The Institute of Science & Technology

The Journal

Spring 2016

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The Journal

The Official Journal of The Institute of Science & Technology

Spring 2016

The Professional Body for Technical, Specialist, and Managerial Staff

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Editor's welcome

Welcome to the spring 2016 edition of the IST's Journal.

I'm pretty sure that you will enjoy this edition. It's packed with interesting and varied articles, member's news items (please let us know what's going on in your world), and information about upcoming events. My thanks, as always, to each and all the contributors to this edition – please keep the articles and papers coming in. Our new online newsletter has been a big hit with our members. Its editors, Natalie Kennerley and Kevin Oxley, have done a brilliant job in putting it together.

The year ahead is shaping up to be another busy one for the IST. Terry Croft, IST chairman, sets the scene in his Chairman's View. Our membership numbers continue to grow, as does professional registration. It is lovely to see the reward for the IST team's very hard work done in 2015.

Don't forget that the IST Technical Conference is coming up in September. Last year we hit the venue's capacity limit early, and so to avoid disappointment this year our venue capacity is significantly increased. However, delegate bookings are already beginning to grow (as of April 4th) so please don't delay, enrol early.

Make a note in you diary – **IST ONE DAY TECHNICAL CONFERENCE – 15th September 2016**

A "full house" at the start of last year's conference in Leeds. This year our venue is the Manchester Conference Centre, Manchester, M1 3BB.

Our name, Institute of Science & Technology, often leads people to think that we are only about pure science and its associated technology. We're not. But the question that I am often asked by prospective members is "I don't work in science, so is the IST right for me?"

My answer usually starts with "The IST is for any and all of those technicians and specialists who use a knowledge and understanding of science and technology in their work, and if you think about it that's a very broad and all-embracing job spectrum indeed. Just about all technical work starts with and uses the fundamentals of science, be it engineering, medicine, arts, textiles, or IT – to mention but a few."

In this edition Philippa Nobbs helps by offering an explanation of the relationship between science, engineering, and technology.

I personally believe that the IST is the ideal professional body for the professional technician, who invariably, is working in today's widely diverse, varied, and cross-disciplined environments. It is an institute that can and does support growing your technical career. Maybe, even growing to a point where your career specialises to such an extent that it leads you to consider joining a speciality focused professional body, and that's absolutely fine.

Ian Moulson
Editor

Chairman's view

In the UK there has been a stigma surrounding the role of technician for a very long time. So much so that technicians quite often believe it themselves. When asked "what's your job" we are reluctant to say, "I'm a technician" as though it's embarrassing. Not so in Europe and the USA! As I visit other universities in my day job (**www.sheffield.ac.uk/tdm**) as well as our industrial colleagues I have become aware of a significant sea change. Technicians are talking proudly of their professional roles as technicians. Universities are recognising their major contribution to both teaching and research. Companies and government bodies in partnership with the IST have been promoting and celebrating the achievements of their technical staff. This (necessary) change has been brought about through the IST's staff and volunteers who have worked tirelessly in getting the message out there (**www.timeshighereducation.com/news/sheffield-centre-tackle-decline-university-techncians**).

Our teams and individuals have listened to technical staff up and down the country and from all sectors. They have taken on board their frustrations, their aspirations and their suggestions. The Executive has then used this intelligence to focus the IST resources on how best to address these issues and concerns. I am glad to say the hard work over the last several years is definitely paying dividends. Employers from all sectors are embracing the National Professional Technician Registration scheme (**www.istonline.org.uk**) and demonstrating their commitment to CPD and focussed training and development. This has resulted in a win-win situation for both the employee and the employer.

As part of our "educational" campaign, one tool in particular that has proved an asset in the technical community's armoury is TECHNET (**www.technicians-network.net**)

It was developed by Natalie Kennerley and her colleagues as the key Technicians' Network – by technicians for technicians. Each TECHNET network whether in a company or a university allows technicians to share information, ideas and problems (and their solutions) quickly and effectively.

Here we are springtime again. What does the rest of the year hold for us? Well there is so much going on from presentations and workshops on a variety of topics up and down the country (keep an eye on our regular e-newsletter for more details of events) to our annual conference, which is taking place in Manchester this year on the 15th September 2016. Outreach activities include visits to UTC's, schools and academies promoting careers as Professional Technicians across the sectors. We are also involved in a number of events throughout the rest of 2016 supporting Apprenticeships following on from our support of the national "Apprenticeship Week" which ran from 14th to 18th March 2016.

The above picture shows the University of Sheffield's Vice-Chancellor Professor Sir Keith Burnett, CBE, FRS with the first cohort of apprentices in the Faculty of Science.

In addition to these events a number of "customised" events will also be taking place with our Corporate–Affiliates. As part of this partnership scheme we will be delivering seminars and workshops specifically tailored to their requirements including a number of CPD activities. So if your company or university is not yet part of this scheme then they can get further information from **www.istonline.org.uk**.

So enjoy the coming months as we move into summer but please don't forget that the annual conference in September is on a first come basis, as numbers are limited due to the high demand particularly for the workshop activities and breakout sessions. With keynotes from both Helen Sharman OBE, FRSC (IST President) and Professor Malcolm Press (Vice Chancellor Manchester Metropolitan University) as well as an exciting programme of talks and workshops you don't want to miss this – "YOUR Conference". Check out the website for further information at **www.istonline.org.uk**

Terry Croft
Chairman

IST members' news

Andy Kowalski - my multiple technical roles

Throughout my career in Loughborough University's Department of Chemistry I have had multiple roles, and worked in many different sections of the department, and this variety, flexibility, and challenge is something that I think might be useful to highlight to new entrants to our profession.

*Technicians **perform a highly technical service** for their employers and give vital support to both teaching and research. A point that Professor Robert Allison (the VC at Loughborough University) stressed at the HEaTED conference in January 2014.*

So let me tell you a little bit about my career in the Department of Chemistry. On entrance to the Organic section in April 1975, I began to learn more about gas liquid chromatography (GLC), high pressure liquid chromatography (HPLC), and nuclear magnetic resonance techniques (NMR), together with the use of standard instrumentation for undergraduate use, such as infra-red (IR), ultra violet /visible spectroscopy (UV/VIS) spectrophotometers.

Following a promotion I then moved to the Inorganic section where I used thermo gravimetric analysis (TGA) instrumentation, high temp furnaces, BETT and Vac frames (used in surface analysis and work under reduced pressure [physical chemistry applications]). I also trained junior technical staff in laboratory techniques, and engaged in trying out new experiments for undergraduate use.

I also worked on some of the research following on from final year projects that needed finishing off, especially in aspirin stability studies, cement analysis for calcium and silicon content, and determining how cements that were bound with organic substrates behaved. I carried out method development work on alumina columns with respect to Ferrocene, and also performed nickel pyridine analysis via TGA.

In 1990 I moved to the Analytical section, where I gained further experience in HPLC, GLC, atomic absorption (AA) – used in metal analysis, and an introduction to computer applications to chemistry. I had extra experience of learning about inductively coupled plasma-atomic emission (ICP-AES) spectroscopy, used in analysis of metal mixtures and a relatively new technique, and how they can be applied to water analysis in respect of metal presence.

From1995, I spent a few years working in the medical microbiology laboratories supporting the teaching and research that was going on there. This also included getting laboratories ready, use of instrumentation including small and large autoclaves for preparing media, and storage of it in molten state in ovens, and the use of centrifuges.

In 2001 I then took on a new administrative role in the departmental stores. The then manager was leaving and could not be replaced due to financial reasons. I set about computerising many of the processes and set up a database of chemicals stored. I instigated a computerised accounting procedure for items removed from stores, and also learnt about the necessary ordering procedures and online ordering, purchase card ordering, and reconciliation via Dcal, which was the University's financial system.

I was responsible for all Health & Safety in that area, including doing regular Risk Assessments in order to be complaint with university policy. I completed a dedicated course in Management so that tasks could be done more effectively and money saved wherever possible. This took place on part time basis from September 2002 to October 2003. I obtained my Diploma in late January 2004.

Following the recommendation of the course tutor, I started an Institute of Leadership & Management (ILM) course on a part time basis in December 2004 in Management Coaching and Mentoring, obtaining a Diploma in May 2005.

In 2005 I was asked to take over management of the main wet chemistry teaching laboratory, due to staff sickness. That was for a period of two years where I managed the laboratory and staff.

