengthening surveillance data is an important aspect of reducing the burden of foodborne diseases, it is acknowledged that data from surveillance systems and sentinel sites tend to only show the tip of the clinical iceberg due to under-diagnosis and under-reporting. Data from routine statistics or epi [epidemiological] studies may be fragmented, concentrate on fatal health outcomes or only be partially available. For an affected person to feature in such health statistics, they don't only have to seek medical care, and provide a specimen for laboratory investigation, but they also have to test positive in the laboratory investigation and be reported to the relevant health authority. Often this entire process does not take place, which means that cases are missing from routine surveillance data.

Also, studies investigate particular conditions and may in this context exaggerate claims on mortality, largely because several coexisting diseases can contribute to, and compete for, the cause of death.

Therefore comprehensive studies are required to identify the full extent of the burden of foodborne diseases. To date, only a few countries have undertaken burden of enteric disease studies, a global assessment has never been carried out, and very few burden of foodborne disease studies examine chemical or parasitic causes.

That's, in summary, why WHO and its partners launched the Initiative to Estimate the Global Burden of Foodborne Diseases in 2006.

Q Do you know what percentage of the burden is detected by surveillance data and sentinels?

A It's difficult to make an estimation with regard to the exact percentage of data available, but what is clear is that we are confronted with data gaps – especially in the area of chemical contamination of food. The Foodborne Disease Burden Epidemiology Reference Group (FERG) is trying to circumvent these problems on the one hand through modelling techniques, and on the other hand through new data collection which will take place during FERG country studies.

Q So presumably a similar approach can be taken with microbial infection?

A The data situation is better for microbial contamination of food. Collecting first-hand data which the FERG envisages will be necessary for foodborne diseases due to chemicals and toxins, doesn't correspond to the traditional Burden of Disease (BOD) approach. This approach is based on data that are available – that is, one conducts epidemiological reviews for mortality, morbidity and disability for a particular disease, assembles, appraises and reports on the available data, and relies on modelling techniques to estimate the burden where data is lacking.

In some areas, however, the FERG considers the collection of data as important, for example, with regard to the chemical contamination of foodstuff as data is so scarce in this area.

Q How is the global burden of disease estimated?

A The Global Burden of Disease Study proposed a single metric, a summary indicator which has been widely used by WHO and others in the field of burden

of disease estimation. The disability-adjusted life-year (DALY) expresses the **y**ears of **l**ife **l**ost to premature death (YLL) and the **y**ears **l**ived with **d**isability (YLD) for varying degrees of severity, making time itself become the common metric for death and disability. So one can say that one DALY is a health gap measure equating to one year of healthy life lost. As well as introducing information on non-fatal health outcomes and mortality in international health policy debates, DALYs have the advantage of being internally consistent as core co-morbidity is aggregated. So claims on mortality due to a particular condition cannot be exaggerated and epidemiological assessment is decoupled from advocacy by interest groups of particular health policies or intervention.

Q How would you like the DALY to be used?

A Sound epidemiological evidence on the burden of foodborne diseases expressed in DALYs will enable policy-makers and other stakeholders to allocate appropriate resources to foodborne disease prevention and control efforts, as well as to monitor and evaluate food safety measures. DALYs can also be used to develop new food safety standards, by the CODEX Alimentarius for example, assess the cost effectiveness of interventions and finally, what our stakeholders have claimed very often, to quantify the burden of foodborne diseases in terms of monetary costs.

Q Can you explain a little more about the: The Foodborne Disease Burden Epidemiology Reference Group (FERG) and its role in the WHO initiative?

A The FERG is an external advisory body to the WHO which provides objective advice on foodborne disease estimation and on knowledge translation. This advisory body is supporting the initiative to achieve its overarching goal, which is, to enable policymakers and other stakeholders to set appropriate and evidence-informed priorities in the area of food safety. The main tasks of the FERG can be divided into two main areas:
First of all the FERG has been established to:

- Conduct epidemiological reviews for mortality, morbidity and disability for each of the major foodborne diseases.
- Assemble, appraise and report on existing foodborne disease estimates.
- Provide models for the estimation of the foodborne disease burden where data are lacking.
- Develop source attribution models to estimate the proportion of disease that is foodborne (and differentiate the foodborne disease burden from that of waterborne and airborne diseases).
- Develop user-friendly tools for burden of foodborne disease studies and policy situation analysis at country level.

While this first area is allocated at the global level to provide global estimates, the second area focuses on foodborne disease studies at country level which will be implemented from 2011 onwards. These studies will provide first-hand burden estimates and supplement the FERG's epidemiological reviews. WHO will offer training opportunities for the countries who will implement the national foodborne disease burden studies to increase their capacity to conduct these assessments and secure sustainability.

The national foodborne disease burden studies will be complemented by policy situation analyses and other knowledge translation activities to ensure that the burden data generated by the Initiative are meaningful to end-users and that research uptake in food safety policy-making and practice will take place. It is important that with the work of the FERG, we seek to overcome

Table 1. List of parasitic and pathogenic causative agents for which burden of disease estimates are to be derived according to Task Force

Parasites	Enteric pathogen
Ancylostoma duodenale	Adenovirus
Angiostrongylus cantonensis	*Aeromonas spp.*
Angiostrongylus costaricensis	Astrovirus
Anisakis simplex	Bacterial toxins (*B. cereus*)
Ascaris lumbricoides	Bacterial toxins (*C. perfringens*)
Blastocystis hominis	Bacterial toxins (*S. aureus*)
Capillaria philippinensis	*Brucella sp.*
Clonorchis sinensis	*Campylobacter sp.*
Cryptosporidium spp.	*Clostridium botulinum*
Cyclospora spp.	Enteroaggerative *E. coli* (EAggEC)
Dicrocoelium dendriticum	Entero-pathogenic *E. coli* (EPEC)
Dientamoeba fragilis	Entero-toxigenic *E. coli* (ETEC)
Diphyllobothrium latum	Enterovirus
Echinococcus spp.	*Helicobacter pylori*
Echinostoma spp.	Hepatitis A virus
Entamoeba histolytica	Hepatitis E virus
Fasciola spp.	*Leptospira sp.*
Fasciolopsis buski	*Listeria monocytogenes*
Gastrodiscoides hominis	*Mycobacterium bovis*
Giardia intestinalis	Non cholera Vibrios
Gnathostoma spinigerum	Norovirus
Heterophyes heterophyes	Prions
Hymenolepis nana	Rotavirus
Isospora belli	*Salmonella* (non-typhoidal) *sp.*
Linguatula serata	*Salmonella* (typhoid) *sp.*
Metagonimus yokogawai	Shiga-toxin producing *E. coli* (STEC)
Nanophytes salmincola	*Shigella sp.*
Opisthorchis felineus	*Vibrio cholerae* 01/0139
Opisthorchis viverrini	*Yersinia sp.*
Paragonimus spp.	
Sarcocystis hominis	
Taenia saginata	
Taenia solium	
Toxocara spp.	
Toxoplasma gondii	
Trichinella spp.	
Trichostrongylus spp.	
Trichuris trichiura	

Adapted from WHO Initiative to Estimate the Global Burden of Foodborne Diseases, Geneva, 26–28 November 2007, p24.

the often observed research-policy gap so that the efforts of the Initiative will not remain an academic exercise, but will catalyze real change in public health policymaking and practice. The FERG Country Studies Task Force therefore also comprises a subgroup, the 'Knowledge Translation and Policy Group' which specifically aims to foster evidence-informed decision-making in food safety.

Q Which microbial diseases are referred to within this initiative as foodborne diseases?

A According to a set of predefined criteria, the FERG has developed a comprehensive list of causative agents for which foodborne disease burden estimation will take place within the scope of this WHO Initiative. The list of the enteric task force of the FERG starts with adenovirus and goes on to include *Salmonella*, *E. Coli*, *Campylobacter* and *Yersinia* [see Table 1, taken from *the 2007 report of the "WHO Initiative to Estimate the Global Burden of Foodborne Diseases First formal meeting of the Foodborne Disease Burden Epidemiology Reference Group (FERG)"*]. As you will see, the meeting report covers 29 enteric causative agents all in all.

Q I guess it's difficult to answer the question: which diseases take priority and why because this differs from country to country?

A Exactly, the country studies will cater for local needs. It is important for us that countries which participate in the burden studies identify their own research priorities. This will increase country ownership of the data and catalyze research utilization by national policy and decision-makers. On the other hand, at the global level, the FERG operates, as mentioned earlier, according to its priority list of causative agents established at the first FERG meeting in autumn 2007. The FERG used the following criteria when identifying this list:

1. Proportion of foodborne transmission.
2. Severity of illness and/or sequelae caused.
3. Frequency of illness and/or sequelae caused.
4. Global relevance.
5. Particular regional relevance.
6. Propensity to cause outbreaks (infectious causes).
7. Already existing evidence to derive disease burden estimates.

Q What has this initiative found to date?

A At the FERG stakeholder meeting in 2009 the WHO Initiative shared for the first time its preliminary data with the public. Four sets of preliminary data were reported at this meeting, related to work on diarrhoeal diseases, pork tapeworm, dog tapeworm and peanut allergies. In the area of diarrhoeal diseases, it became obvious that the current official mortality figures are largely underestimating the true burden, as they are relying on mortality rates of children under the age of five years. Examining other age groups, the study commissioned by WHO came to the conclusion that in addition over one million people over the age of five years die of diarrhoeal diseases in two WHO regions alone. For pork tapeworm (*Taenia solium*) the commissioned scientists discovered that in countries where pork is consumed and pork tapeworm is frequent, 30% of epilepsy cases may be caused by neurocyticercosis, a parasitic infection of the brain. In addition, with regard to the dog tapeworm (alveolar echinococcosis), work has shown that nearly 20,000 people are newly infected every year, most of whom die from the disease. Finally, the work of FERG has also shown that nearly four million people in Europe could have some sort of peanut allergy, with almost 200,000 suffering severe life-threatening reactions. These kinds of preliminary findings which were presented at the 2009 stakeholder meeting, have led in most cases to peer-reviewed articles which are available on our website.

Also at the stakeholder meeting in 2010, preliminary findings were made public, this time focusing on aflatoxin and foodborne trematodes. These findings still need some refinement prior to peer-reviewed publication, but they also reinforce the picture, just as the year before, that the global impact of foodborne diseases that we are currently aware of, is just the tip of the iceberg.

Q Is there a timescale for this initiative?

A We had originally foreseen that the work of FERG would be completed within five years. But new components have been added to the Initiative (e.g. the country studies and the knowledge translation work). We realize that we will need to revise the timelines to do justice to the amount of work that our expert group the FERG is being confronted with. As I said earlier, we publicly shared the first preliminary burden results at the FERG stakeholder meetings in 2009 and 2010 which have or will shortly be published in the peer-reviewed literature. This year we are going to start with the second track of the Initiative's work: the country studies. Four countries (Albania, Japan, Thailand and Uganda) were chosen for the pilot phase, after an open call for application and will be followed in 2012 by full studies in all six WHO regions.

We hope that in two to three years' time, we will have:

- A **global report and a global interactive atlas** on foodborne disease morbidity, disability and mortality.
- A number of **peer-reviewed journal series**' describing global foodborne disease morbidity, disability and mortality as well as their policy implications (with at least 50% of the publications from authors from developing countries).
- **Training modules** for countries to conduct national foodborne disease studies and policy situation analyses, as well as a number of tools to effectively bridge the gap between research and policy/ decision making through knowledge translation in food safety.

These are the outputs, but then as an outcome, we would really like to see changes from the food safety policymakers and stakeholders. We hope that they will increasingly base food safety decision making and practice on sound scientific evidence, that resources will be reallocated to foodborne disease prevention and control, and that ultimately food safety will be addressed more prominently on the public health agenda, nationally and internationally.