The laboratory was the introductory point for all new students (fresher's) starting out on their chemical studies, but also involved lab courses for the MSc Med Chem students and their projects.

By October 2007 the financial situation had improved and new technical staff were able to be appointed to take over running of the laboratory while I could then return to sole management of the stores, which unfortunately had not been that well managed in my absence. So on top of normal duties I had to assist the university's Financial Director in tracking down a deficit of £38,000. It transpired that this was because of poor record keeping by my stand-in, and was sorted out.

I continued to drive through improvements in procurement issues, finding better service providers and suppliers, and learning how to use the university's new Agresso financial system for all ordering procedures. I also dealt with HMRC and Home Office requirements with respect to supplies brought in from overseas. Showing students and school leavers on work based training was also part of that role as was training of other technical staff in the department.

As well as my technical work I also took part in job evaluations, real time and virtual, attendance at equality and diversity sub committees of the University, and also attendance at HSE meetings as a HSE rep for Unite the Union.

A technical career in higher education can, and very often is, a very varied one. Even in a single department!

Andy Kowalski
MIScT MRSC MCMI

Recently retired Andy is a former Loughborough University technician. He has recently obtained CPD accreditation for his coaching from the CPD office in Surrey and has started his own consulting company using his wide experience gained over his 40 years Loughborough. Further details can be obtained from website at www.andykowalski.wix.com/consulting

E: andykowalskiconsulting@hotmail.com

Estelle Asmodelle, FIScT

Estelle lives and works in Australia, and has recently published a paper in the Asian Journal of Physics.

This is a contemporary review of the involvement of Mileva Maric, Albert Einstein's first wife, in his theoretical work between the periods of 1900 to 1905. Separate biographies are outlined for both Mileva and Einstein, prior to their attendance at the Swiss Federal Polytechnic in Zurich in 1896. Then, a combined journal is described, detailing significant events. In additional to a biographical sketch, comments by various authors are compared and contrasted concerning two narratives: firstly, the sequence of events that happened and the couple's relationship at particular times; secondly, the contents of letters from both Einstein and Mileva. Some interpretations of the usage of pronouns in those letters during 1899 and 1905 are re-examined, and a different hypothesis regarding the usage of those pronouns is introduced. Various papers are examined and the content of each subsequent paper is compared to the work that Mileva was performing. With a different take, this treatment further suggests that the couple continued to work together much longer than other authors have indicated. She also evaluates critics and supporters of the hypothesis that Mileva was involved in Einstein's work, and refocuses this within a historical context, in terms of women in science in the late 19th century. Finally, the definition of collaboration (co-authorship, specifically) is outlined. As a result, recommendations are stated, the first of which is that Mileva should be seriously considered as an honorary co-author of one, possibly two, papers, and secondly, of which it is recommended that a serious inquiry should be made, concerning the extent of Mileva Maric's involvement in Albert Einstein's published works between 1902 and 1905.

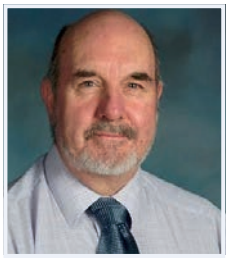
Asian Journal of Physics Vol 24, No 4 (2015) March
Subjects: History and Philosophy of Physics (physics.hist-ph)

Estelle Asmodelle is a computer scientist and a student in astronomy with the University of Central Lancashire, in the UK.

Estelle also writes articles on astrophysics, and is a member of the Australian Society for General Relativity & Gravitation. She also runs a blog on astrophysics at

www.relativecosmos.com

John Dwyer - a family IST coincidence



I was going through some past IST journals a couple of weeks ago and came across the article in Spring 2015 that celebrated IST's long standing members, which reminded me of a coincidence of my eldest brother Arnie and me. I was speaking to him on the phone a few years ago on the day I received the news that I had been elected as a Fellow of the IST, and mentioned this to him. It transpires that he has been a member of the IST since 1965, to which I was completely unaware in all the years I had been a member of the IST. He joined the IST when he was a Senior Technician in the Chemistry Department in what was then the Liverpool College of Technology, which then became Liverpool Polytechnic and is now John Moores University. He moved to Sheffield College of Technology (now Sheffield Hallam University) in 1968, as the first Chief Technician in the Chemistry department. He retired in 1995, when he was 60 years of age, and has still continued as a member to this day 51 years later. This follows a few coincidences in our career paths, as Arnie joined the Liverpool Dental School as a Laboratory Assistant in 1950-52, then after serving in the RAF for a few years; he started work in Liverpool College of Technology. It so happened that I worked for Liverpool Polytechnic in 1974 in the School of Pharmacy then moved to the Dental School. I went from the Dental School to the Royal Liverpool University hospital from 1990 -95 and then onto Lancaster University, where I am currently.

John Dwyer
FIScT

John is Faculty Superintendent and Area Safety Officer for the Faculty of Health and Medicine at Lancaster University. He is a Fellow of the IST and until recently was a member of the Strategy board as coordinator for Partnerships. One such partner is HEaTED through which he has been actively promoting professional registration (PR) of technical staff throughout the UK.

John has recently taken up the role of Champions Co-ordinator for PR, with the aim to develop a network of Champions around the UK HE Sector and the Environment Agency.

The IST Newsletter

We wanted to produce a regular newsletter as a great way to keep in touch with the membership. The newsletter provides helpful information about what's currently happening within the technical community and how the IST Executive and members are engaging with current issues. It's a great way to market events and other related events such as those offered by; HEaTED, Science Council, S-labs, it also provides web links to interesting features and broadcasts. We would like to use the newsletter to builds relationships with our membership by asking them to contribute or to use the newsletter to promote their own local events – we would like our members to use the newsletter as their voice. The newsletter is sent out to other affiliated organisations as a means of promoting technical values and to emphasise the IST's involvement in the technical community.

The newsletter goes out quarterly with additional supplements for special features or news flash bulletins.

To ensure you receive your copy please add **office@istonline.org.uk** to your contacts list.

IST Journal Publication

Back copies of our bi-annual Journal publication are viewable online, but access is restricted to our current members only. Members can log in using their surname as the username and their date of birth (format: yyyy-mm-dd) as their password.

The Journal Back Issues
http://istonline.org.uk/ist-journal-publication

If you experience any problems accessing the publications please contact us (office@istonline.org.uk), quoting your Surname, Membership Number and Date of Birth.

Article submissions for the IST Journal
We welcome article submissions from all areas of pure and applied science, and all areas of technology, including areas such as IT, media, and the arts. We like to cover existing, historical, and new technological advances, and also unusual aspects of science. We particularly want to encourage submissions from people who want to publish for the first time, and can offer help and assistance in putting a first article together.

Contact the editor: **i.moulson@istonline.org.uk**
Or the IST office: **office@istonline.org.uk**

The guidelines for article submissions to the IST Journal are:

1. Article submission deadlines for 2016/2017
2. Autumn edition is 1st September.
3. Spring edition is 1st March.
4. Articles should be submitted electronically in Microsoft Word .doc format with images sent separately as JPEG files (in the highest resolution possible please as we may not be able to reproduce low resolution images). Please cross reference to images and captions in your article text.

   This is our preferred option but other formats can sometimes be accommodated; please contact the Editor.
5. Short articles: these can be submitted in any length up to roughly 2,000 words.
6. Major articles: these are normally no longer than roughly 6,000 words per edition, but please contact the Editor for longer submissions as they can usually be accommodated across two or more editions.
7. All accepted articles will be edited into the IST Journal's house-style and may be corrected for grammar. Text layout and images may be changed, altered, or omitted.
8. All articles must be written in UK English. Poorly translated articles may be declined by the editors.
9. Article submissions should be submitted via email to **office@istonline.org.uk**. Your email should clearly state "Journal Article Submission" and the article and images sent with it as separate email file attachments.

We can provide subscriptions for hard copies of our Journal – rates for 2016 are as below, for further details please contact (**office@istonline.org.uk**):

UK – £25 per year (2 editions per year) EU – £40 per year (2 editions per year)

Non EU – £55 per year (2 editions per year)

Communications and the IST

We are working hard to ensure that we provide our members with the best service that we can, and one of the areas that we have updated is our communications. There are now a number of ways in which we can stay in contact and provide information for our members.

Email – This continues to be our preferred method for direct contact with our members, particularly as we have a significant number of overseas colleagues for whom hardcopy mailings can be problematic (and costly).

Our main email addresses are:

office@istonline.org.uk – general enquiries

memberships@istonline.org.uk – enquiries regarding new memberships and renewals

registrations@istonline.org.uk – enquiries regarding CSci/RSci/RSciTech registrations and renewals

It is important that we have everyone's up-to-date email address so if yours changes please let us know.

Website (**istonline.org.uk**) – We post both important announcements and general information that we think will be useful for our members on our website, so visit us there on a regular basis to see updates.

Social Media – We use social media routes for quick communications, networking and hope to encourage both members and non-members alike to engage in online discussions and provide ideas and feedback. The platforms that we use are:

Twitter (@istonline) – we encourage ideas, feedback, and discussions using **#istforum**

Facebook (institute.of.science.and.technology) – feedback, ideas and comments welcome

LinkedIn and Google+ – join in group discussions, links through to these groups (and our Twitter account and Facebook page) are available on our website.

Applying for Fellowship

FIScT

Fellowship of the Institute is the most senior grade available and is an indicator of a very high level of achievement in the field and an outstanding contribution to the profession.

Fellowship candidates will require considerable experience gained over a number of years of responsible work, and be able to demonstrate important achievements relating to the application of science, technology, or management skills. Fellows of the Institute are elected by the Executive on the recommendation of a Fellowship Panel which comprises at least 3 Fellows of the Institute in good standing. The Fellowship Panel will take into consideration, in support of each application, qualifications, professional work experience, length of service, supervisory ability, contribution to the advancement of science and/or technology, and the candidate's commitment to furthering the aims and objectives of the IST.

Individuals may be nominated for Fellowship by existing members of the Executive of the Institute, or they may apply in their own right using the appropriate form available from the Registered Office or the IST's website. The same criteria apply in either case, although the process differs slightly. Guidance information in respect of the application process is also available on our website.

New Fellows are expected to contribute to the advancement of the IST and to play a full and active role in promoting the institute. In their first year of membership new Fellows will also be encouraged to submit a suitable article for publication in the IST's biannual Journal.

Application forms and guidance documents can be downloaded at (**istonline.org.uk/membership/fellow**).
T: 0114 276 3197
E: office@istonline.org.uk

Application for membership

Membership

Membership of the Institute is open to specialist, technical, and managerial staff in a broad range of environments such as science, engineering, industry, local authorities, schools, FE, HE, research/analytical/ health facilities, government departments, and many more in the UK and overseas. There are five grades of membership in the Institute. An applicant does not initially apply for a specific grade of membership, the grade offered by the Institute being dependent upon the qualifications and experience of the applicant.

Why Join?

To help us maintain, build and expand the (IST) community.

IST can help by supporting and developing your:

- career and interests
- professional standing
- knowledge and skills
- network of contacts

Together we can be a voice to be heard and listened to.

Application for membership at Junior, Affiliate, Associate, and Member grades can be made by email or by post to the IST office using the standard application form which is available for download

(**http://istonline.org.uk/membership/**). The form must be accompanied by a copy of each relevant certificate, diploma etc. (scanned copies sent electronically are accepted). Completed applications should be emailed through to **memberships@istonline.org.uk** or posted to our Sheffield Office.

Membership Application Notes for those applying for membership are available (**http://istonline.org.uk/membership/**).

When an application has been accepted, the applicant will be notified of the grade offered, at which time a full subscription payment will be required (within one month of notification). After the subscription has been received the new member's name will be added to the Register of Members and a Certificate and member's card will be sent. Following entry on the Register members are entitled to the designated post-nominal letters relevant to their grade.

Membership fees are:

- Junior: £5
- Affiliate: £20
- Associate: £35
- Member: £45
- Fellow: £58

*Retired or unemployed members can claim a reduction of 50% off the normal rate

Previous members whose membership may have lapsed can apply for reinstatement by completing and returning a Membership Reinstatement Form to **memberships@istonline.org.uk**

Payment of subscriptions can now be made online

What we're about

The Institute of Science and Technology has been supporting specialists with the technical skills that the world's economy needs for more than 68 years. We represent all sorts of technicians, experts, and managers wherever they work: from science labs and engineering facilities to recording studios and IT departments.

As technology continues to develop at a tremendous pace, the IST is there to help technicians be the best they can be. We encourage our members to further their careers by pursuing professional and personal development, and by attaining a professional status that recognises the value of their experience and expertise.

In that way, we are always thinking about the future for our members and the organisations they work for. It is our mission to ensure that industry, business, research, schools, colleges, and universities have the staff they need to keep up with constant advances in science and technology.

Central to this is the IST's belief that technicians deserve formal recognition for the work that they do, the experience they've racked up and the expertise they have to share. We know that our members are skilled professionals, and now we can give them official accreditation as a Chartered Scientist (CSci), Registered Scientist (RSci), Registered Science Technician (RSciTech) or Registered Practicioner (MIScT(Reg) or FIScT(Reg)) to prove it.

By registering, technicians are promoting the professional standing of themselves and their colleagues. They are showing that they are making a vital contribution in their fields and achieving a status that makes them a key asset for the long-term.

We are working hard to bring technicians from all disciplines into our international community of specialists. Our members work across a wide range of fields, which gives each of them the chance to make contacts across business, industry, research, and education, and address the challenges these areas face together.

There is advice and guidance available for members (particularly new or young ones) through the IST's Mentoring Support Network. Our work with organisations such as HEaTED and unionlearn, promotes the professional development of technicians in all areas. Together, we are ensuring technicians get the support and opportunities they need to achieve their potential.

We know how important it is for technicians to be able to develop their skills and have their expertise recognised. We know too, as we look to the future, that many more highly skilled technicians are needed. That's why the IST has dedicated itself to continuing to raise the status of specialist, technical and managerial staff and to continue to support their progression.

The IST is an organisation run by technicians for technicians.

The number of skilled technicians joining the IST's registration scheme is growing fast. That's because more and more of our members are discovering the great benefits and opportunities that professional recognition can bring.

The IST is one of the Science Council's Licenced Bodies and can now award Chartered Scientist (CSci), Registered Scientist (RSci) or Registered Science Technician (RSciTech) status to experienced technicians.

To register, you simply need to show that you have, and use, the skills that qualify for professional status, while always continuing with your professional development. A full explanation of what you need to do to get registered status can be found on the IST website: **istonline.org.uk/professional-registration**

In addition, the IST is running workshops in different organisations to explain the application process in more detail. If you are interested in one of these workshops, and there is enough interest where you work, email **office@istonline.org.uk**

You can also meet some of the people who have registered so far by visiting our website: **istonline. org.uk/professional-registration/case-studies**

The Institute of Science & Technology

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Not working in science or science technology?

IST Registered Practitioners

The Institute of Science and Technology is uniquely an organisation run by technicians for technicians. We support these incredibly important staff in all areas, not just science but technologists in all fields.

As the professional body for specialist, technical and managerial staff, we are actively involved in the professional recognition of technical staff in education, research, government, and industry. It is our view that our Registration Schemes are essential to establish your professional standing, acknowledge your expertise and to enhance your career prospects.

Technicians and technologists working in non-science fields may not be eligible to join the Science Council's Registers but the IST recognises the exceptional work that technicians and technologists working in non-science fields do. We are committed to providing all our members with a means to endorse their status and to enable them to demonstrate transferable skills, up-to-date professional competence, and continuing professional development. We do this through our Registered Practitioner Scheme and by the designation of **MIScT(Reg)** or **FIScT(Reg)** status to members who meet the criteria.

Registered Practitioners must have attained a high level of technical proficiency supported by sufficient knowledge of modern technology to enable them to relate to operating practises in their chosen field.

Want to find out more?
Visit: istonline .org.uk
Follow us on Twitter @istonline

The Institute of Science & Technology

Chartered Scientist
Registered Scientist
Registered Practitioner
Registered Science Technician
IST CPD Award

Since 1987, the IST has operated a register of competent and qualified technical practitioners

Criteria for Registration include:

- Corporate Membership of the Institute of Science & Technology
- Higher National Certificate or Diploma (other qualifications judged to be of equivalent standard also satisfy the requirements)
- NVQ/SVQ level 3 or 4 in an appropriate occupational area
- Completion of the HEaTED/IST CPD award*
- Appropriate experience (in terms of breadth, depth, and length)

Importantly, there is also a route for mature applicants who have achieved a high standard of professional competence but who may not have the formal academic qualifications.