Lucy Harper
Communications Manager

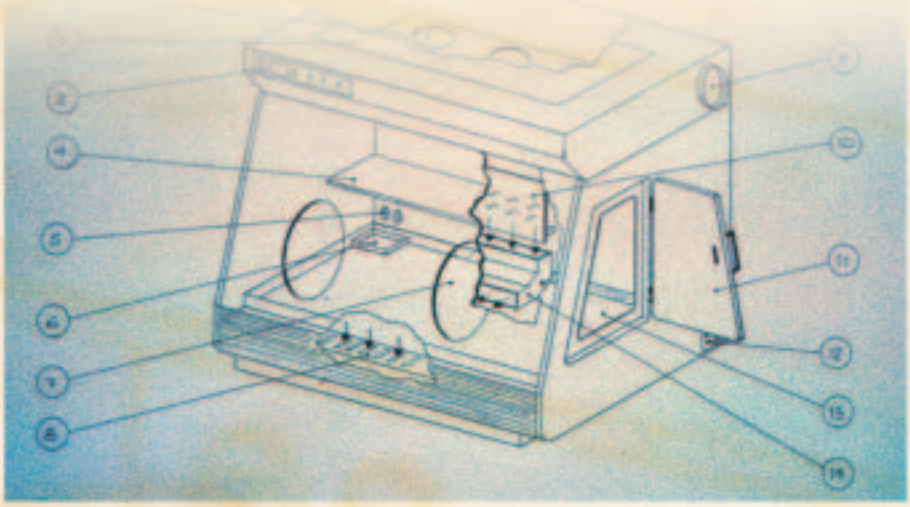


Figure 1. *Number of isolates of F. necrophorum by age for different clinical presentations. Abscess data: Prior 1994, Bacteraemia data: Brazier 2002, PSTS data: Batty and Wren 2005*

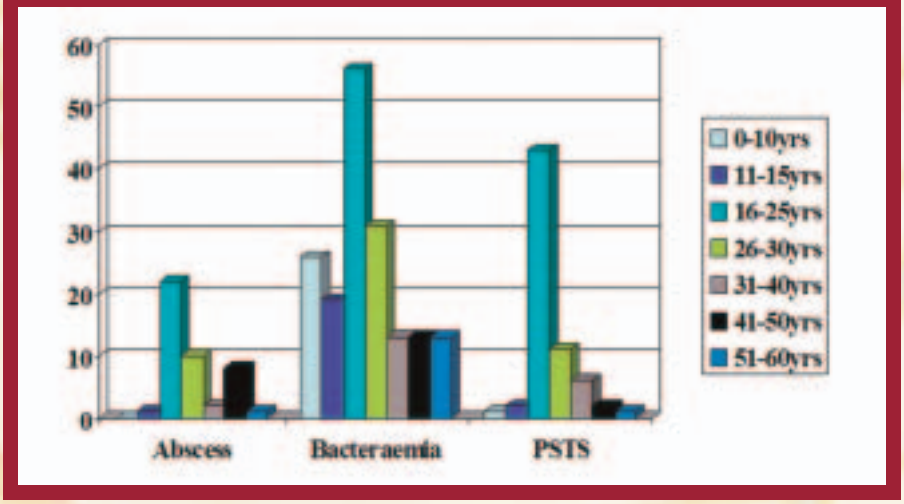


Figure 2. *Bare hand facility in an anaerobic chamber*
(Image by kind courtesy of Don Whitley Scientific Ltd)

historical**Perspectives**

Anaerobic microbiology over the last 40 years — a personal reflection

Anaerobic bacteriology is a major component of the work of a diagnostic bacteriology laboratory. Some workers have shown that anaerobic bacteria constitute approximately 60 to 70% of the flora found in polymicrobial infections. Success is very much influenced by the methodology used in the laboratory and the state and type of sample being sent for analysis. Research and innovative changes throughout this period have combined to lead to improvements in culture methods, identification methods and the recognition that certain anaerobes are associated with specific clinical syndromes. Pioneering clinical studies have revealed the significance of anaerobic bacteria in human diseases where significant morbidity and mortality still occur even in today's era of advanced medicine and therapy.

New insights into age-old diseases

Microbiologists recognize that clostridial diseases are ancient in origin, with tetanus described at the time of ancient Greece. Although tetanus, botulism and gas gangrene were common in the past, better medical care, improved food preparation and the use of immunization programmes made them rare occurrences. However, the rise of drug abuse has influenced a concurrent increase in these diseases. The occurrence of an outbreak of severe gas gangrene due to *Clostridium novyi* type A in Scotland (followed by cases in other parts of the UK) indicated the use of a drug that was likely to be contaminated with spores. Botulism, tetanus and gas gangrene due to *Clostridium histolyticum* (rarely seen in peacetime) followed in waves of infection and remain ongoing in various locations across the UK.

Old bacteria and new diseases

These are exemplified by *Clostridium difficile*, a bacterium first isolated from the faeces of neonates in 1935 and thought to be non-pathogenic. Subsequently in 1977 work carried out in both the United States of America and the United Kingdom, showed this organism to produce toxins that gave rise to an inflammatory diarrhoea and was the cause of pseudomembraneous colitis in humans who had been treated with antibiotics — a proverbial institutional "own goal". The detection of toxin was made by looking for the typical cytopathic effect as observed on a tissue-culture monolayer.

Specificity was achieved by neutralization of this effect with antitoxin. The loss of expertise (the cell lines were usually provided by the virologists who are all now almost exclusively molecular!) and the analysis time associated with tissue culture, led to the development of more rapid ELISA techniques to detect the toxin. Recent investigation has, however, shown these tests to have low specificity and positive predictive values for the diagnosis of the disease. Work to improve diagnosis is ongoing. There is now, a recently marketed sensitive commercial cell cytotoxin assay and this may encourage some laboratories to take it up again. The Department of Health in the UK has sponsored a four centre study to investigate a "best test algorithm" (using a number of different *C. difficile* targets) in the hope that it will achieve the most accurate diagnosis.

In recent years *Fusobacterium necrophorum*, an anaerobic Gram-negative bacillus associated with Lemmiere's disease in 1936, has been reported as a cause of severe, recurrent sore throat by some workers since 2005. Recent investigation using molecular methods suggests that around one in five people harbour this organism in their throat in very small numbers. However, when it is sought in sick patients it is present in very large numbers and in the absence of any other significant pathogen. Admission to hospital has been required for some patients. The age distribution of patients with Lemmiere's disease, peritonsillar abscess and recurrent sore throat syndrome (these presentations primarily involve *F. necrophorum*) is, unsurprisingly, very similar.

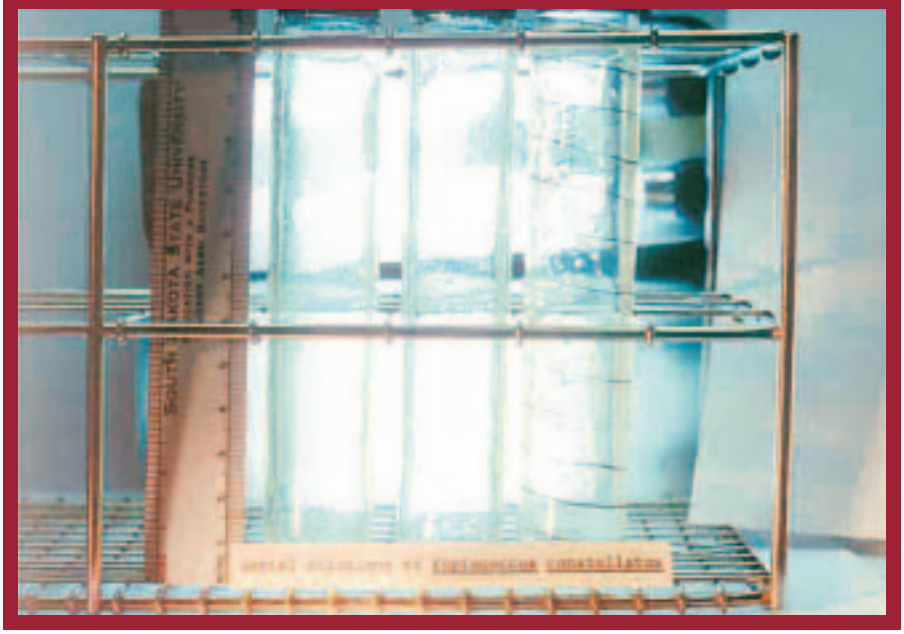
Propionibacterium acnes, classically identified as a normal resident of the skin, has also been identified in recent years as an opportunistic pathogen. The ability of the organism to produce extracellular products that allow it to stick to surfaces has carried it to the forefront of contaminated surgical hardware, tips and lines. More recent associations in the literature have included the infection of spinal discs and neurosurgical wounds, both of which can be long standing and insidious in character.

The anaerobic cocci are a well known group that, at least numerically, have clinical importance. Good anaerobic techniques reveal that approximately one third of all anaerobic isolates from human material in the diagnostic laboratory are Gram-positive anaerobic cocci. Infections where these organisms have been shown to be relevant in the last 20 years include infected sebaceous cysts, infected ulcers (especially in diabetic patients), infected prostheses, soft tissue abscesses and, less commonly, puerperal pyrexia. It is becoming clear that some species of anaerobic cocci contain surface structures that enable them to exist as biofilms enhancing their contribution to chronic infection.

Table 1. Expansion of anaerobic genera from 1970 to 2010

	Genera recognized in 1970	Genera recognized in 2010
Anaerobic cocci	Peptococcus	Peptococcus
	Peptostreptoccocus	Peptostreptoccocus
	Veillonella	Veillonella
		Finegoldia
		Gallicola
		Parvimonas
		Peptoniphilus
Gram-negative bacilli	Bacteroides	Bacteroides
	Fusobacterium	Fusobacterium
	Leptotrichia	Leptotrichia
		Prevotella
		Porphyromonas
		Sneathia
		Tannerella
Gram-positive bacilli	Clostridia	Clostridia
	Actinomyces	Actinomyces
	Propionibacterium	Propionibacterium
	Eubacterium	Eubacterium
	Bifidobacterium	Bifidobacterium
	Lactobacillus	Lactobacillus
		Slackia
		Eggerthella
		Atopobium
		Olsenella
		Filifacter
		Varibaculum
		Pseudoramibacter
		Collinsella
		Oribacterium
		Mogibacterium

Figure 3. *Hungate roll tubes*



New bacteria and new diseases

The development of good anaerobic technique has led to the discovery of new organisms associated with specific body sites or infections. *Bilophila wadsworthia*, a new anaerobic Gram-negative bacillus, has been recovered from infected appendices, infections of the biliary tract and liver abscesses. This organism is slow growing and is stimulated by the presence of bile salts. Another organism of interest is *Anaerobiospirillum succiniproducens* which has the morphology of an "elongated campylobacter". Causing diarrhoea in puppies, it has been found in the blood of immunocompromised patients who may or may not have diarrhoea at the time.

What has happened in the laboratory within the last 40 years?

Culture work in the 1960s relied on the use of anaerobic jars, from which the air was evacuated and replaced with a gas mixture containing hydrogen and carbon dioxide. Residual oxygen was removed through the use of a catalyst, which enabled the air to react with hydrogen contained in the gas mixture in the jar, to form water. Redox indicators such as methylene blue were used as chemical indicators to show that full anaerobiosis had been achieved. However these old jars were very much prone to leakage.

The use of water-generated sachets were the first helpful development, gas cylinders were not required and the sachet released the requisite amounts of hydrogen and carbon dioxide into a clear polycarbonate jar. Methylene blue on paper strips could be used as the indicator.

A final development on the sachet theme was the introduction of sachets that remove air from the jar and release carbon dioxide. These sachets do not require the use of a catalyst nor do they release hydrogen, bringing advantages from a safety point of view. Methylene blue was subsequently replaced by resazurin, a more sensitive indicator of anaerobiosis that becomes colourless at a lower redox potential. Automated evacuation and replacement systems for the more standardized use of jars are now available.

Normal flora studies were carried out using a 1950s invention, the Hungate Roll tube (see Figure 3). These used

Table 2. Anaerobic blood culture isolates by decade

Decade	% of positive blood cultures yielding clinically significant anaerobes
1960s	12
1970s	11.5
1980s	9
1990s	8
2000s	6.5

pre-reduced anaerobically sterilized (PRAS) media which was "spun" and allowed to set onto the inside of a glass tube. Colonies were examined and picked whilst the tube was being flushed with oxygen-free gas. As can be appreciated, this was an excellent method, however, the media was difficult to make up (every stage being performed under oxygen-free conditions) and the whole method was labour-intensive requiring specialized apparatus.

Anaerobic chambers provided the answer for those laboratories with large clinical workloads. Essentially large constructions (flexible "tents" or rigid boxes) running at 37°C and containing anaerobic gas mixtures drawn from cylinders, these chambers allowed large numbers of cultures to be examined under anaerobic conditions without removal from the atmosphere. Many large diagnostic laboratories now use chambers in preference to large numbers of anaerobic jars (see Figure 2).

The use of selective media based on the inclusion of aminoglycoside antibiotics such as neomycin (to which, theoretically, anaerobes are resistant) enabled easier recovery of anaerobes from polymicrobial mixtures. Improvements in the types of media available were mainly achieved in the 1980s and relied on the inclusion of nalidixic acid. Experimentation followed by studies using clinical samples, showed the advantage of nalidixic acid media especially for the non-sporing anaerobes. It soon became obvious that using one medium for clinical anaerobic work was insufficient and that at least two media were required to recover all the anaerobes likely to be present in a sample. The development of fastidious anaerobe agar (FAA) enabled the more luxurious growth of the more exacting anaerobes (e.g. the fusobacteria) and is now the basal medium of choice for clinical diagnostic work.

The work of Lilian Holdeman and Ed Moore at the VPI Anaerobe Laboratory using Gas-Liquid Chromatography (GLC) to analyze the acid products of glucose metabolism showed this method to be useful in the identification of the various anaerobic genera. An innovative use of this method reported from the UK, revealed it to be helpful in the rapid diagnosis of anaerobic infection by analyzing the pus sample from a patient for the acidic products produced by the anaerobes. GLC and biochemical tests were combined to identify anaerobic bacteria to species level but many laboratories found this to be beyond their capabilities or their budgets! Commercial identification kits were developed to meet this need and have gone through a number of generations. However, the expansion of the number of anaerobic genera and species due to molecular and DNA studies, has left the databases used for these kits woefully inadequate.

The future of anaerobic microbiology in the laboratory

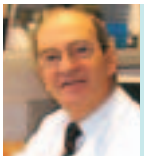
The future holds significant changes in the field of anaerobic bacteriology. The use of molecular based identification including DNA and RNA studies and the use of MALDI-TOF analysis will undoubtedly give rise to more new species. The maintenance of good technique will be ever more important to assess the relevance of these newly discovered species in clinical infection.

Awareness of anaerobic microbes commonly found in the normal flora will be essential in the future since these species are increasing as significant isolates in the blood cultures of immunocompromised patients (*F. nucleatum* and *Leptotrichia* species in leukaemia patients undergoing chemotherapy are two important examples).