Registration is renewed each year with evidence of Professional and Personal Development. There is a small fee for admission to the Register and a nominal annual renewal fee.

** The IST CPD award can be used to demonstrate CPD activity for the RSci, RSciTech and RegPrac schemes and fulfil associated registration scheme competencies. Individuals automatically become members of the IST, and although the IST CPD award is not a qualification it does allow the individual to formally demonstrate work based experience and learning.*

New members and registrations

New members

Membership No.	Name	Grade
T15519	MIScT	Miss S A Fryer
T15520	AssocIScT	Miss Akpoguma
T15521	MIScT	Mr A Nadi
T15522	MIScT	Mr P L Osborne
T15523	MIScT	Mr R Godwin
T15524	MIScT	Mr A Bamford
T15525	MIScT	Miss T L Webster
T15526	MIScT	Dr H J Smith
T15527	MIScT	Mr K A Burnett
T15528	MIScT	Mr P Morgan
T15529	AssocIScT	Mr O Edobor
T15530	MIScT	Mr P W Chan
T15531	MIScT	Miss E Markham
T15532	MIScT	Mrs S J Surfleet
T15533	MIScT	Mrs F M Milne
T15534	MIScT	Mr M Green
T15535	MIScT	Dr C Allen
T15536	MIScT	Mrs V Thomas-McArthur
T15537	MIScT	Mr M P Thomas
T15538	AssocIScT	Mr R Shepherd
T15539	MIScT	Mr J D Wright
T15540	MIScT	Miss S J Hicks
T15541	MIScT	Dr J Yu
T15542	MIScT	Mr B E Findlay
T15543	FIScT	Mr M Murray
T15544	MIScT	Mr S A Burgess
T15545	MIScT	Mrs C L Davies
T15546	MIScT	Dr S J Mabbutt
T15547	AssocIScT	Mr O S Ebosieh
T15548	AssocIScT	Miss E O Imanah
T15549	MIScT	Mrs I Suresh
T15550	AssocIScT	Miss A J Dibie
T15551	MIScT	Mr R W Carter
T15552	MIScT	Miss K Callaghan
T15553	MIScT	Mrs P N Nomeh
T15554	MIScT	Miss F N Lato
T15555	MIScT	Mrs M Johnson
T15556	MIScT	Mr W R Saint
T15557	MIScT	Mrs S M Foster
T15558	MIScT	Mr A Welham
T15559	MIScT	Mr R J Swales
T15560	MIScT	Mrs A A Olatunde
T15561	AssocIScT	Miss I M Edebiri
T15562	MIScT	Miss S Hill
T15563	MIScT	Mrs D S G Croom-Carter
T15564	MIScT	Mrs K Chauhan
T15565	MIScT	Mrs D Farina
T15566	MIScT	Dr D S Milner
T15567	MIScT	Miss G M Walton
T15568	MIScT	Mrs R Dawe
T15569	MIScT	Mr A N Sheward
T15570	AssocIScT	Miss C D Lowry
T15571	MIScT	Mrs Tidball
T15572	AssocIScT	Miss J Broom
T15573	MIScT	Mr I J Leaves
T15574	MIScT	Miss A I Tochwin
T15575	MIScT	Miss Sherrington
T15576	AssocIScT	Mr D Parkinson
T15577	MIScT	Mr J A Faulks
T15578	MIScT	Mr M S Heath
T15579	AssocIScT	Mrs O Obaraye
T15580	MIScT	Mr D C Gentle
T15581	MIScT	Dr A J Foster
T15582	MIScT	Mr M R Sutton
T15583	MIScT	Mr T Davies
T15584	AssocIScT	Mr V Ehigie
T15585	FIScT	Dr H P Sharman
T15586	MIScT	Mr W I Booth
T15587	MIScT	Dr M S Gião
T15588	MIScT	Dr S Krishnan
T15589	MIScT	Dr K Gulia
T15590	AssocIScT	Mr I Orumwense
T15591	MIScT	Mr M D Spence
T15592	MIScT	Mr R J Pedrick
T15593	MIScT	Miss C L Bathurst
T15595	FIScT	Mr T D J Haycock
T15596	MIScT	Mr A Hemstock
T15597	MIScT	Mr A P Delorenzi
T15598	MIScT	Mr M T Murphy
T15599	MIScT	Mr S A Chapman
T15600	MIScT	Mr C J Hill
T15601	MIScT	Mrs W A Usman
T15602	MIScT	Mr A A Adeala
T15603	MIScT	Mr D Dunstan
T15604	MIScT	Mrs C E Kolenda
T15605	MIScT	Dr M Mehmi
T15606	MIScT	Miss S Mehmi
T15607	MIScT	Miss T Tang
T15608	MIScT	Mr Y K Ng
T15609	MIScT	Dr A A Bowden
T15610	MIScT	Mr T Doyle
T15611	MIScT	Mrs A A Kehinde
T15612	AssocIScT	Mr T O Weir
T15613	MIScT	Mrs J M Inch
T15614	MIScT	Miss L Wilson
T15615	MIScT	Mr S R Sharpe

Membership No.	Name	Grade
T15616	MIScT	Mr D Rowe
T15617	MIScT	Dr M Gulcur
T15618	AssocIScT	Miss L E Idusogie
T15619	MIScT	Mr D O Oaikhinan
T15620	MIScT	Mrs G Newsome
T15621	MIScT	Mr P Brien
T15622	MIScT	Mr Nicolson
T15623	MIScT	Dr C Hutton
T15624	MIScT	Mr A Quin
T15625	MIScT	Miss J Mehers
T15626	MIScT	Mr O Greenwood
T15627	AssocIScT	Mr C J Ikpegede
T15628	MIScT	Ms S Choudhury
T15629	MIScT	Miss H L Wright
T15630	AssocIScT	Mr E Marriott
T15631	AssocIScT	Mr N J Bond
T15632	AssocIScT	Mr G Reynolds
T15633	MIScT	Mr O F Amayo
T15634	FIScT	Dr O Akinnuoye
T15635	MIScT	Mr A Price
T15636	MIScT	Mrs E Rickaby
T15637	MIScT	Ms Z A Alimi
T15638	MIScT	Mr R J Webster
T15639	AssocIScT	Miss J M Whitnear
T15640	AssocIScT	Miss T E Blackbourn
T15641	MIScT	Mr Sandeep Gopaul
T15642	MIScT	Mr M Haigh BEng
T15643	AssocIScT	Mr A C Green
T15644	MIScT	Dr Z Daniel
T15645	MIScT	Miss A L Stewart
T15646	AssocIScT	Mr D Schofield
T15647	MIScT	Dr M T B H Sultan
T15648	AssocIScT	Mr J Leach
T15649	MIScT	Mr F Fletcher
T15650	MIScT	Ms M H Craigon
T15651	MIScT	Dr E J Bennett
T15652	MIScT	Mrs A J Valentine-Baars
T15653	MIScT	Miss E K Igbinigie
T15654	MIScT	Miss K R Barnes
T15655	MIScT	Dr S Ansell
T15656	MIScT	Dr Halcovitch
T15657	MIScT	Miss L K Pearce
T15658	MIScT	Mrs M F Oyeleke
T15659	MIScT	Ms A Hallows
T15660	MIScT	Dr G Hessman

Total: 141

Science Council Registrations

Membership No..	Name	Grade
T15310	Mr M N El-Guindy	CSci
T15353	Mr E Wallis	CSci
T15387	Dr J J Bomphrey	CSci
T15440	Dr R Whalley	CSci
T15473	Dr G Niven	CSci
T15488	Dr C E M Stevenson	CSci
T15551	Mr R W Carter	CSci
T14577	Mr J R M Webster	RSci
T14905	Mr K Arnold	RSci
T14930	Mr T Williamson	RSci
T14985	Mr C B Birchall	RSci
T15124	Mr O Cooper	RSci
T15449	Mrs S L Galloway	RSci
T15456	Mr T S Gregson	RSci
T15461	Mr D L Lath	RSci
T15485	Mr D Fox	RSci
T15486	Mr C J Gelauf	RSci
T15492	Mrs S J Wellington	RSci
T15493	Miss E Smart	RSci
T15498	Mr F Bayer	RSci
T15500	Mrs B Frater	RSci
T15512	Mr D C Chilton	RSci
T15516	Ms R M Austin	RSci
T15523	Mr R Godwin	RSci
T15540	Miss S J Hicks	RSci
T15552	Miss K Callaghan	RSci
T15555	Mrs M Johnson	RSci
T15556	Mr W R Saint	RSci
T15557	Mrs S M Foster	RSci
T15558	Mr A Welham	RSci
T15565	Mrs D Farina	RSci
T15604	Mrs C E Kolenda	RSci
T15609	Dr A A Bowden	RSci
T15613	Mrs J M Inch	RSci
T15614	Miss L Wilson	RSci
T15623	Dr C Hutton	RSci
T15644	Dr Z Daniel	RSci
T15204	Mr A Ford	RSciTech
T15382	Miss R L Gaskell	RSciTech
T15480	Mr M J A Oxford	RSciTech
T15489	Dr T H Bishop	RSciTech
T15507	Mr A Wilson	RSciTech
T15519	Miss S A Fryer	RSciTech
T15524	Mr A Bamford	RSciTech
T15525	Miss T L Webster	RSciTech
T15528	Mr P Morgan	RSciTech
T15636	Mrs E Rickaby	RSciTech

Total: 47

What is the relationship between science, engineering and technology?

Philippa Nobbs

It's a question that we at the IST are regularly asked.

Science

- is the body of knowledge of the physical and natural world
- seeks to describe and understand the natural world and its physical properties
- uses varied approaches, e.g. controlled experiments, observational studies, to generate knowledge
- produces knowledge that can be used to make predictions

Engineering

- is the application of knowledge in order to design, build, and maintain technologies
- uses varied approaches, e.g. design processes, engineering analysis, to produce and evaluate solutions and technologies
- aims to produce the best solutions given resources and constraints

Technology

- is the body of knowledge, systems, processes and products that result from science and engineering
- can be used to describe almost anything created and made by humans to solve a problem or meet a need
- results from the processes of engineering

Engineering may be defined as 'the practical application of science and maths'. Therefore, engineering is 'applied science' making an 'engineer' an 'applied scientist' who takes on board scientific discoveries and theory and puts them to work in the real world.

In short, engineers 'turn science into reality'. Scientists produce knowledge and, as applied scientists, engineers use that knowledge to create products, structures/buildings, machines, technology, complex systems, etc.

Engineering involves the use of materials, e.g. metals, semiconductors, ceramics and polymers, which have defined structures and properties that are well understood, enabling them to be used to their full potential and exploited in new ways. The characterisation of a material depends on its structure, processing, properties and performance. Materials exhibit various properties, including mechanical, chemical, electrical, thermal, optical and magnetic. The properties of a material determine its usability and, hence, its engineering application. The techniques involved in using materials, e.g. cutting, shaping, joining, also utilise principles of chemistry and physics.

Materials, for an engineer, are of utmost importance. The usage of the appropriate materials is crucial when designing systems, and, hence, engineers are always involved in materials. Thus, materials science is becoming increasingly important in an engineer's education.

Branches of engineering include:

aerodynamics, aeronautical engineering, aerospace engineering, agricultural engineering, astronautics, automotive engineering, bioengineering, chemical engineering, civil engineering, computer-aided engineering, cosmonautics, electrical engineering, electronics engineering, environmental engineering, ergonomics, fluid dynamics, genetic engineering, geotechnics, hydraulics, mechanical engineering, mechatronics, military engineering, mining engineering, naval engineering, nuclear engineering, process engineering, production engineering, sanitary engineering, structural engineering, traffic engineering.

All start with the same basic training and qualifications leading to specialisation when an individual has found which area s/he chooses to follow as a career.

Philippa Nobbs

BA(hons), MCGI, MIOSH, FIScT

Philippa is the IST's Education Officer. She represents the IST in various national projects concerning training, qualifications and professional registration. She has been involved in many aspects of technician training, both locally and nationally and has written training and assessment material for the IST and for national schemes.

UMBA University Bioscience Managers' Association

Arthur Nicholas

About Us

The University Bioscience Managers' Association (UBMA) is the collective voice for the Biosciences sector Technical Resource Managers, representing 70 Universities across the UK and Ireland. Our members are pivotal in the planning and management of human, physical and financial resources in University Biosciences teaching and research.

Our History

The University Biological Supervisors' Association (UBSA) was formed in 1983 by Basil Boam (Life President) and David Smart (Life Vice – President) both Superintendents from the University of Sheffield. In April 2000 the name was changed to the University Bioscience Managers' Association (UBMA). In 2012, members of the National Association of Biochemistry & Biological Sciences (Managers) (NABBS) joined with the UBMA bringing together a wealth of knowledge and expertise under the single umbrella of UBMA.

Our Aims

Through networking, collaboration and working with other professional bodies, members aim to continually improve quality, efficiency and effectiveness in Bioscience teaching and research. We proactively inform and seek to influence national policy toward developing and disseminating best practice and professional development of the Technical workforce.

What we do

Provide forums for the exchange of ideas

- JISC Email Group: "SUPT-UBMA-COM@JISCMAIL.AC.UK" UBMA – members email list.
- Protected: Members Portal: http://ubma.org.uk/members-portal/
- An annual conference held at one of our member institutions.

Proposed future conference venues:

- Hull University 2017
- Imperial College London 2018
- Coventry University 2019
- Manchester University 2020
- University of Limerick 2021

Seek to influence national policy by the representation of Members views through

- Organisational membership of The Royal Society of Biology (RSB).
- Corporate Affiliation to The Institute of Science & Technology (IST).
- A memorandum of understanding with the Heads University Biosciences (HUBS).
- A close working relationship with the Science Council on matters of HE policy and practice.

Encourage training and development of Technical staff at all levels

- Presenting at Professional Development Zones in Trade Exhibitions and Conferences.
- Promoting and sponsoring Professional Registration and IST membership via "The John Robinson Professional Development Awards" and encouraging member organisation led initiatives.
- Collaborating with HEaTED in the delivery of UK Regional Network Events.

The 2016 conference was hosted by the University of Exeter.

Disseminate best practice through

- Presentations and workshops at the annual conference.
- Providing a friendly, inclusive and vibrant network environment which promotes the sharing of knowledge, experience and expertise amongst its members.

Join Us

Membership of UBMA is open to staff with resource management responsibilities in higher education bioscience and life sciences disciplines.

UBMA members contribute just 48p/wk. to be part of an effective, structured organisation steered by a committed executive, elected annually from within the ranks of the membership. The executive committee work with and for the membership, responding to their individual professional needs and shared aspirations for the profession.

As Chair of the Association, I'd like to invite you to join with Resource Managers from across the full spectrum of Biosciences: Environmental; Sports; Medicine; Agricultural in shaping the future of our shared profession. Simultaneously, seize the opportunity to add value to your personal professional development and enhance your professional standing whilst forming career enriching, professional relationships and friendships within the UBMA "family".

Follow us on Twitter @_UBMA

Join our Linkedin group

If you have any questions concerning the Association or would like to approach the UBMA about collaborative projects, please contact us at:

ubma.org.uk/contact-us/

Dr Arthur Nicholas M.Sc., D.M.S., Dip.NEBOSH, M.I.Biol., GIOSH, MISTR, FIScT is a University Safety Co-ordinator at the University of Manchester. Progression through the Technical career structure, at the University, lead into work with Estates & Facilities and Environmental Sustainability. Arthur currently works with the University's H&S team and is a member of an USHA national working party reviewing UCEA "Placement" guidance.

He was elected as Chair of UBMA in 2012 and to the University's General Assembly in 2014. His other professional activities with RSB, HEaTED, IST, ISTR and IOSH have presented numerous opportunities for personal and professional development and, in some small way, enabled a contribution to the effectiveness of the activities they undertake.

Wy not join us • become part of the bigger picture

Join with us in shaping the future of our profession: **http://ubma.org.uk/membership-appication/**

The engineer Chas W. Cook

Alan Gall, IST Archivist

Figure 1. Charles William Cook pictured in Town and Country News 1934

Introduction

At the tender age of eleven Charles William Cook began his working life as a railway telegraph clerk. Nearly sixty years later he retired as head of the firm known as Chas. W. Cook & Sons Ltd, but continued as a director in the role of technical consultant.