Other areas where development is needed include the development of a reliable method of sensitivity testing of clinical isolates and the continual need to look for anaerobic bacteria in rare clinical presentations of infection. Despite our best efforts, morbidity and mortality of anaerobic infections is still significantly high, indeed the percentage of positive blood cultures yielding significant anaerobic isolates has only halved in 40 years.

suggested further reading

- Wadsworth, K.T.L. *Anaerobic Bacteriology Manual*. 2002. Star Publishing Co. Belmont, Ca. Anaerobe Laboratory Manual. 4th Ed 1977. VPI Institute, Blacksburg, Va. USA
- *Clostridium difficile*: Its role in intestinal disease. 1988. Academic press.
- *Clostridium difficile*. *Clinical Infectious Diseases*. 2008. Supplement 1.
- Riordan, T. Human infection with *Fusobacterium necrophorum* (Necrobacillosis) with a focus on Lemmiere's syndrome. 2007. *Clin. Micro. Rev*. **Vol. 20**: pp622-659.
- Levy, P., *et al*. *Finegoldia magna*: A forgotten Pathogen in Prosthetic Joint Infection Rediscovered by Molecular Biology. 2009. *Clin. Inf. Dis*. **Vol. 49**: pp1244-1247.
- Lutz,M.F., *et al*., 2005. Arthroplastic and osteosynthetic infections due to *Propionibacterium acnes*: a retrospective study of 52 cases, 1995-2002. *Eur. J. Clin. Micro. Inf. Dis*. **Vol. 24**: pp739-744.
- Baron, E.J. *Bilophila wadsworthia*: a unique Gram-negative anaerobic rod. 1997. *Anaerobe*. **Vol. 3**: pp83-86.
- Tee, W. Three cases of *Anaerobiospirillum succiniproducens* bacteraemia confirmed by 16S rRNA gene sequencing. 1998. *J. Clin. Micro*. **Vol. 36**: pp1209-1213.
- Wren, M.W.D. The Gram-Positive Anaerobic Cocci. In: Topley and Wilson's Microbiology and Microbial Infections. *10th Ed*. Arnold, London. 2005.
- Eribe E.R.K., *et al*. *Leptotrichia species* in human infection. 2008. *Anaerobe* **Vol**. **14**: pp131-137.



M.W.D Wren, MBE
Consultant Biomedical Scientist, HPA Collaborating Centre, UCL Hospitals, London

StatNote 25

In StatNote 24 (Hilton & Armstrong, 2011), multiple linear regression was described as a method of studying the relationship between a dependent variable (*Y*) and two or more independent (*X*) variables. A major objective of such an analysis was to identify the most important *X* variables that influence *Y* and to rank the *X* variables in order of importance. There is usually no unique or satisfactory solution to this problem. One method would be to use the sizes of the 'standard partial regression coefficients', calculated routinely in multiple regression, as a measure of the relative importance. Hence, the standard partial regression coefficient of the regression coefficient b1 is $b_1\sqrt{(\Sigma x_1^2/\Sigma y^2)}$. Any ranking of the *X* variables by this method, however, may be affected by correlations between the variables themselves. Multiple regression analysis assumes that the *X* variables are relatively independent of each other, a situation rare in practice. In addition, the contribution of a specific *X* variable to the total variation in *Y* is frequently greater when that variable is considered alone than when it is included with other variables in a multiple regression equation. For example, three different length measurements (X_1, X_2, X_3) are likely to be strongly inter-correlated and each may correlate significantly with weight (*Y*). If one of the *X* variables (say X_1) is entered into a regression equation, however, addition of the other two (X_2 or X_3) is not likely to improve the predictive power of the regression very much.

A second problem is if there are a large number of *X* variables included in the regression, the regression coefficients will change with each grouping of the variables. Furthermore, if the multiple correlation coefficient (R^2), which measures the overall significance of the multiple regression, is small, most of the variation in *Y* may remain unexplained and could be attributable to random error or to variables not included in the study. Inclusion of additional variables will also change the relationships between the existing *X* variables and their regression coefficients. An investigator may also wish to select a small subset of the *X* variables which give the best prediction of the *Y* variable. In this case, the question is how many variables should the regression equation include? One method would be to calculate the regression of *Y* on every subset of the *X* variables and choose the subset that gives the smallest mean square deviation from the regression. Most investigators, however, prefer to use a 'stepwise multiple regression' procedure. There are two forms of this analysis called the 'step-up' (or 'forward') method and the 'step-down' (or 'backward') method. This StatNote illustrates the use of stepwise multiple regression with reference to the scenario introduced in StatNote 24, *viz.*, the influence of climatic variables on the growth of the crustose lichen *Rhizocarpon geographicum* (L.)DC.

Scenario

We return to the scenario described in StatNote 24. The radial growth rate (RGR) of thalli of the crustose lichen *R. geographicum* was measured in 17 successive three-month periods over 51 months in north Wales (Armstrong & Smith, 1987). Radial growth was measured at between eight and ten randomly chosen locations around each lichen thallus at three-month intervals from April 1993 to June 1997 using the method described by Armstrong (1973). Essentially, the advance of the marginal fungal hypothallus, using a micrometer scale, was measured in relation to fixed markers on the substratum. Radial growth in each period was averaged for each thallus and then over the 20 thalli to examine the pattern of seasonal growth. Climatic data included records of: (1) total rainfall over each three-month period, (2) the total number of rain days, (3) maximum (Tmax) and minimum (Tmin) temperature recorded on each day and averaged for each three-month period, (4) the total number of air and ground frosts, (5) the total number of sunshine hours, and (6) average daily wind speed. Hence, the data comprise for each three-month period, a single dependent (*Y*) variable, *viz.*, radial growth of the lichen and eight possible defining climatic (*X*) variables and are presented in Table 1.

How is the analysis carried out?

Analysis by the 'step-up' method

In the 'step-up' method, variables are entered into the multiple regression equation one at a time. At each stage, introduction of a new variable can be tested to determine whether its effect is statistically significant, usually by an 'F' test, or by examining whether there is a significant change in 'R^2'. With reference to the 'F' tests, two criteria are frequently used. First, 'F to enter' sets an 'F' value which has to be exceeded before a variable will be added into the equation. Second, 'F to remove' sets a value that after adding a new variable, a variable previously entered should be removed. If alteration in 'R^2' is used as the test criterion, there should be a change of at least a few percentage points before a new variable is included in the equation. The analysis continues until the next variable has an 'F to enter' which fails to achieve significance.

In practice, the computer software calculates first the regression of *Y* on each *X* individually. The *X* variable giving the largest reduction in the sums of squares (SS) of deviations or the largest 'F to enter' is selected as the first variable (step 1) (X_1). Second, all the possible bivariate regressions of the remaining variables with X_1 are calculated and the variable giving the greatest additional reduction in the SS of deviation is selected as X_2 (step 2).The process is repeated with the remaining *X* variables until a non-significant reduction in the SS is achieved and the analysis is then terminated.

Interpretation

The analysis of the *R. geographicum* growth data using the 'step-up' method is shown in Table 2. These results essentially confirm those of the original multiple regression analysis described in StatNote 24. Mean maximum temperature is the first variable selected ($R^2 = 0.57$) and therefore appears to have the most important positive influence on lichen growth and, when expressed as a percentage, accounts for 57% of the variance in growth. The second variable selected is the total number of sunshine hours during the growth period which has a negative influence on growth ($R^2 = 0.15$) and accounts for an additional 15% of the variance in growth, the two variables together accounting for 72 % of the total variance. The other variables were not included in the regression having failed to meet the 'F to enter' criterion. Hence, we would conclude that the radial growth of *R. geographicum* is most strongly related

In the twenty-fifth of a series of articles about statistics for biologists, **Anthony Hilton** & **Richard Armstrong** discuss:

Stepwise multiple regression

Table 1. Radial growth rate (RGR) (*Y*) of the lichen *Rhizocarpon geographicum* in 17 successive three-month periods in north Wales, UK in relation to eight measured climatic variables (*X*)

	Independent (X) variables							
RGR Y	***Tmax* (°C)**	***Air frosts***	***Rain days***	***Rainfall (mm)***	***Tmin* (°C)**	***Ground frosts***	***Sunshine hours***	***Wind speed (ms⁻¹)***
0.04	7.6	8	59	207.7	6.2	16	609.0	8.6
0.58	20.1	0	38	306.0	11.6	0	237.3	8.1
0.15	10.6	3	47	317.7	5.5	33	181.9	10.7
0.18	11.6	17	51	194.5	1.9	49	171.6	11.8
0.07	8.3	8	24	97.8	6.1	33	619.0	8.1
0.37	19.6	0	41	287.4	11.4	1	287.4	8.7
0.33	19.4	3	68	457.7	6.0	25	186.9	9.3
0.17	6.8	43	44	175.8	0.26	57	276.8	8.7
0.10	13.9	2	48	295.6	6.9	19	488.5	10
0.29	17.9	0	63	328.0	12.0	0	318.4	10
0.16	10.6	17	52	318.8	4.2	41	200.6	8.7
0.35	19.8	34	49	233.4	0.87	52	217.4	8.4
0.18	14.5	2	48	197.8	7.0	16	521.2	8.5
0.14	18.0	0	42	231.1	11.3	3	495.5	7.5
0.22	10.9	13	57	463.9	5.0	26	223.0	8.6
0.20	8.9	8	72	349.8	4.0	17	199.2	12.4
0.34	17.9	2	31	140.3	7.2	20	220.3	6.7

Tmax = maximum temperature, *Tmin* = minimum temperature

to mean maximum temperature, more weakly related to total sunshine hours, and not related to variations in rainfall or to the other variables measured.

Analysis by the 'step-down' method

In the 'step-down' method, which is less commonly used, the multiple regression of *Y* on all the *X* variables is calculated first. The contribution of each *X* to a reduction in the SS of the *Y* values is then computed and the variable giving the smallest reduction eliminated provided that the 'F' value falls below a predetermined value. This variable is then excluded and the process repeated until no variable not yet excluded gives an 'F' value below the predetermined boundary. This analysis applied to the present data selected exactly the same variables as the 'step-up' method, *viz*. radial growth was most strongly related to mean maximum temperature and more weakly related to total sunshine hours.

Conclusions

Stepwise multiple regression techniques are useful in identifying the major variables influencing the dependent variable *Y* and in ranking them in order of importance. The 'step-up' and 'step-down' methods may not necessarily select the same variables for inclusion in the regression and these differences are magnified when the *X* variables are themselves inter-correlated. The 'step-up' method is the most frequently used and is relevant when a study wishes to define the variables that influence *Y* more rigorously and to exclude variables that make relatively small contributions to the regression. The 'step-down' method may retain more variables, some of which may make small contributions to the regression, but by retaining them, a better prediction may result. Investigators should also note the high probability of making a 'Type-1' error when carrying out stepwise multiple regression, i.e., claiming a significant effect when one is not present.

Hence, if there were 20 *X* variables included in a study and none of them actually influenced *Y*, the probability of achieving at least one significant 'F to enter' would be $1-(1-0.05)^{20}$, i.e. 0.642, greater than a 50% chance!

Table 2. Stepwise multiple regression of the lichen growth data in Table 1 by the 'step-up' method

Variable selected	***Step***	***R***	***R²***	***R² change***	***F to enter/remove***
Mean *Tmax*	1	0.76	0.57	0.57	20.17
Sunshine hours	2	0.85	0.72	0.15	7.72

Tmax = Maximum temperature, *R* = Multiple correlation coefficient, *F* = Variance ratio

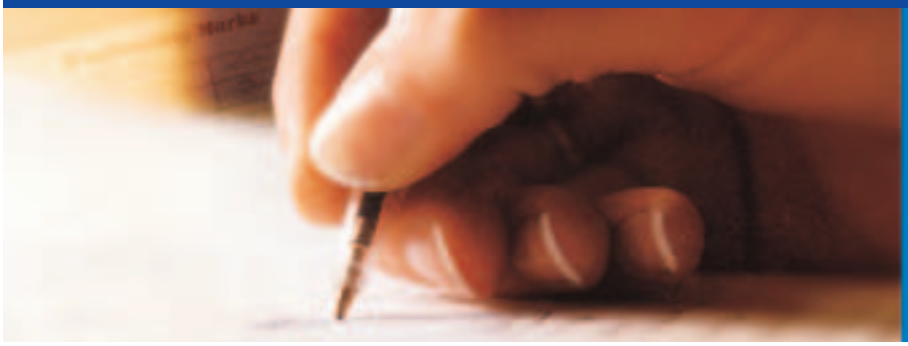
references

- Armstrong, R. A. (1973) Seasonal growth and growth rate colony size relationships in six species of saxicolous lichens. *New Phytologist* **Vol. 72**, pp1023-1030.
- Armstrong, R. A. and Smith, S. N. (1987) Development and growth of the lichen *Rhizocarpon geographicum*. *Symbiosis* **Vol. 3**, pp287-300.
- Hilton, A. and Armstrong, R. A. (2011) StatNote 24: Multiple linear regression. *Microbiologist* March, **Vol. 12**, No. 1 pp40-43.

Dr Anthony Hilton[1] and Dr Richard Armstrong[2]

[1]Biology & Biomedical Sciences and [2]Vision Sciences, Aston University, Birmingham, UK

careers



Science Journal Editing

Ed Elloway tells us about his career in Journal Editing leading to his current position as Production Editor for a publishing house

I have been an Editor for almost nine years, and it's a very rewarding job. No two days are the same (usually)! I knew from midway through my PhD that, although I was still very interested in science, research and lab work were not for me. At around the same time, I realized that my interest in language was a good pointer as to what I could be doing career-wise. For some practice, I volunteered to help some of my friends in the lab with proofreading their theses. It was in doing this that I decided that this was definitely the direction I wished to follow in my career once I had completed my PhD.

I was confident in my abilities (or at least I believed I could acquire the necessary skills) and I'd always been interested in aspects of language, although I hadn't studied any since GCSE level. I've always been rather pedantic (which I know can be annoying!), so I thought this career would be ideal for me, but I had received no formal training. Could I convince any potential employer that this was my ideal career? I spent a few months applying for all the editing and proofreading jobs that I could find (in both science and other fields), but to little response. A few companies sent tests which I completed and returned and one of these companies interviewed me, but that was the only response I received. I decided that it was clearly experience I was lacking, although this was a Catch-22, as how could I get experience without having a relevant job? Helping to read friends' theses is good experience, but there's no measurable standard and it doesn't come with a certificate.

However, I did some online research and decided that the Publishing Training Centre, widely recognized as the foremost professional training body for the publishing industry, might help me to find a route in. I investigated what they could offer and learned that they offered distance-learning courses in proofreading and copyediting, which I thought would be a good place to start. Both courses are still offered, no doubt updated to reflect current practices, as well as others, both by distance-learning and in-house (at Book House in Wandsworth, south London). The course offered two main benefits to me: first, some all-important experience, and, secondly, demonstration that I was serious about this as a career path.

Ironically, soon after commencing the proofreading course, I was offered a position by the company who had interviewed me six months previously. I had no hesitation in accepting and the fact that they were based in London added to the appeal. But despite starting the new job, I completed the distance-learning course and found it very helpful. Proofreading was just one aspect of my job, but it was a good grounding and a useful way to learn the proofreading symbols that I would be using regularly. As it was a distance-learning course, it could be done (within reason) at one's own pace and I would recommend it, even if a career in editing has already been embarked upon.

Types of editor

Almost nine years later, I'm still with the same company, though my job has changed in that time, through the addition of new skills, rather than changing position. I started off as an Editorial Assistant, which reflected the fact that I didn't have much experience and was undergoing training (generally considered to take two years) before becoming Staff Editor. In essence, there was little difference between these two jobs, despite the job titles, and my job mostly involved copyediting, proofreading, proof collation, checking revised proofs and peer-review. Other companies use different job titles (desk editor, editor, journal editor and so forth) and often don't do as wide a variety of tasks. Many jobs consist of copyediting and proofreading, without any peer-review element. There are also different jobs with vaguely similar names, such as commissioning editors, who actively commission articles from authors, rather than waiting for submissions, and acquisitions editors, who find titles (journals and/or books) to publish, whether brand new or already in existence with other publishers. Other editing jobs might also incorporate some aspect of writing, although mine doesn't and I'm quite happy with that, much preferring to work on others' work than create my own.

What my job entails

I enjoy the variety my job affords, although the peer-review elements of Staff Editor (essentially selecting reviewers for particular papers and processing reports) weren't as appealing to me as the other parts of the job, and as a consequence of mentioning this in appraisals, I gradually did less and less peer-review. All of our copyediting is done on screen, but all of the proofreading is done on paper. It is certainly easier to pick up errors on paper, although easier to correct them on screen and this combination results in a polished paper.

As with all publishers, we use a Style Guide, which specifies how certain aspects should appear in our articles. This includes such things as spelling,

using British English, which, contrary to popular belief, means -ize endings (as this reflects a Greek origin, rather than being an Americanism), as well as the more familiar haem (rather than heme), colour (rather than color) and so on. The Style Guide also specifies the format of references, how abbreviations are treated, the presentation of key words, the use of footnotes, how appendices appear (although these are rather rare) and so on. The Style Guide also defines hundreds of abbreviations and whether or not these are considered or not standard (such as ATP or DNA) and hence do not need to be defined. The document is quite daunting for those new to the job, but much of it is picked up quickly by the conscientious!

Part of my job is to keep the Style Guide updated. This is a document that evolves as style (particularly scientific conventions) changes, such as the recommendation not to italicize restriction endonuclease names. If this all sounds rather dull, perhaps editing and proofreading is not the best option for a career!

It's important to bear in mind that editing is not meant to be rewriting. Although articles are put into a house editorial style, it is important to maintain an author's own writing style. The best editing is a bit like housework: it's not noticed when it's done properly, but certainly is noticed when it isn't!

Proof collation involves combining the corrections from the authors and the proofreader (although not all publishers use their own proofreaders) on a new proof, according to whether the correction marked is necessary or not. Authors, for example, often mark corrections that are not made as they are contrary to house style. Often other corrections are things that might be ideal, but aren't strictly essential and are too numerous to worry about, since typesetters can charge more for making extensive corrections. Once collated, the proof is sent back to the typesetter and then a final revised proof is sent in order to check that all corrections have been made satisfactorily. Once these are approved, the issue is printed or, for web-only publications, electronic files are produced for publication online.

Changes and the future

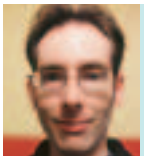
Over the time I have been in the job, there have been several changes, such as increased use of electronic procedures, for example using electronic figures, rather than hard copies. There is concern in the publishing industry that, ultimately, there will be a move to all-electronic publishing, with no print at all. This increased use of electronic facilities is something to be aware of if you are considering an editorial role. We use external typesetters, but some publishers do their own typesetting and make their own proof corrections directly on-screen. Other changes that have taken place mean that many procedures of today are likely to be unrecognizable to an editor from a decade or so ago. I've heard tales of peer-review databases that involved putting knitting needles through holes in cards to select reviewers, before the advent of computer databases, and I remember using two different colour pens to define whether an error on a proof was a typesetting error or an author or copyediting error, although we stopped doing this years ago.

After a few years, I was put in charge of one of the journals, and my job title changed to Executive Editor. This new position involved all of the previous tasks, plus some aspects of production, such as assembling ('closing') issues and making sure an issue was put together on time. This added responsibility was welcome and added further variety to my job. Some time after this, I was given yet more responsibility, when I added Production Editor to my job title. This included more production duties, with closing issues of different journals (mainly our flagship journal) from our portfolio and liaising with external suppliers. And that brings us to date.

A typical day

In many ways, there is no such thing as a typical day, as, with such a repertoire of tasks, I could be doing any one or all of them on any particular day. That said, I normally edit at least part of an article and proofread an article every day, as there is normally a pile of articles that require attention in either aspect. Other duties are more dependent on the publication schedule and the frequency of the journal. Our flagship journal is published twice each month, so consequently, there are revised proofs to be checked twice a month. Closing the issue is a task shared between myself and my colleague, who is Head of Production. This involves taking all of the papers that have been collated and putting them in a particular order which is based on where the colour figures fall in the signatures (have a look from above at a typical hardback (case-bound) book, and you can see that it is made up of separate sections; these sections are called 'signatures', and normally comprise 16 pages). For another journal for which I am responsible, I don't need to consider this, as the papers are incorporated in a predefined order. However it is done, this stage normally occurs after proof collation and before revised proofs.

If you are considering a job in publishing, it is worth finding out exactly what roles the job might entail, since, as I mentioned above, these do vary between publishers. Downsides of the job include dealing with argumentative authors who don't like their papers being altered (thankfully, these are rare and most appreciate the job you do), chasing authors for articles they promised to deliver or for their proof corrections and generally busy periods approaching publishing deadlines which can be a bit hectic. But, for all that, it's generally very rewarding. It's also worth noting that it's probably not a job from which one will make one's fortune, and salaries can vary fairly considerably between publishers, but that's not why I do it! As for qualifications, there are few actual publishing-specific qualifications that can be gained, but the Publishing Training Centre (http://www.train4publishing.co.uk/) and the Association of Learned and Professional Society Publishers (http://www.alpsp.org/ngen_public/) are good places for information and guidance. My particular company required a qualification at PhD level, but not all do. It's a very rewarding job and I can't think of any other job I'd rather be doing. To find out if this is a job for you, a simple test would be to read any piece of text and if errors jump out at you and you have the urge to fix them, then it may well be worth considering this as a career. Good luck!



Ed Elloway

In the loop pecs

News from the SfAM Postgraduate and Early Career Scientist Committee

PECS Events at the

Clontarf Castle, Dublin, Ireland, 4-7 July 2011

This year the Summer Conference will be held at Clontarf Castle in Dublin — a great location and venue, we're sure to have a good time with the exciting lectures and SfAM activities during the week.

The student icebreaker session on the Monday is going to be a fun opportunity for everyone to get to know each other with a similar theme to last year. This will take place at the Guinness Storehouse after the buffet and drinks reception, so prepare to be dragged along by one of us! This was a good opportunity last year for PECS members to meet each other and formed a valuable networking opportunity for many. We hope as many Student Members as possible come to this session at the beginning of the week as an introduction to the student events and a way to get to know the PECS Committee and other Student Members.

On the Tuesday, following the afternoon talk by Alec Kyriakides on 'Food Safety – the retailer's perspective', we will be holding a student session. We decided that it would be a great idea to give this session the topic: "Enhance YOUR employability". This session is for all PECS and Student Members and will consist of several short talks to discuss the skills needed to enhance your employability. We have gathered a number of people to talk about these different skills and what you can do to improve them.

SfAM Honorary General Secretary, Dr Mark Fielder will explain what stops a 'good' presentation from becoming a 'bad' one. SfAM Communications Officer, Clare Doggett will talk about interview skills, followed by SfAM Communications Manager, Dr Lucy Harper talking about how we can all increase our communication skills and its importance in employability. A discussion about enhancing your CV will end the series of talks by a final speaker (TBA).

We feel this session will be beneficial for most students and early career scientists who are not aware of the range of skills needed, and how to improve them, when looking for employment. This will be an informal session, giving you the chance to ask questions etc. We hope that by the end of these talks you'll

PECS NEWS

With the Summer Conference rapidly approaching the PECS team thought this would be a good opportunity to help members reconnect with each other through our Facebook discussion page. To facilitate this we have started a new discussion group to talk about past and present conferences and would encourage you all to get involved and get writing!
http://www.facebook.com/#!/pages/SfAM/94913188313

Phillip Humphryes
PECS Communications Officer

Summer Conference

be able to 'sell yourself' with your CV, wow them at an interview and amaze them with a fault free presentation. You will also learn how to improve your communication skills to set yourselves apart.

After the student session, buffet and trade show, we will be teaming everyone up for the annual S*f*AM Quiz!

On Wednesday, when the S*f*AM AGM will be taking place, we will be holding our own annual all member PECS meeting, so if you have an idea of something you want us to do for you, please come along and let us know.

If you're planning on joining us in Dublin it would be nice to speak to you via the Facebook PECS discussion boards beforehand (located on the S*f*AM Facebook fan page). This way you'll be able to know who we are and which other members are going.

Hope to speak to you all soon and see you there!

PECS Events at the Summer Conference

Monday 4 July

21.00	**Icebreaker Session** Let's get everyone talking with this fun ice breaker!
(Time TBA)	**Fish and chips on the pier**
21.30	**Quiz Night**

Tuesday 5 July

17.10-18.10	**Student Session "Enhance YOUR employability"** A variety of speakers talk about enhancing your skills.

Wednesday 6 July

16.45-17.15	**PECS Annual Meeting** **If you have an idea for PECS please get involved and join us**
20.30	**Quiz**

Samantha Price
PECS Events Team
De Montfort University

Joanna Griffin
PECS Events Team
De Montfort University

Emmanuel Adukwu
PECS Events Team
University of Northampton

Students into Work Grant reports

am I eligible — can I apply?

Yes — if you are FULL Member who can offer an undergraduate microbiology student the chance to obtain work experience. If you would like to read about the experiences of students who have benefited from this grant, you can do so below.

For further information visit: **www.sfam.org.uk/grants.php**

Isolation and characterization of the periplasmic sensory domain of the Tlp3 chemoreceptor of *Campylobacter jejuni* 11168

***Campylobacter jejuni* from the** thermophilic group of *Campylobacter* is capable of causing human infections, although it is part of the normal microbiota of most birds and mammals. The zoonotic transmission of *C. jejuni* from birds and mammals to humans often leads to gastroenteritis (Frost, *et al.*, 1987; Allos 2001) and it is now the most frequently diagnosed bacterial cause of human gastroenteritis worldwide, accounting for over 70% of all enteric infection by bacteria (Ketley 1995; Dingle, *et al.*, 2002). Approximately 10% of the population of the world is affected by *C. jejuni* and of that number, only 1% of the cases are documented and reported. Studies have shown that up to 80% of poultry sold for human consumption is found to be contaminated with *Campylobacter* and the numbers can exceed 10^3 per 100g (Goossens, *et al.*, 1995; Altekruse, *et al.*, 1999), whereas only 500 cells are capable of causing disease symptoms (Black, *et al.*, 1988; Skirrow & Blaser, 1992).

Specific virulence factors are known to contribute to the overall pathogenicity of *C. jejuni*. These virulence factors include adhesins, fimbrin, flagella, mediators of chemotaxis and lipooligosaccharide (LOS) (Ketley, 1997). However, the mechanisms of *C. jejuni* that play a role in pathogenesis and the host's response to the infection are not well understood (Goossens *et al.*, 1995; Chang & Miller, 2006). Cellular motility and chemotaxis have been implicated in the virulence of pathogenic bacteria and have a proven role in the invasion and colonization of the host intestinal tract (Josenhans & Suerbaum, 2002).