A genial Londoner, known to all as Chas, he established a reputation as an outstanding engineer who was willing and eager to embark on new ventures. After a period acquiring engineering skills at several London based machinery makers, his career path turned in a different direction with an appointment as mechanic at the Royal Institution of Great Britain. At the RI he constructed equipment for James Dewar (of vacuum flask fame) and also made the acquaintance of a research worker called Joseph Petavel.

Petavel left the RI for a research fellowship at the University of Manchester, taking with him a very favourable impression of Chas Cook. It was on Petavel's recommendation that Chas received a job offer as Manchester's instrument maker. His employment contract encouraged work for outside customers on the condition that the university received priority when required. For the next seventeen years Chas remained in the post, during which time his services were called upon to support cutting-edge research, and in tandem he developed a range of scientific equipment for general sale.

The advent of World War One saw Chas involved with submarine and aviation innovations. A handed-down family story is that he constructed depth charges that were tested in a lake at Manchester.

After an upset with some of his employees, Chas Cook bought a hotel at Ashby de la Zouch where he converted the disused spa baths at the rear into workshops. He combined the hotel business with a garage and continued to manufacture apparatus designed at Manchester. One product was the Mahler-Cook bomb calorimeter, sold through a number of the large laboratory suppliers. He also continued to design and manufacture apparatus for university customers. A mammoth cloud chamber for Patrick Blackett was one of the special projects undertaken while at Ashby.

Charles Cook's sons persuaded him that Birmingham offered a prime location for an engineering firm like theirs. A reluctant Chas agreed to the move, pacified with the promise of a London office.

After Charles Cook's death, the business went through a number of ownerships. It finally closed in 1990 although still a viable business. A resurrection that lasted for several years followed. Under the name of Chas W. Cook (MM) Ltd, the final incarnation of the company was dissolved in 1998.

Early life

Charles William Cook was born at Carshalton Cottage, Ceylon Road, Hammersmith to William and Charlotte (née Carey) on 27 May 1868. The family bible shows that Charlotte gave birth to six children, two before Chas and three after. William Cook gave his profession as a railway station signalman in 1868 and if he worked at Kensington Station, the journey there would have taken about five minutes on foot.

Staff records for the London & North Western Railway Company at Kensington do record a William Cook as a signalman, earning 24 shillings per week.

By 1871 the family had moved to 4 Hope Street, Battersea where Chas's brother Alfred was born. Presumably, William's employment with the railway enabled Chas to start work as a telegraph clerk around 1879. In an interview for *Town and Country News* in 1934, Chas gave an account of his self-education by "attending the old South Kensington Science and Art Classes and the several Polytechnics, then commencing in London." An apprenticeship with an engineering company started his career as a mechanical engineer at the age of fifteen.

Employment in London and starting at the Royal Institution

Notes from a job interview at the Royal Institution in 1897 list four previous employers. If these are in chronological order then the earliest is Masson, Scott [& Co Ltd] (probably when it existed as Masson, Scott & Bertram). This firm, run by a partnership of Andrew Masson and Robert Scott, manufactured papermaking machinery. The 1891 census records Charles W Cook as a steam engine maker. This fits in with the period from about 1887 at Willans and Robinson of Thames Ditton, manufacturers of steam engines. The next position was at Ransome & Co, likely to have been the wood cutting machinists and ironfounders A. Ransome & Co Ltd. Not long after, he moved to Lennox, Reynolds and Fyfe where he spent three years. This last employment proved pivotal.

The new Davy-Faraday Research Laboratory at the Royal Institution on Albemarle Street recruited a mechanic in December 1896, one William Dittmar. Because the standard of work produced by Dittmar fell far below expectations, he lasted only a few months. Responsible for staff selection was Dr Alexander Scott, the laboratory Superintendent.[1] He engaged Charles Cook and the two would keep in touch for many years after.

How did Chas know about the vacancy? In all likelihood, it was through Robert Nicol Lennox who employed Chas at Lennox, Reynolds and Fyfe. Lennox happened to be the chief assistant to James Dewar, Fullerian Professor of Chemistry at the RI since 1877. Dewar was working on the liquefaction of gases, which required large compressors. *Nature* commented: " ... the laboratories of the Royal Institution have gradually approached more and more nearly to the likeness of an engineering workshop."[2] In this environment, Chas Cook developed his expertise in building high-pressure equipment.

The year after Chas Cook joined, the RI saw a controversy aired in the letters pages of *Nature*, about Dewar's method of liquefying hydrogen. William Hampson, an Oxford MA, had developed a process for refrigeration and applied for provisional patent protection on 23 May 1895. The full patent granted 28 March 1896 described the invention as "The Self-intensive Refrigerator of Gases". "Self-intensive" referred to the use of a heat exchanger to cool hot compressed gas with expanded gas and so successively increase cooling.

Before lodging the provisional specification with the Patent Office, Hampson had approached Robert Lennox at the RI with full details of the method, receiving a promise of help in developing the apparatus.[3] When Dewar described the results of experiments to liquefy hydrogen and details of the apparatus "... admirably constructed by the engineers, Messrs. Lennox, Reynolds and Fyfe ..."[4] Hampson concluded that his idea of self-intensive refrigeration had been stolen and the exchange of letters to *Nature* resulted in Dewar resorting to personal abuse.[5] Hampson threatened to sue Lennox, Reynolds & Fyfe, but didn't on the grounds that he had insufficient financial means to pursue the case.

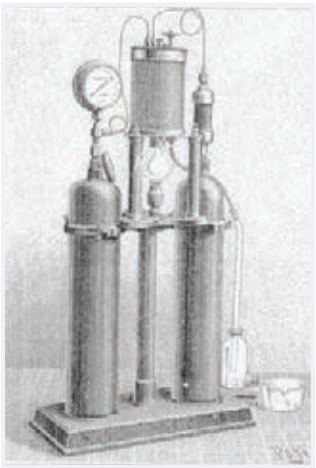

Figure 2. Apparatus for liquefying gases, made by Lennox, Reynolds and Fyfe as shown in the French journal La Nature, 25 July 1898

Robert Lennox managed to combine his commercial interests with assisting the (sometimes dangerous) work for James Dewar. With financial assistance to the tune of £800 from Kenneth Reynolds and Alfred Fyfe, a factory had been erected in Fulham, called the Rosebank Works. The factory undertook chemical engineering projects and manufactured for sale the apparatus subject to the claim of "infringement of patent" by Hampson. This business activity didn't go unnoticed by Chas Cook and his firm later quoted 1896 as the date of establishment, the final year that Chas worked for Lennox.[6]

Joseph Petavel

Petavel studied both mechanical and electrical engineering at University College, London. In 1896 he secured a Solomon's Scholarship, awarded by the Institution of Electrical Engineers. He was nominated by University College for an 1851 Exhibition Scholarship worth £150 per year, which he received in June 1896.

Petavel began work in the Davy Faraday Laboratory in 1897. At the RI, along with other projects, he studied the behaviour of gases during explosions in thick-walled vessels and developed a gauge to measure high pressures. Petavel's precision in making measurements and talent for designing apparatus eventually led to an appointment as the first director of the National Physical Laboratory.

Chas Cook arrived at the RI two months after Petavel. The skills of the two married together well and a number of Petavel's equipment designs were still displayed in the Chas W. Cook & Sons Ltd catalogue of c.1943. The RI years were certainly formative for Charles Cook, who later dabbled in many different engineering projects but made high-pressure equipment his speciality.

James Dewar had a reputation for being quarrelsome and obnoxious. Lennox left after a row and Alexander Scott was effectively sacked. A note that he wrote to his assistant while at the University of Cambridge in 1891 gives a flavour of his temperament.

In view of the fact that I require the use of the rooms ... and that I cannot occupy them until such time as you remove therefrom, I order you to do so forthwith. When I have further need of your services I will acquaint you in due course with my requirements[7]

Petavel was banned from the laboratory after Dewar took offence at some remarks Petavel had made during an argument. An apology saw Petavel reinstated but Dewar did not easily forget such events. Perhaps the incident reduced any guilt Petavel might have felt when he later recommended "head-hunting" Chas Cook.

1895 – 1905

Two years prior to becoming mechanic at the RI, Chas had married Lottie Marie Washbourne. Alfred William, their first child, followed in 1896 and then Charles Edgar in 1898. The family lived in a terraced house south of the River Thames at 122 Disraeli Road, of Putney High Street, from at least 1900 until leaving London in 1905.