Analysis of the published genome sequence of *C. jejuni* 11168 implies that the components of the chemotaxis pathway are similar to other bacteria such as *E. coli* (Parkhill *et al.*, 2000; Szurmant & Ordal, 2004). Sequencing of the *C. jejuni* NCTC 11168 genome and comparative genome sequence analysis revealed a number of genes involved in chemotaxis, including 10 genes coding for 10 putative chemoreceptors termed Transducer Like Protein (Tlp) receptors. These Tlp receptors are classified into several groups according to their structural similarities (Parkhill, *et al.*, 2000; Marchant, *et al.*, 2002). Group A containing receptors Tlp1, Tlp2, Tlp3, Tlp4, Tlp7 and Tlp10 have a similar structure to methyl-accepting chemotaxis proteins (MCP) of *E. coli*. The group A receptors have three distinctive regions: a periplasmic domain, a transmembrane domain and a cytoplasmic domain. The highly variable periplasmic (chemosensory) domains of group A Tlp receptors are thought to be responsible for sensing chemical gradients in the external environment, which is followed by the initiation of a signal transduction cascade allowing the bacterial cells to relocate themselves to the favourable environment. To date only a selected number of specific ligand binding associations have been carried out for specific Tlp receptors.

This project focused on isolating and characterizing the chemosensory domain of the Tlp3 chemoreceptor ($Tlp3^{peri}$) with regard to biological function and ligand binding specificity.

The DNA sequence of $Tlp3^{peri}$ was amplified by PCR from *C. jejuni* 11168 using specifically designed primers. *Nde*I and *Xho*I restriction sites were incorporated into the primer termini for further cloning procedures. The amplified 744 bp $Tlp3^{peri}$ PCR product was ligated into the intermediate cloning vector pGEM-T Easy (Promega) using standard molecular cloning techniques. The plasmid constructs were transformed into competent *E. coli* DH5α cells and screened using Luria Broth agar plates supplemented with ampicillin, IPTG (isopropyl-β-D-thiogalactopyranoside) and X-Gal (5-bromo-4-chloro-3-indolyl-β-D-galactopyranoside). Recombinants were selected using blue/white colony selection and the integrity of the $Tlp3^{peri}$ insert was verified using specific restriction enzyme digest analysis and DNA sequencing.

In order to express the $Tlp3^{peri}$ protein, the $Tlp3^{peri}$ DNA fragment was excised from the pGEM-T Easy cloning vector into the pET-19b expression vector. The pET-19b expression vector contained a polyhistidine tag, an ampicillin resistance gene marker and an IPTG inducible T7 RNA polymerase promoter which enabled the over expression of the targeted 6xHis-fusion protein. The recombinant plasmid construct was transformed into *E. coli* BL21 (DE3) for protein expression.

The expression and the solubility of the 35 kDa $Tlp3^{peri}$ His fusion protein were induced by IPTG followed by Western blot analysis and detection using anti-His antibodies. In order to identify $Tlp3^{peri}$ protein-ligand associations, a sufficient amount of $Tlp3^{peri}$ protein was extracted following large scale protein expression and

protein purification using His-Select resin.

The purified Tlp3^{peri} protein was hybridized with various glycans as well as 18 of the 20 amino acids. The Tlp3^{peri} protein did not bind to any of the glycans present on the slide however it had a significant binding affinity to the amino acid isoleucine.

The role of the Tlp3 protein as a chemoreceptor for isoleucine needs to be further verified using *C. jejuni* 11168 Tlp3^{peri} mutants. The role of Tlp3 chemoreceptor in chemotaxis can potentially provide an insight into the mechanism of colonization in animals and disease production in humans allowing for developments of new drugs targeting specific biological pathways. Due to time restrictions *C. jejuni* 11168 Tlp3^{peri} mutant studies are yet to be carried out.

References

- Allos, B.(2001) *Campylobacter jejuni* Infections: Update on Emerging Issues and Trends. *Clinical Infectious Diseases*, **Vol 32**(8), pp1201-1206.
- Altekruse, S., Stern,N., Fields, P. and Swerdlow D. (1999) *Campylobacter jejuni* an emerging foodborne pathogen. *Emerging Infectious Diseases*, **Vol 5**, pp28-35.
- Black, R.E., Levine, M.M., Clements, M.L., Hughes, T.P. and Blaser, M.J. (1988) Experimental *Campylobacter jejuni* infection in Humans. *Journal of Infectious Disease* 157, **Vol 157** (3), pp472-479.
- Chang, C, and Miller, J.(2006) *Campylobacter jejuni* Colonization of Mice with Limited Enteric Flora. *Infection and Immunity*, **Vol 74** (9), pp5261-5271.
- Dingle, R.E., Colles, F., Ure, R., Wagenaar, J. and Duim, B. (2002) Molecular characterization of *Campylobacter jejuni* clones: a basis for epidemiologic investigation. *Emerging Infectious Diseases*, **Vol 8**, pp 949-955.
- Frost, J., Loo, S., Cordeiro, M. and Li, D. (1987) Radical-based dephosphorylation and organophosphonate biodegradation. *Journal of the American Chemical Society*, **Vol 109**, pp2166-2171.
- Goossens, H, Giesendorf,B., Vandamme,P. and Vlaes, L. (1995) Investigation of an outbreak of *Campylobacter upsaliensis* in day care centers in Brussels: Analysis of relationships among isolates by phenotypes and genotypic typing methods. *Journal of Infectious Diseases*, **Vol 172** (5), pp1298-1305.
- Josenhans, C. and Suerbaum, S. (2002) The role of motility as a virulence factor in bacteria. *International Journal of Medical Microbiology*, **Vol 291**, pp605-614.
- Ketley, J. (1995) Virulence of *Campylobacter* species: a molecular genetic approach. *Journal of Medical Microbiology*, **Vol 42**, pp312-327.
- Ketley, J. (1997) Pathogenesis of enteric infection by *Campylobacter. Microbiology*, **Vol 143**, pp5-21.
- Marchant, J., Wren, B. and Ketley, J. (2002) Exploiting genome sequence: predictions for mechanisms of *Campylobacter* chemotaxis. *Trends in Microbiology*, **Vol 10** (4), pp155-159.
- Parkhill, J., Wren, B., Mungal, K. and Ketley, J. (2000) The genome sequence of the food-borne pathogen *Campylobacter jejuni* reveals hypervariable sequences. *Nature*, **Vol 403**, pp665-668.
- Skirrow, M. and Blaser, M. (1992) Clinical and epidemiologic considerations. In *Campylobacter jejuni*: Current status and future trends, Nachamkin, I., Blaser, M.J. and Tompkins, L.S. (eds) ASM Press, Washington, DC, pp3-9.
- Szurmant, H. and Ordal G. (2004) Diversity in Chemotaxis Mechanisms among the Bacteria and Archaea. *Microbiology and Molecular Biology Reviews*, **Vol 68** (2), pp301-319.

Hossinur Rahman

Assessing the Antimicrobial Effects of Himalayan Oregano Oil

In May 2009 I started a 10 week project in the microbiology lab of the University of the West of England (UWE) in Bristol, looking into the antimicrobial effects of Himalayan oregano oil. I had just completed my degree in Applied Microbiology from UWE and was commencing a Masters degree in Biomedical Science the following September. The opportunity to work on this project was very welcome as it provided some good laboratory experience necessary for my MSc and for possibly finding a relevant job in the future as I wanted to go into research. This research project opened up many possibilities for further research and the results from the project could aid anyone who would like to continue the research.

Due to the increasing resistance of many microbial pathogens to antibiotics in common usage, an alternative antimicrobial agent would be of benefit. My project aimed to find out if Himalayan oregano oil would be an effective antimicrobial agent against two significant bacterial pathogens. In addition, oregano oil can be produced sustainably by harvesting leaves from the plants that grow in abundance in the Himalayas, providing a valuable source of income for families in the region.

It has been hypothesized that the differing chemical composition of Himalayan oils makes a difference to their antimicrobial properties. Amongst the main constituents of oregano oil are carvacrol, thymol and cymine. GC/MS analysis of different batches of oregano oil showed that the levels of these constituents varied greatly according to environmental conditions during growth and harvest. This project sought to discover differences in antimicrobial activity, related to chemical composition.

One Gram-positive and one Gram-negative pathogen were used in the project; *Staphylococcous aureus* and *Pseudomonas aeruginosa*, respectively, both of which were genetically modified with a plasmid containing the *luxCDABE* genes regulated by a constitutive promoter, to produce bioluminescent strains.

As essential oils are insoluble in water, a method needed to be devised to keep the oils in solution in order to be used in minimum inhibitory concentration (MIC) experiments by tube dilution in Iso-Sensitest broth. Several substances were used, including ethanol, Tween 20, Tween 80 and DMSO. Using these chemicals, a stock of the oil was prepared, with the final concentration of 2% to be used for the MIC. The stock of each batch of oil was serially diluted (1% to 0.015625%), in duplicate for both species of bacteria, with the necessary controls. After overnight incubation at 37°C, the MIC was measured as the lowest concentration showing inhibition. This method, however, was abandoned due to the inability of the chemicals to keep the oils in solution, with at least two of them showing antimicrobial properties themselves, rendering the results inaccurate. Subsequent MIC estimation was carried out using a modified disc diffusion method.

To test the efficacy of the oils and how rapidly they would kill the bacteria, kill curves were constructed by measuring the decrease in light output from the self-bioluminescent reporter strains. Three oils were chosen according to their composition; high thymol, carvacrol or cymine. Stationary phase and exponentially growing phase cultures of both bacterial species were diluted or grown to an optical density of 0.5 at 600nm. Dilutions of the oils, according to the MICs, were pipetted into culture tubes already filled with the separate cultures. Relative light units (RLUs) were measured in a single tube luminometer against a control of broth and oil although due to the length of time of some of these experiments, some of the readings were taken with a 96-well plate reader every 30 seconds for 45 minutes. This machine enables automated readings over a certain amount of time without the problem of cultures altering in any way before the next set of repeats are taken. However, unlike the experiment using the single tube luminometer, the samples could not be shaken to keep the oils in suspension.

This project has opened up many opportunities for research and it was a pleasure for me to have the opportunity to work on this one. It also presented many technical challenges which have shown me that laboratory work can be far from straightforward. Importantly, this project has helped me gain the confidence and the necessary experience,

due to the time in the lab, to go on to further study and to eventually find a job in the field. I have gained skills and I feel more confident in talking about my results to my supervisors. I feel I can tackle any problem I may find in an experiment head-on and have the necessary skills to overcome these issues with some ease. I would like to take this opportunity to thank my supervisors, Dr Shona Nelson and Professor Vyv Salisbury and the lab technicians for their never ending support throughout the entirety of this project. Their guidance has also helped me gain enough confidence to carry through to the next level. I would finally like to thank the S*f*AM for this valuable opportunity to gain research experience and hone my skills in the laboratory by providing the financial support for this project.

Shelley Giles

President's Fund reports

am I eligible — can I apply?

It is not only our Student Members who require our help. Senior microbiologists often find difficulty in funding attendance at meetings. If you are in this position you are eligible for this fund.

For further information visit: **www.sfam.org.uk/grants.php**

Diversity- Function relationships in the regulatory testing of chemicals

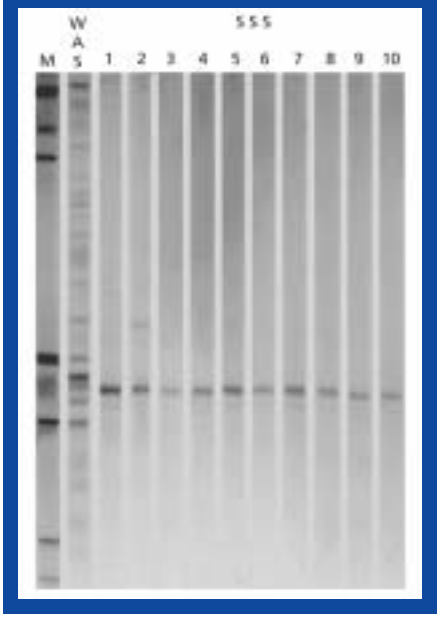
Environmental pollution is increasingly becoming one of the world's most challenging problems. Reliably estimating the fate and effects of new and existing chemicals on our environment is, therefore, incredibly important. The biodegradability of chemicals is measured using highly prescribed regulatory tests, predominantly the Ready Biodegradability Test (RBTs, Organisation for Economic Co-operation and Development (OECD), 1982), where chemical degradation is measured after exposure to an environmental bacterial source for 28 days (river waters, sea waters, lake waters, soils and activated sludges). This forms the basis for persistence based prioritization of chemicals.

While the assessment of biodegradability is critically important in assessing the fate and persistence of chemicals, the tests themselves are empirically derived (multiple inoculum sources, in amounts varying from 10μl to 5,000μl), often producing highly variable results. A chemical might fail a test, not necessarily because the compound is poorly biodegradable, but because the test itself has failed due to high variation; chance inclusion of competent degrading organisms present in the starting inoculum of one replicate but not another. The likelihood of such rare organisms being present will be a function of the diversity of the inoculum bacterial community. By using DNA fingerprinting techniques such as DGGE (Muyzer *et al.*, 1993), we can show how RBT test variation is affected by the microbial diversity of test inocula. Results from RBTs using inocula from wastewater treatment plants can also give us a great insight into the functional capacity (ability to degrade certain chemicals) of activated sludge reactors.

Firstly, the effect of standard OECD preparation on inoculum microbial diversity was investigated by DGGE analysis of whole activated sludge (WAS) and 'standard' RBT inoculum. RBTs were then performed in sterile 96-well plates containing 250μl of 4-nitrophenol (4-NP) medium (classified as readily biodegradable). To this, 50μl of inoculum was added. Inocula were derived from the activated sludges of two domestic wastewater treatment plants with different sludge ages and nitrifying capacities; Spennymoor (long sludge age, nitrifying) and Sedgeletch (short sludge age, non-nitrifying). The plates were then sealed and incubated for 28 days at 30^{o}C, and degraded wells (those that had turned from yellow to colourless) scored for each dilution. Using a most probable number (MPN) approach, the number of specific degraders present in each inoculum were then calculated. Samples of degraded and non degraded wells were also taken for DGGE analysis.

Standard inocula, prepared as per the OECD guidelines, differed from whole activated sludge in two ways. Firstly, the

Figure 1. DGGE image comparing whole activated sludge (WAS) with dilutions of standard OECD inocula (SSS1-10)



total number of organisms present was reduced by an order of magnitude. The detectable bacterial diversity of the 'standard' inoculum was also significantly reduced compared to whole activated sludge (p=0.00, ANOVA). While an average of 26.25 bands were detected in WAS, an average of only 1.10 bands were detected in the 'standard' sludge (SSS1-10) (Figure 1). Sedgeletch inoculated RBTs had a significantly higher probability of degradation compared to Spennymoor (p=0.000, ANOVA), and Sedgeletch inoculum was also shown to have a significantly higher number of 4-NP degraders (by an order of magnitude). This is interesting as the two sludges were quantitatively similar (total cells, solids content) when sampled. Sedgeletch and Spennymoor activated sludge had significantly similar DGGE band richness before inoculation. After the RBT, Sedgeletch derived tests had become significantly richer (p=0.04, ANOVA). Positive RBTs (those wells that had turned colourless) were also significantly richer than negative RBTs (p=0.010, ANOVA). Sedgeletch inoculated RBTs seem to have become enriched over the test period, due to the selection of more minority 4-NP degrading organisms. These results confirm that bacterial diversity has a very important role to play in RBT inocula, but due to the detection limit of DGGE we cannot truly see its effect. While DGGE 'band richness' can help to infer a general diversity of an inoculum, it is not specific. Techniques that provide a better resolution of detectable diversity must, therefore, be employed to give us a better insight. Only by truly standardizing RBT inocula can we hope to prevent test variation. Based on these results, standardizing inoculum diversity may well be the way forward.

I would sincerely like to thank the SfAM for their generosity in awarding me the President's Fund grant, without which I would not have been able to present this work at the 4th International Young Water Researchers conference in Berkeley, California. This conference enabled me to 'spread the word' about the applications of microbial techniques, and also to make new contacts for future collaboration.

Andrew Goodhead
Newcastle University

further reading

- Organisation for Economic Co-operation and Development (OECD) (1981). OECD's guidelines for testing of Chemicals.
- Blok, J. and Booy M. (1984). Biodegradability Test-Results Related to Quality and Quantity of the Inoculum. *Ecotoxicology and Environmental Safety*, **Vol. 8**(5), pp410-422
- Curtis, T. P., Sloan, W. T., and Scannell, J. W. (2002). Estimating prokaryotic diversity and its limits. Proceedings of the National Academy of Sciences of the United States of America, **Vol. 99** (16), pp10494-10499.
- ECETOC from http://www.ecetoc.org.
- Edwards U., Rogall T., Blöcker H., Emde M. and Böttger E. C.. (1989). Isolation and Direct Complete Nucleotide Determination of Entire Genes — Characterization of a Gene Coding for 16s-Ribosomal RNA. *Nucleic Acids Research,* **Vol. 17**(19), pp7843-7853.
- Loyer, M. W. and Hamilton M. A. (1984). Interval Estimation of the Density of Organisms Using a Serial-Dilution Experiment. *Biometrics,* **Vol. 40**(4), pp907-916.
- Muyzer, G., de Waal, E. C. and Uitterlinden, A. G. (1993). Profiling of Complex Microbial-Populations by Denaturing Gradient Gel-Electrophoresis Analysis of Polymerase Chain Reaction-Amplified Genes-Coding for 16s Ribosomal-RNA. *Applied and Environmental Microbiology,* **Vol. 59**(3), pp695-700
- Nyholm, N., Lindgaardjorgensen, P. and Hansen, N. (1984). Biodegradation of 4-Nitrophenol in Standardized Aquatic Degradation Tests. *Ecotoxicology and Environmental Safety,* **Vol. 8**(5), pp451-470.
- Thouand, G., Capdeville, B. and Block J. C. (1996). Preadapted inocula for limiting the risk of errors in biodegradability tests. *Ecotoxicology and Environmental Safety,* **Vol. 33**(3), pp261-267.
- Thouand, G., Friant, P., Bois, F., Cartier, A., Maul A. and Block J. C. (1995). Bacterial Inoculum Density and Probability of Para-Nitrophenol Biodegradability Test Response. *Ecotoxicology and Environmental Safety,* **Vol. 30**(3), pp274-282.

Microbial degradation of herbicides

Herbicides are chemicals that inhibit or interrupt normal plant growth and development. They are used widely in agriculture, industry, and urban areas for weed management. Like any other anthropogenic compounds, herbicides have elicited interest as there is public concern over their possible hazardous effects on humans and the environment. Herbicides can be detected in the atmosphere, both nearby and distant from areas where they have been applied. They have been shown to volatilize from agricultural soils and have been found in the vapour phase in the atmosphere, in association with a decline in amphibian populations and rainwater (Dorsey *et al.*, 2003).

Herbicides can dissipate from the environment by photolysis (broken down by light), metabolism by plants and animals, or by microbial degradation. Microbiological metabolism is usually the major route of mineralization. Like other biological processes, biodegradation is governed by physico-chemical parameters such as oxygen, pH, temperature and the nutrients present in a particular environment and also to a large extent by the nature of the microhabitat with respect to microbial community and xenobiotic compounds. Prior exposure of microbial populations to pesticides is important, as it is often responsible for the adaptation of microorganisms that evolve new genetic functions under stress. Atrazine, a pre-emergence herbicide deployed only over the last 60 years, was previously considered to be non-metabolizable by the majority of soil bacteria during the first 35 years of its use. Recently, pure cultures of bacteria that can degrade it have been described (de Souza *et al.*, 1998). In general, microorganisms responsible for degradation of xenobiotics belong to a few genera: *Achromobacter*, *Alcaligenes*, *Arthrobacter*, *Bacillus*, *Flavobacterium*, *Nocardia* and *Pseudomonas* (Mateen *et al.*, 1994).

Biological degradation of herbicides can occur aerobically or anaerobically. Klint *et al.*, (1993) observed no biodegradation of atrazine in groundwater or in groundwater combined with aquifer sediment systems, over a period of 539 days under anaerobic conditions. Anaerobic degradation, however, was shown to occur under strongly reducing conditions by Seybold *et al.*, (2001). Aerobic degradation of atrazine by *Pseudomonas* sp. ADP strain was described by Mandelbaum *et al.*, (1995). The transformation of a herbicide by microorganisms may lead to the complete degradation of the herbicide (mineralization), but this is not always observed. For instance, atrazine disappearance has been demonstrated in soils, but its microbial mineralization is not commonly observed (Dorsey *et al.*, 2003). Recently a survey carried out in our laboratory showed that atrazine was degraded but not mineralized in enrichment cultures

from soil and the degraders obtained were restricted to only a few genera (Omotayo *et al.*, unpublished data). The transformations of herbicides to their corresponding metabolites usually involve the enzymes hydrolase and oxygenase (Mateen *et al.*, 1994). Lack of one or more of these enzymes in the microorganism may be the cause of incomplete degradation of the herbicide. In our study, atrazine was transformed by a *Nocardioides* sp. to a major intermediate metabolite, cyanuric acid by aminohydrolase enzymes and further degradation was not observed (Omotayo *et al.*, unpublished data).

Some herbicides are persistent in natural environments, as biodegradation proceeds slowly. Dinoseb (2,4-dinitro-6-*sec*-butylphenol) is a very persistent herbicide (now banned) that is highly toxic to virtually all living systems. Others like atrazine are somewhat persistent in natural environments, but biodegradation slowly occurs in soils and sediments (Dorsey *et al.*, 2003). Phenylcarbamate or carbanilate herbicides are rapidly degraded in soils, particularly those with a history of herbicide treatment, while, 2,4-dichlorophenoxyacetic acid is a readily degraded herbicide of moderate toxicity to non-target organisms. The rapid degradation or loss in efficacy of these herbicides has been shown to be associated with the adaptation of the microbial population. If the herbicides are structurally different, adaptation of microorganisms to degrade one herbicide may not confer on them the ability to degrade other herbicides of the same group. For instance, microbial populations evolved traits responsible for the degradation of structurally related thiocarbamates, even though the soils were exposed to only one of the herbicides (Mateen *et al.*, 1994).

Microorganisms respond to new chemical inputs in the environment by evolving new enzymes and pathways (Wackett, 2004). They may obtain the new catabolic genes needed for degradation of that compound from other microorganisms through conjugational or transformational events. They may also modify existing genes through mutational processes. These observations are consistent with the idea that a new metabolic pathway for atrazine catabolism may have evolved and spread in recent evolutionary times (Shapir *et al.*, 2007). The genes for the degradation of these compounds are often plasmid associated (Chaudhry & Chapalamadugu, 1991). Nevertheless the loss of plasmid-associated degradative function in herbicide-degrading bacteria has been reported (Mateen *et al.*, 1994) and this has subsequently led to the loss of degradation of the herbicides by the microorganisms. During the course of our study, the loss of atrazine degradation by some of the microorganisms isolated was a situation frequently encountered (Omotayo *et al.*, unpublished data). It is therefore essential to understand the biochemistry and genetics of plasmid-borne bacterial degradation of herbicides. The use of recombinant DNA techniques would assist in the characterization of the appropriate degradative genes which could be transferred to construct improved strains with enhanced ability to degrade several herbicides.

I wish to thank the S*f*AM for awarding me the President's Fund grant to participate in the 2008 American Society for Microbiology general meeting in Boston, USA.

Ayodele E. Omotayo
University of Lagos, Nigeria

References

- Chaudhry, G.R. and Chapalamadugu, S. (1991) Biodegradation of halogenated organic compounds. *Microbiol. Rev.,* **Vol. 55**, pp59-79.
- de Souza, M.L., Newcombe, D., Alvey, S., Crowley, D.E., Hay, A., Sadowsky, M.J. and Wackett, L.P. (1998) Molecular basis of a bacterial consortium: interspecies catabolism of atrazine. *Appl. Environ. Microbiol.*, **Vol. 64**, pp178-184.
- Dorsey, G.A., Little, S.S., Knaebel, D.B., Plewak, D., Printup, H. and Rhoades, J. (2003) Toxicological profile for atrazine, U.S. Department of Health And Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, September 2003 Atlanta, Georgia.
- Klint, M., Arvin, E. and Jensen, B. K. (1993) Degradation of the pesticides mecoprop and atrazine in unpolluted sandy aquifers. *J. Environ. Qual.*, **Vol. 22**, pp262-266.
- Mandelbaum, R.T., Allan, D.L. and Wackett, L.P. (1995) Isolation and characterization of a *Pseudomonas* sp. that mineralizes the s-triazine herbicide atrazine. *Appl. Environ. Microbiol.*, **Vol. 61**, pp1451-1457.
- Mateen, A., Chapalamadugu, S., Kaskar, B., Bhatti, A. R. and Chaudhry, G. R. (1994) Microbial metabolism of carbamate and organophosphate pestide. In Chaudhry, G. R. (ed.) Biological Degradation and Bioremediation of Toxic Chemicals: Dioscorides Press, Portland, Oregon, pp198-233.
- Seybold, C.A, Mersie, W. and McNamee, C. (2001) Anaerobic degradation of atrazine and metolachlor and metabolite formation in wetland soil and water microsomes. *J. Environ. Qual.*, **Vol. 30**, pp1271-1277.
- Shapir, N., Sadowsky, M.J., Daugherty, S.C., Nelson, K.E. and Wackett, L.P. (2007) Evolution of catabolic pathways: Genomic insights into microbial s-triazine metabolism. *J. Bacteriol.*, **Vol. 189**, pp674–682.
- Wackett, L.P. (2004) Evolution of enzymes for the metabolism of new chemical inputs into the environment. *J. Biol. Chem.*, **Vol. 279**, pp41259–41262.

Genetic control of the degradation of polycyclic aromatic hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants and are generated continuously by the inadvertent incomplete combustion of organic matter, for instance in forest fires, home heating, traffic and waste incineration (Johnsen *et al.*, 2005). Massive soil contamination with PAHs originated from extensive industrial coal gasification during most of the 20th century. As gas works were typically located in densely populated urban regions to facilitate the distribution of the coal gas, PAH contaminated sites are mostly found in or near cities, thus representing a considerable public health hazard (Johnsen *et al.*, 2005).

A vast array of microbial species (bacteria, fungi and algae) can utilize both low- (three rings or fewer) and high-molecular-weight (four or more rings) PAHs such as naphthalene, acenaphthalene, anthracene, fluoranthrene and pyrene as sole carbon and energy sources (Cerniglia *et al.*, 1992). The most commonly isolated organisms with PAH-degradative capabilities are *Pseudomonas* species, with *Ps. putida* being the most frequently studied. Other genera that are commonly studied and shown to be PAH-degraders are *Nocardia*, *Mycobacteria and Sphingomonas* (Cerniglia *et al.*, 1992). PAH-degrading microbial populations have the potential for use within bioremediation strategies to clear up contaminated sites. Bioremediation of contaminated sites relies either on the presence of indigenous degrading bacteria, the capabilities of which might be stimulated *in situ*, or on the inoculation

of selected microorganisms with desired catabolic traits in bioaugmentation techniques.

Metabolism of PAHs involves the oxidation of the molecule via a multi-component enzyme system to form a dihydrodiol, which is then processed by either an ortho or meta cleavage pathway, which results in an intermediate. This is then further processed to form tricarboxylic acid cycle (TCA) intermediates (Johnsen *et al.*, 2005).