From a letter written by Chas to the RI, we know that his wages were paid while he recovered from an illness by taking "a course of the Hot Mineral Waters" at Bath.[8] The letter mentions the extra expenses incurred by the necessity of taking Lottie with him to Bath because of his "helpless condition". This affliction, said to be rheumatism, had previously occurred in 1898. At that time the expenses were covered by the chemist and industrialist Ludwig Mond (who had funded the establishment of the Davy-Faraday Laboratory). On the basis of this prior generosity, James Dewar recommended paying for the 1901 trip to Bath.[9]

Petavel left the RI in 1901 to take up a John Harling Research Fellowship at the University of Manchester. However, he crossed paths again with the RI when, on Dewar's recommendation, he was placed in charge of low temperature apparatus at the St. Louis International Exposition of 1904. On show was the apparatus for the liquefaction of air and hydrogen, as used at the RI and manufactured by Lennox Reynolds and Fyfe. According to Robert Hutton at the University of Manchester, Dewar then refused to supply the necessary vacuum vessels and Hutton managed to get them manufactured in Germany and shipped to St Louis in the nick of time.[10]

After the trials and tribulations of the St Louis exhibition, Petavel went on holiday to the Far East, returning to Manchester in April 1905.

The year 1905 saw two notable events for Chas Cook: the birth of his son Albert Leslie and an invitation to become instrument maker at the University of Manchester.

Arthur Schuster, Langworthy Professor of Physics, did much to develop his department in terms of accommodation, equipment and personnel. Acting on Petavel's recommendation, he wrote to Chas Cook offering a role that combined the duties of university instrument maker and a self-employed engineer. After several drafts of the employment contract, Schuster proposed a wage of one shilling and nine pence per hour for a guaranteed workload of 2000 hours per year. It was allowed, and expected, that Chas Cook would supplement his income with outside work. Accounts were to be kept so that the proportion of commercial work could be identified. As is known from Schuster's report to Council for 1906-07, there was no need to invoke the minimum hours clause: "He has met with considerable success and the university will not be called upon for any portion of the guarantee which they gave to Mr Cook ..."

Figure 3. Arthur Schuster photographed for an article in Nature 1907

From Chas Cook's letter of acceptance to Schuster, some light is shed on the business activities conducted outside of the Royal Institution job. "As regards the contract I have been trying to obtain, the work is the making & supplying of a plant for the preparation & making of waterproof paper but I fear there is not too much money in the scheme, & at present nothing is settled." Undoubtedly, this was connected with the previous employment with Masson, Scott,

manufacturers of papermaking machinery. The fact that Chas Cook had plenty to keep him occupied when he arrived at Manchester probably ended any further developments on this front.

The letter continued with a comment on a possible workshop being offered by the university: "I would, however, much like the premises in Coupland St for another reason, this being their suitability, on account of the large gates opening on to the pavement, for motor car work, of which I hope to get repair work etc." Chas had developed a great interest in motor vehicles from an engineering point of view. However, in later life at least, he preferred to be driven around rather than drive cars himself.

Chas gave three months notice to the RI by way of a letter dated 26 June 1905, thanking the laboratory's Committee "for your kindness to me during the eight & a half years I have had the honour to be in your service". He proposed to leave on 15 September so that he could take up his new position later in the month, on the 25th.

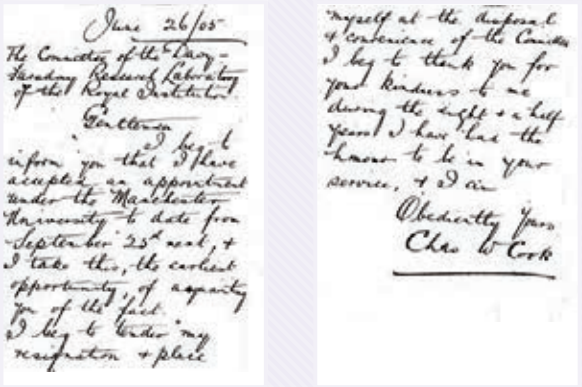

Figure 4. Charles Cook's letter of resignation (courtesy of Professor Frank James, Royal Institution)

Chorlton on Medlock

For the cook family, the first ten years in Manchester were spent in close proximity to the university, in the district of Chorlton on Medlock. Their house, on the corner of Coupland Street and Higher Chatham Street, was a very basic end-terrace dwelling, without any gardens to the front or rear. Ninety-three Lloyd Street, occupied from about 1908, represented a step up as it did have some space between the front door and the pavement. Around this time, street lighting was almost exclusively by high-pressure gas lamps and replacement with electric light did not keep pace with the supply of electricity to industrial users. Some moves were made to convert in 1912 but the First World War halted further progress.[11] Electrification did result in a much improved transport network that replaced a system based on horse-drawn trams. Nearly all the work was completed by 1906 to provide one of the most extensive tram services in the country.[12] The need for transport to work did not arise for Chas Cook until he moved house to Stretford Road.

The professors of the university tended to live to the south of Chorlton on Medlock, in the more affluent areas of Rusholme, Fallowfield and Withington. For example, Harold Bailey Dixon (chemistry) and Arthur Schuster (physics) occupied large detached houses, surrounded by their own grounds, in the fashionable district of Victoria Park. Horace Lamb (mathematics) and Grafton Elliott-Smith (anatomy)[13] had large properties in Fallowfield, Thomas Frederick Tout (ancient and mediaeval history) and Samuel Alexander (philosophy) semi-detached homes in Withington. Living in Didsbury, in spacious surroundings, were Robert Seymour Conway (philology) and Harold Herford (English literature and language). All these professors (with the exception of Arthur Schuster, who is not mentioned) caught the tram that ran from Palatine Road, past the university in 1913.[14]

Chas Cook's only daughter, Margery, was born at 93 Lloyd Street in 1911. The two other children born to Chas and Lottie at Manchester died as infants: Stanley John in 1909 and Robert James in 1916. After the birth of Robert James there were no further additions to the family. Sons Alfred William and Charles Edgar joined their father at the works. Albert Leslie, born just before the move from London, was too young to be involved with the business while it still operated in Manchester.

The arrival of Ernest Rutherford

The negotiations to engage Ernest Rutherford as professor of physics at Manchester are recorded in an exchange of letters with Arthur Schuster, which have been reproduced in several publications. In a letter dated 7 October 1906 Schuster wrote:

A great acquisition has been the establishment last year of a first class instrument maker within 150 yards of the laboratory. He works by agreement on cheap terms for us and is an excellent man. He was assistant at the Royal Institution and constructed a good deal of Dewar's high-pressure apparatus.[15]

Rutherford arrived in Manchester on 24 May 1907 and one of his first experiments was to observe if high pressure had any influence on radioactive decay rates.[16]

Schuster had already been examining the effect of high pressure on the curie point of iron with the same equipment. An article in *Nature* referred to the two lines of investigation:

In both these problems the design of the high-pressure portion of the apparatus had been due to Dr. Petavel, and for the latter purpose Mr. Cook, the university mechanician, has succeeded in constructing a combined pump and ram, in which pressures up to 37,000 pounds per square inch can be maintained without perceptible leak over long periods. The effect on radium of pressures up to 2000 atmospheres has been studied and will be available shortly.[17]

The results showed that pressure had no influence on decay rates.

Figure 5. Alpha Ray Electroscope (Chas W. Cook & Sons Ltd catalogue c.1943)

Restructuring of the physics degree programmes to reflect the new emphasis on radioactivity introduced by Rutherford created a demand for appropriate teaching aids and research apparatus. This was a new area for Chas Cook but he soon turned his hand to making the necessary instruments. An alpha ray electroscope made by him still exists in the physics department at the University of Manchester (or rather the bottom half of the device). It matches very well the picture shown in the Cook catalogue of c. 1943 (figure 5). The alpha ray electroscope was used in practical work at Manchester and a description with schematic drawing is to be found in Doris Bailey's notebook of 1911.[18] She was an honours physics student who graduated in 1912 after taking mainly radioactivity studies in the final year.

Work at the University of Manchester

Starting life as Owens College in 1851, the Victoria University received its charter on 20 April 1880, with Owens as its only constituent college. University College, Liverpool became a constituent in November 1884 and Yorkshire College, Leeds in November 1887. The Victoria University of Manchester Act incorporated Owens with the Victoria University of Manchester, itself formed by charter on 15 July 1903. Liverpool and Leeds achieved independent status as universities in the same year.