The naphthalene catabolic genes within the well-studied *Ps. putida* G7 strain are organized into three operons on the 83-kb NAH7 plasmid: one encoding the upper-pathway enzymes involved in the conversion of naphthalene to salicylate, the second encoding the lower pathway enzymes responsible for converting salicylate into the TCA cycle intermediate and the third encoding a regulatory protein (NahR) (Habe & Omori, 2003).

Many PAH degrading pseudomonads possess genes involved in the PAH-biodegradative pathways that are highly homologous to the cluster of naphthalene genes (*nah* genes) cloned from the NAH7 plasmid of *Ps. putida* G7 (Zocca *et al.*, 2004). Sanseverino *et al.*, (1993) demonstrated the homology between PAH degradative genes from three *Pseudomonas* strains. These plasmids have homologous regions of upper and lower NAH7 plasmid catabolic genes and have been shown to encode the genotype for mineralization of naphthalene, phenanthrene and anthracene (Sanseverino *et al.*, 1993). Takizawa *et al.*, (1994) identified and characterized the gene cluster (*pah* genes) encoding the degradation of naphthalene and phenanthrene in *Ps. putida* OUS82. The *pahA* and *pahB* genes, which encode the first and second enzymes, dioxygenase and *cis*-dihydriol dehydrogenase, respectively, were identified and sequenced. The genomic structure and encoded enzymes are homologous to that seen in *Ps. putida* G7 controlling naphthalene degradation and in fact the *pah* region of *Ps. putida* OUS82 strongly hybridized to a corresponding region of plasmid NAH7 of PpG7 (Takizawa *et al.*, 1994).

The naphthalene catabolic plasmids (NAH plasmids) not only mediate degradation of naphthalene but also phenanthrene, anthracene, dibenzothiophene, fluorene and methylated naphthalene and the genes within these plasmids are referred to as *nah*-like genes. Classical *nah*-like genes have almost identical organization and nucleotide sequence in the pseudomonads. This can be attributed to their presence in the NAH plasmids, which are moderately large and self-transmissible (Habe and Omori, 2003). However, the nucleotide sequence homology and the organization of isofunctional clusters of genes cloned from genera *Burkholderia*, *Comamonas*, *Ralstonia* and *Sphingomonas* are not so conserved in respect of the *nah* genes (Zocca *et al.*, 2004). *Burkholderia* sp. strain RP007 was isolated from a PAH-contaminated site in New Zealand and is capable of degrading phenanthrene, naphthalene and anthracene (Laurie and Lloyd-Jones, 1999). Naphthalene and phenanthrene are degraded through a common pathway *via* salicylate and 1-hydroxy-2-naphoic acid, respectively. *phn* genes were different in nucleotide sequence and gene organization from previously characterized PAH-catabolic genes (Laurie and Lloyd-Jones, 1999).

There is extensive evidence for the wide distribution of PAH-degradative genes, homologous to the *nah* genes in *Ps. putida* G7, within the pseudomonads. There is also much evidence for the broad substrate-specificity of the catabolic genes to degrade PAHs and other aromatic compounds. Some differences occur in the nucleotide sequence and organization within differing bacterial genera; however, it appears that these species are equally capable of degrading multiple PAHs and therefore may contain catabolic genes of equivalent versatility. The disparity between the *nah*-like genes and isofunctional genes cloned from genera *Burkholderia*, *Comamonas*, *Ralstonia* and *Sphingomonas* may result in an inability to probe microbial populations for PAH-degradative potential with single universal primers; rather, degenerate primers or genus-specific primer sets may be required.

The PAH-degradative capabilities of bacteria can be utilized within bioremediation techniques. The presence of PAH-degradative genes within a broad diversity of bacteria provides a vast selection of species with differing survival traits to tailor bioaugmentation techniques for various contaminated sites. Additionally, the broad substrate-specificity of these catabolic genes to degrade many PAH substrates would allow the bioremediation of sites contaminated with multiple PAHs and other aromatic compounds.

References

- Cerniglia, C.E. (1992) Biodegradation of polycyclic aromatic hydrocarbons. *Biodegradation*, **Vol. 3**, pp351-368.
- Habe, H. and Omori, T. (2003) Genetic polycyclic aromatic hydrocarbon metabolism in diverse aerobic bacteria. *Biosci. Biotechnol. Biochem.*, **Vol. 67**, pp225-243.
- Johnsen, A.R., Wick, L.Y and Harms, H. (2005) Principles of microbial PAH-degradation in soil. *Environ. Pollut.*, **Vol. 133**, pp71-84.
- Laurie, A. D. and Lloyd-Jones, G. (1999) The *phn* genes of *Burkholderia* sp. strain RP007 constitute a divergent gene cluster for the polycyclic aromatic hydrocarbon catabolism. *J. Bacteriol.*, **Vol. 181**, pp531-540.
- Sanseverino J., Applegate, B. M., King, J. M. and Sayler G. S. (1993) Plasmid-mediated mineralization of naphthalene, phenanthrene and anthracene. *Appl. Environ. Microbiol.*, **Vol. 56**, pp1931-1937.
- Takizawa, N., Kaida, N., Torigoe, S., Moritani, T., Sawada, T., Satoh S. and Kiyohara, H. (1994) Identification and characterization of genes encoding polycyclic aromatic hydrocarbons dioxygenase and polycyclic aromatic hydrocarbon dihydriol dehydrogenase in *Pseudomonas putida* OUS82. *J. Bacteriol.*, **Vol.176**, pp2444-2449.
- Zocca C., Di Gregorio, S., Visentini, F. and Vallini, G. (2004) Biodiversity amongst cultivable polycyclic aromatic hydrocarbon-transforming bacteria isolated from an abandoned industrial site. *FEMS. Microbiol. Lett.*, **Vol. 238**, pp375-382.

Rachel Long
University of Exeter

President's Fund Grant

The **President's Fund** provides grants to Full Ordinary and Full Student Members to assist them to present at scientific meetings or attend workshops related to their area of work. What is more, this grant is available to ***all*** Full Ordinary and Full Student Members irrespective of their country of residence.

If you think you are eligible, why not apply for the fund? The maximum grant available is £1200.

For further information visit:
www.sfam.org.uk/grants.php

corporate news

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

ALControl know how Dry-Bags™ take the hassle out of media preparation

A new video, which shows food microbiologists how Oxoid Dry-Bags™ are a labour-saving, convenient and rapid way to prepare and dispense large volumes of culture media and diluents, can be seen at www.oxoid. com/video-wall.asp

"*We aim to provide microbiologists with products that enhance the efficiency of their laboratory*," said Cheryl Mooney, food and industrial product manager, Oxoid. "*Using Oxoid Dry-Bags, ALcontrol Laboratories was able to free up their staff and resources for other important tasks, enabling them to increase capacity for product testing in their laboratory*."

Each Dry-Bag™ contains pre-weighed dehydrated culture medium or diluent and is irradiated for sterility. You simply add water — either through filter sterilization or by adding pre-sterilized water under aseptic conditions. Dry-Bags™ eliminate the washing of glassware and heat sterilization. Once water is added and powder dissolved, the Dry-Bag™ is ready to use immediately. When empty, the bag is disposed of with normal laboratory waste.

Oxoid Dry-Bags™ are flat-packed in boxes of five or ten bags, and can be stored at room temperature. For further information about the range of media and diluents available as Dry-Bags™, please contact us.

further information

Visit: www.oxoid.com
Tel: +44 (0) 1256 841144
Email: val.stroud@thermofisher.com

corporate news

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

EZ-Accu Shot™ Select

Technopath are pleased to announce that Microbiologics have unveiled EZ-Accu Shot™ *Select*, an extension of the remarkably popular EZ-Accu Shot™ product brand. EZ-Accu Shot™ *Select* boasts all the same features and benefits as the original EZ-Accu Shot™, but will include five compendial microorganism strains for Growth Promotion Testing in one convenient package.

Microbiologics manufactures a wide variety of biological reference materials that are used for Quality Control testing worldwide.

EZ-Accu Shot™ *Select* is packaged as a kit containing five Quality Control strains required by the Pharmacopeias for Growth Promotion Testing, all of which are derived from the American Type Culture Collection (ATCC). The strains included are *Aspergillus brasiliensis* ATCC® 16404™, *Bacillus subtilis* subsp. *spizizenii* ATCC® 6633™, *Candida albicans* ATCC® 10231™, *Pseudomonas aeruginosa* ATCC® 9027™, and *Staphylococcus aureus* subsp. *aureus* ATCC® 6538™. Each strain comes in the form of a quantitative, instant-dissolving lyophilized pellet.

As required by the Pharmacopeias, EZ-Accu Shot™ *Select* microorganisms deliver less than 100 Colony Forming Units (CFU). For added convenience, the EZ-Accu Shot™ *Select* kit also contains hydration fluid and individual peel-off information labels for each strain; everything needed for Growth Promotion testing in one convenient package.

further information

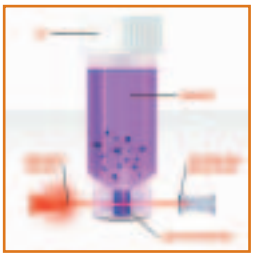
Visit: www.techno-path.com
Tel: +44 (0)283 0833 808
Email: info@techno-path.com

Neogen develops Soleris® assay to rapidly detect heterotrophic bacteria

Neogen has expanded its comprehensive line of food safety and quality testing products to include a rapid assay to detect the growth of heterotrophic bacterial microorganisms (e.g., *Pseudomonas* spp.) in a wide variety of sample types.

Neogen's new Soleris® NF-TVC (total viable count) can produce accurate results in as little as 24 hours — which represents a 24-hour improvement over traditional testing methods that can require up to 48 hours.

Unlike testing alternatives, Neogen's new assay can be used to test large sample sizes. The presence of heterotrophic bacteria, such as *Pseudomonas*, is a critical factor in the shelf life of fluid dairy products, aseptic UHT products, bottled water, and many other food and personal care products. The new Soleris® assay delivers speed and the increased sensitivity over alternative methods that comes with using up to a full 5 ml sample with the Soleris® system. Soleris® is the only rapid microbiological system that is capable of consistently delivering reliable results on difficult product matrixes, while at the same time being an effective, economical choice for common safety and quality testing.



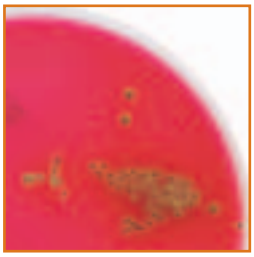
The new assay is a new option for use with Neogen's Soleris® technology, which is now used by hundreds of the world's largest food and nutraceutical manufacturers to detect indicator microbes in a fraction of the time needed for traditional methods.

further information

Visit: www.neogeneurope.com
Tel: +44 (0) 1292 525610
Email: info_uk@neogeneurope.com

m-Endo Agar LES

Designed for the enumeration of coliforms using membrane filtration, m-ENDO Agar LES will permit the differentiation of *Escherichia coli* from other coliform organisms that may be present in your water samples. A preliminary enrichment step using Lauryl Sulphate Broth can be used which will enhance the recovery of coliforms from your sample, alternatively membranes can be placed directly onto the agar surface when enrichment is deemed unnecessary.



SGL are very aware of the pressures on the microbiology labs of today from customers, auditors and accreditation authorities. With these ever-increasing demands, laboratories have little time left for microbiology. Many busy microbiology labs worldwide have turned towards ready prepared media to alleviate these pressures. They no longer spend hours preparing media and have released precious time within their laboratories to get on with the real business of microbiology. Laboratories using ready prepared culture media no longer have to worry about purchasing dehydrates, consumables or preparation vessels, nor associated equipment maintenance, media wastage, quality control of their media and of course staffing time.

further information

Visit: www.sglab.co.uk
Tel: +44 (0)1536 403815
Email: info@sglab.co.uk

The first direct detection kit for pathogenic Listeria

Technical Service Consultants new SwabSURE ListeriaP is an innovative, Campden BRI validated, ISO 18593 compliant, easy to use colour-change testing system for presumptive detection of pathogenic Listeria from food contact and environmental surfaces. ListeriaP permits easy differentiation between pathogenic *Listeria monocytogenes* and *Listeria ivanovii* from other background microorganisms including *Bacillus* spp., *Enterococcus* spp., *Micrococcus* spp., *Klebsiella* spp., and other *Listeria* species like *Listeria innocua*., simplifying the testing process involved in meeting safety and regulatory requirements such as HACCP.

The pre-moistened foam swab optimises sample collection whilst the unique TSC neutralising buffer inactivates any disinfectant residues including QAC's, phenols, peroxides and most sanitisers, enhancing cell recovery. The selective media with its patented chromogenic substrate reliably detects *Listeria monocytogenes* down to 1 CFU by changing colour from straw to turquoise within 24 to 48 hours. This visual screen reduces unnecessary and costly subculturing and further identification needs, eliminating false positives, a common problem with other traditional methods.

To order your Swab kit for the detection of pathogenic *Listeria* quote order number SS-L01. For further details, validation results or to request a free sample pack of 5 tests please contact us.

further information

Visit: www.tscswabs.co.uk/listeria
Tel: +44 (0)1706 620600
Email: sales@tscswabs.co.uk

NRS II™ Transwab®: Food and pharmaceutical ready to use environmental sampling devices from MWE

NRS II™ Transwab® are completely ready to use and feature a leak proof blue screw cap and labelled tube. The tubes are made from shatter proof polypropylene and are filled with exact specified solution volumes. The tube contains a high visibility blue shaft swab already attached to the cap, thereby avoiding the need to carry additional packaging or to dispose of after use.

NRS II Transwabs® offer a choice of fills all of which let users conform to HACCP requirements in accordance with national regulations, or with buyers' requirements. These fills include;

- NRS (Neutralising Rinse Solution)
- BPW (Buffered Peptone Water)
- Letheen broth (without thiosulphate)
- Butterfield Solution
- D/E Neutralising Broth
- Peptone Saline (also called Maximum Recovery Diluent), and
- TSB (Tryptone Soy Broth)

A dry version without solution is also available for customers to use with their own formulations. NRS II™ conforms to ISO18593 requirements, and other national and international standards.

further information

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

New Sterilin filtration products offer vast choice of membrane types and pore sizes

Sterilin Syringe filters are available with pore sizes of 0.22µm and 0.45µm, and Sterilin Filtration Units in pore sizes of 0.10µm, 0.22µm and 0.45µm. The smallest pore size is ideal for the reduction of *Mycoplasma* in samples. The largest pore size is suitable for the clarification of aqueous solutions and solvents, pre-filtration, filtration of protein-free media, solvents and aggressive chemicals, and for the sterilization/ultra-cleaning of aqueous solutions.

Sterilin Syringe Filters with a PES (polyethersulfone) membrane demonstrate faster flow rates compared to other membrane types, with low protein binding and low levels of extractables.

Sterilin Filtration Units are available with a choice of PES, MCE, PVDF or NY filters. The Sterilin Filtration Unit has easy grip sides to improve handling and an ergonomic cap design. It is available in a choice of volumes (150ml, 250ml, 500ml and 1L) and the 45mm screw thread is compatible with most manifolds. The Unit has been pressure tested to ensure leak-free performance.

Sterilin filtration products are gamma irradiated and ceritified non-pyrogenic to <0.5EU/mL to ensure that the quality of valuable samples is protected.

further information

Visit: www.sterilin.co.uk
Tel: +44 (0) 844 844 3737
Email: katie.emery@sterilin.co.uk

Quality biological reagents for quality testing

VLA Scientific offers a wide range of specialist biological reagents and diagnostic kits for effective and reliable laboratory testing. They are available for sale to the animal health industry and veterinary diagnostic laboratories worldwide. The agency has over 100 years experience in the diagnosis and control of diseases of farm livestock and other animals. Our products benefit from:

- **Extensive expertise**

Our scientists have a unique breadth of veterinary and scientific expertise and a comprehensive knowledge of animal and zoonotic diseases. Many of the reagents and products available are used by national and international reference laboratories.

- **Excellent specialist facilities**

The reagents are manufactured in a dedicated reagent production unit certified to ISO9001. In addition there are 'state of the art' high disease containment facilities for the production of specialist reagents.

- **A comprehensive and quality delivery service**

Our reagents are available either from our network of distributors covering Europe, the Middle East and Asia or direct from VLA Scientific for other areas.

VLA Scientific products, which include antisera, antigens diagnostic kits, are available for:

- Bacterial diseases
- Avian viral diseases
- Mammalian viral diseases
- Monoclonal antibodies
- *Salmonella* antisera
- Bacterial isolates

further information

Visit: www. vla.defra.gsi.gov.uk
Tel: +44 (0)1932 357641
Email: salesdesk@vla.defra.gsi.gov.uk

NCIMB Freeze Drying Service

Do you struggle to maintain your in house culture collection or looking for ways to improve efficiency and reduce costs? Do you need backup to secure your key isolates?

NCIMB has the answers. We provide a contract freeze drying service where we can preserve your isolates (e.g. environmental isolates from routine plant monitoring) in any of our culture delivery formats including ampoules, bottles or our easy to use MicroSnap format so you don't have the worry of maintaining stocks. Applications include:

- Media quality control
- Method validation
- Multi-laboratory standardization

- Antimicrobial effectiveness testing
- Trending
- Back Up and secure storage

Do you worry about back up to your in house collections or key strains? Our safe deposit facility can store your material at a wide range of temperatures including:

- Refrigerated (2°C to 8°C)
- Frozen (-20°C or Vapor Phase Nitrogen - 170°C)
- Freeze dried in the above formats

Typical deposits include bacteria, yeasts, bacteriophages and plasmids, including recombinants up to hazard rating and physical containment requirements ACDP category 2 and GMO class 1.

In addition, our Secure Storage facility operates to cGMP guidelines and is inspected by the MHRA. We have been maintaining the NCIMB culture collections for over 50 years. Let us share our knowledge and help you take care of your collection

further Information

Visit: www.ncimb.com
Tel: +44 (0)1224 711100
Email: enquiries@ncimb.com

The James Hutton Institute
Science connecting land and people

Macaulay Scientific Consulting joins the James Hutton Institute

On 1st April 2011, Macaulay Scientific Consulting Ltd (MSCL) became part of the James Hutton Institute, which has brought together the Macaulay Land Use Research Institute and SCRI to combine existing strengths in crops, soils and land use and environmental research. Based in Aberdeen, MSCL provides both consultancy and analytical services for research and commercial purposes, both within the UK and internationally.

Its aim is to provide expert advice and information for land managers, scientists and policy makers, based on a wide range of advanced analytical techniques, laboratory and field studies, computer modelling, and expertise in the understanding of science, Government policy and the regulation of industry.

MSCL provides a comprehensive range of advanced analytical services for the oil and gas, environmental and food sectors. A wide range of analyses is undertaken related to plants, soils, water, oil, gas and sediments including electron microscopy, infrared spectroscopy and mass spectrometry. MSCL also includes Macaulay Soils (macaulaysoils.com), our high quality soil analysis service and MicroResp™ (www.microresp.com), our unique microplate-based respiration system.

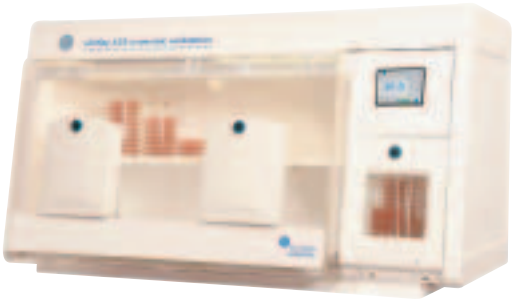
further Information

Visit: www.macaulayscientific.com
Tel: +44 (0)844 9285428
Email: consult@hutton.ac.uk

New Anaerobic Conditions Monitor for Whitley A-Series Workstations

Say goodbye to anaerobic indicator strips and positive and negative control plates. The A35 and A85 Anaerobic Workstations are now available with a fully integrated Anaerobic Conditions Monitor controlled via the colour touch-screen, to give a visual indication of anaerobic conditions.

An events log is now a standard feature that monitors any alerts so that users can check the chamber conditions during periods when the workstation has been unattended. The data gathered can be downloaded for further analysis.



The parameter measured is the concentration of oxygen gas within the workstation atmosphere. The oxygen concentration thresholds used to trigger on-screen indications are based on extensive development of anaerobic incubation equipment over a 27 year period. The colour indications correspond to the following conditions:

- **Green**: Indicates that good anaerobic conditions are present in the chamber.
- **Yellow**: Indicates a slight increase in oxygen concentration. A correctly functioning workstation should return to 'green' within 15-30 minutes.
- **Red**: Indicates that the oxygen concentration has risen above levels considered normal. A pop-up indicator will appear on screen to alert the operator.

further information

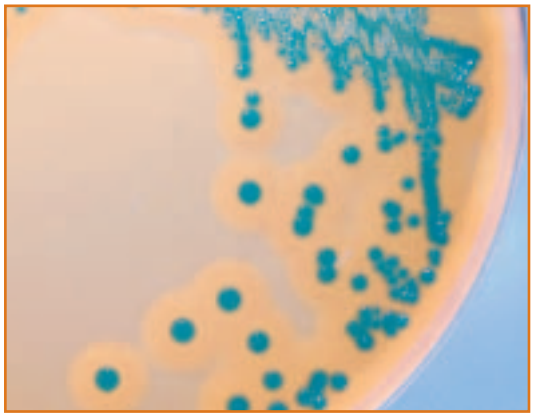
Visit: www.dwscientific.co.uk
Tel: + 44 (0)1274 595728
Email: sales@dwscientific.co.uk

information

Are you a Corporate Member of the Society? If so, this section of *Microbiologist* is for you. Here you can publish short press releases, acquisition notices, news of new staff appointments, technical developments and much more.

Each Corporate Member of the society may publish ***up to*** 200 words on a topic related to their field of activity in each issue of *Microbiologist*. For further information please contact Lucy Harper by email at: **lucy@sfam.org.uk**

Both Corporate Members and Ordinary Members of the Society will find a wealth of useful information and resources in this section.



Listeria culture media from Lab M suit variety of testing protocols

Recently released figures[1] showing an increase in the incidence of listeriosis throughout Europe in 2009 illustrate the continuing need for comprehensive and highly effective methods of enriching and isolating *Listeria* species at all stages in food production. The figures show an increase in the number of listeriosis cases in humans by 19.1% compared to 2008, with 1,645 cases in 2009. Culture media specialists, Lab M provide a wide range of microbiological media for this application, enabling laboratories to accommodate different testing protocols and purchase from a single supplier.

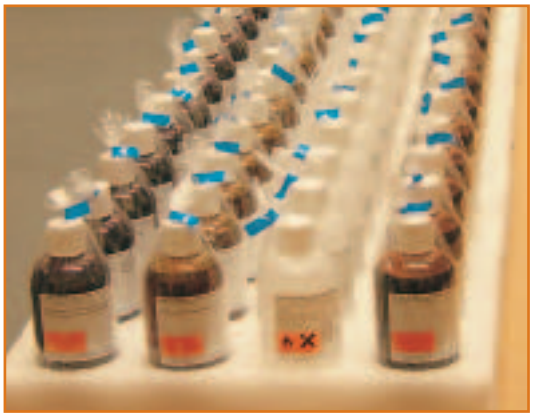
Compliant with the ISO 11290 standard for the detection and enumeration of *Listeria monocytogenes*, the range includes Fraser Broth^{PLUS} (ISO) and Half Fraser Broth^{PLUS} (ISO), which give improved results over traditional formulations. In addition, Harlequin™ Listeria Chromogenic Agar (ISO) uses a novel chromogen to distinguish *L. monocytogenes* from other *Listeria* species. Secondary isolation media are also available, including Listeria Isolation Medium Oxford (ISO).

Lab M, headquartered in the UK, is home to an experienced team whose focus is delivering customer satisfaction and, when required, tailored support to meet the specific needs of any laboratory. Their reputation for producing high-quality dehydrated culture media ensures its routine use in microbiology laboratories around the world.

[1]European Food Safety Authority; The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2009. *EFSA Journal* 2011;9(3):2090. [378 pp.]. doi:10.2903/j.efsa.2011.2090. Available online: www.efsa.europa.eu/efsajournal

further information

Visit: www.labm.com
Tel: +44 (0)161 797 5729
Email: info@labm.com



Stain Range Expansion again

Over 30 new stain preparations have been added to the range of Microbiology stains manufactured in the recently opened extended manufacturing facility at Pro-Lab Diagnostics. The exchange expansion includes new differentiator formulation for Grams, TB and *Cryptosporidium* conforming to recent reference centre recommendations, Calcofluor White /KOH for fluoresecent fungal staining, Lactofuschin, Cold Kinjouns ZN stains and many more. For further details and samples, please contact us.

GDH Testing with Prolisa™

Pro-Lab Diagnostics is pleased to announce a high-quality tool in the fight to diagnose life-threatening disease. Prolisa™ *C. difficile* GDH EIA is available for the most rapid and accurate detection of *Clostridium difficile* glutamate dehydrogenase (GDH) in faecal specimens. This new kit offers an excellent screening method for specimens in accordance with many recommendations now being made with new testing algorithms for *C. difficile*. Full details, presentations, training sessions and samples are available on request from our Technical Team.

further information

Visit: www.pro-lab.com
Tel: +44 (0)151 2531613
Email: uksupport@pro-lab.com

Simple Filtration

The Sterilin range now includes filter products for life scientists. With an extensive range of products available, there is a suitable product for most applications, with a choice of membrane types:

PVDF: (polyvinylidene fluoride) – exhibits extremely low protein binding and is used for the filtration of non- aggressive aqueous solutions and mild organic solvents, or when maximising protein recovery is important.

PES: (polyethersulfone) – faster flow rates than PVDF, cellulosic or nylon membranes. It exhibits low protein binding and has low levels of extractables. It is suitable for the pre-filtration and filtration of both buffers and culture media.

MCE: (mixed cellulose ester) – effectively binds trace proteins. This membrane is an excellent substitute for either cellulose acetate (CA) or cellulose nitrate (CN) membranes.

NY: (nylon) – has excellent chemical resistance; it is hydrophobic and can be used with a broad pH range.

Contact us for our Sterilin 'Simply Filtration' product brochure.

Sterilin® Limited

Sterilin Ltd, Parkway,
Pen-y-Fan Industrial Estate,
Newport, NP11 3EF
Tel: +44 (0) 844 844 3737
Fax: +44 (0) 1495 242 242
e-mail: info@sterilin.co.uk
www.sterilin.co.uk

Use the DuPont Qualicon RiboPrinter® System for microbial characterization and ID - together we can pinpoint contamination with speed, ease and precision

OXOID

Part of Thermo Fisher Scientific

To find out more contact:

Oxoid, Wade Road, Basingstoke,
Hants, RG24 8PW, UK

Tel: +44 (0) 1256 841144
Fax: +44 (0) 1256 329728
Email: oxoid.info@thermofisher.com
www.oxoid.com