Figure 6. Physical Laboratories at Owens College completed in 1900 (Image source: The Owens College, Manchester, P. J. Hartog, 1900)

When Chas Cook arrived at Manchester, Arthur Schuster had only just turned 54 years of age yet was just two years away from retiring as Professor and Director of the Physical Laboratories. Other staff changes in the physics department were more imminent. Charles H. Lees resigned as Assistant Director in 1906 to take up an appointment as Professor of Physics at East London College (now Queen Mary College).[19] Hans Geiger, later to develop the Geiger counter under Rutherford, arrived in the same year. He came initially to sort out Schuster's library.[20] William Arthur Bone left his post as a lecturer in metallurgy to become Professor of Gas Engineering, Fuel and Metallurgy at the University of Leeds.[21]

After arriving at Leeds, William Bone set up equipment made by Chas Cook at Manchester for investigating the reaction mechanisms of gaseous combustion at high pressure. Not until 1915, after Bone had moved to the Imperial College of Science and Technology, London did he publish the results of this lengthy series of experiments.[22] Considerable time and effort went into the construction of the equipment as Bone commented in his paper: "Our thanks are due to the Government Grant Committee of the Society [The Royal Society] for liberal grants out of which the cost of the expensive apparatus employed on the work has been defrayed." To what extent Chas Cook had an influence on the design of the equipment used by Bone is unknown. The Cook catalogue of c.1943 (figure 7) shows the apparatus very much as it appears in the 1915 paper, claiming: "... designed and made by Chas W. Cook for the late Professor W. A. Bone ..." However, William Bone credits Petavel with the design and Chas Cook with just the manufacture.

Figure 7. Apparatus for Research on Gaseous Explosions (Chas W. Cook & Sons Ltd catalogue c.1943)

All the gases needed for the experiments, hydrogen, carbon monoxide, methane, ethane, ethylene, and oxygen, were prepared by chemical reactions and then purified.[23] The first stage consisted of a compression chamber that allowed a gas to enter from its storage vessel. A glycerine/water mixture, forced into the chamber via a hand operated piston pump, compressed the gas and it then passed into a small storage compartment. Bone states in the paper: "The joints and valves of the cylinders are so accurately made [by Chas Cook] that even hydrogen may be stored in them at a pressure of 100 atmospheres for months together without appreciable loss." This pump and storage system formed the basis of the "Cook Liquid Piston" gas compression apparatus that was offered for general sale.

Two types of "Explosion Bombs" were used by Bone, one with a cylindrical reaction chamber, the other with a spherical cavity. Again, satisfaction with the construction was expressed: "All joints in the explosion vessel are "metal to metal" and are so accurately machined that as to be absolutely tight at a test pressure of 1000 atmospheres." Various gas mixtures were electrically detonated in the bombs.

William Bone is remembered for the Bone and Wheeler apparatus for gas analysis. It first went on sale some time after 1908 and a lengthy description of its operation is given in the Gallenkamp catalogue of 1911/12.

Chas Cook made at least two items that were associated with Professor A. Sheridan Delépine: the Delépine-Cook freezing microtome and the Delépine rope driven centrifuge. Delépine became Professor of Comparative Pathology and Bacteriology (1891-1910) and Professor of Public Health and Bacteriology (1910-1921) at Manchester and was influential through the assistance he gave to local authorities. In 1901 he helped with investigations into the arsenic poisoning that came from contaminated beer. The source was eventually traced to arsenic in sulphuric acid that had been used for the production of brewing sugar.[24]

A letterhead[25] from Chas Cook's business on Coupland

Figure 8. The Delépine Rope Driven Centrifuge. "... the centrifugal force at 6,000 revs. per minute being approximately one and a half tons in each tube and the peripheral speed of rotor approximately 300 miles per hour (Chas W. Cook & Sons Ltd catalogue c.1943)

Street indicates that he did include motorcar repairs as he had mentioned to in his 1905 letter to Schuster. It is not clear whether this made a significant contribution to overall earnings. Trade listings for Chas W. Cook in local directories are to be found under the heading of "*Engineers & Machinists*". However, there are no entries under any of the categories the include motorcar repairs.

Manchester in the early 1900s was home to a sizeable motorcar-making fraternity. Slater's Manchester and Salford directory for 1908 lists 30 car manufacturers. Allowing for the probability that some of those listed were not makers of complete vehicles this still gives a good indication of Manchester's prominence in the relatively new industry. The producers actually outnumbered the garages by two to one in that year, although some manufacturers also offered repairs. To an engineer of Chas Cook's wide mechanical interests, at that time, the combination of motorcar repairs and scientific equipment would not have seemed as curious a mixture as it might today. This sideline may have been discontinued when Chas moved on to Bridge Street, but was certainly back in place after the relocation to Ashby de la Zouch.

Chas Cook did not spend long at either the works on Coupland Street or his house at 97 Higher Chatham Street since both were scheduled for demolition in order to provide new facilities for the engineering department. The university Report to Council for 1906-07 states:

Unfortunately, Mr. Cook's premises will be required for the extension of the Engineering Dept. It is hoped, however, that arrangements can be made which will enable Mr. Cook to continue his work in the immediate neighbourhood of the laboratories, where his assistance will chiefly be required.

The university did indeed make suitable provision and Chas Cook eventually moved into new premises.

To be continued

This article will follow on in the next IST Journal edition – autumn 2016

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Notes

[1] See Alan Gall, "Alexander Scott and the Hafnium Affair", *The Journal of the Institute of Science Technology*, Summer 2006, 4-5.

[2] "Liquid Hydrogen", *Nature*, 19 May 1898, 55.

[3] W. Hampson, "Liquid Hydrogen", *Nature*, 23 June 1898, 174.

[4] "Liquid Hydrogen", *Nature*, 19 May 1898, 56.

[5] See James Dewar, "Liquid Hydrogen", *Nature*, 30 June 1898, 199.

[6] The start date of 1896 is incorrectly attributed to Manchester in an exhibition catalogue for a scientific apparatus exhibition, April 1962, organised by the British Association of Chemists at the Donnan Laboratories, University of Liverpool.

[7] Brian Pippard, "Siegfried Ruhemann (1859-1943)", *Notes and Records of the Royal Society of London*, 47/2, 1993, 274.

[8] Letter from Chas W. Cook, addressed "Sir" and presumably to his immediate boss Alexander Scott, dated 22 February 1901. Copy courtesy of Professor Frank James, Royal Institution.

[9] Katherine D. Watson (2002), 201.

[10] R. S. Hutton, *Recollections of a Technologist* (London: Sir Isaac Pitman & Sons, 1964), 44.

[11] Roy Frost, *Electricity in Manchester* (Bolton: Neil Richardson, 1993), 22.

[12] Roy Frost, *Electricity in Manchester* (Bolton: Neil Richardson, 1993), 29.

[13] For further details of Grafton Elliott-Smith see "From the Archives" in this issue of the Journal.

[14] W. M. Calder, "A Tramload of Professors, 1913", *The Manchester Guardian*, 25 May 1951, 5. Calder lists the professors in sequence of catching the tram. Local directories give the addresses and large-scale OS maps provide details of the buildings.

[15] J. B. Birks (ed), *Rutherford at Manchester* (London: Heywood & Co, 1962), 52.

[16] David Wilson, *Rutherford: Simple Genius* (Cambridge, Massachusetts: The MIT Press, 1983), 223.

[17] "Some Scientific Centres. XI – The Physical Laboratories of Manchester University", *Nature*, 24 October 1907, 642.

[18] John Rylands University Library. Special Collections ref: UA/87/2.

[19] David Wilson, *Rutherford: Simple Genius* (Cambridge, Massachusetts: The MIT Press, 1983), 525.

[20] R. S. Hutton, *Recollections of a Technologist* (London: Sir Isaac Pitman & Sons, 1964), 36.

[21] *The Times*, 3 November 1909, 15.

[22] William Arthur Bone, Hamilton Davies, H. H. Gray, Herbert H. Henstock and J. B. Dawson, "Gaseous Combustion at High Pressures", *Philosophical Transactions of the Royal Society of London, Series A*, 215 (1915), 275-318.

[23] Pure gases were not readily available commercially. The ethylene, for example, was obtained by high temperature reaction of ethyl alcohol and phosphoric acid, followed by liquefaction and fractionation.

[24] See Alan Gall, "What's Your Poison?", *The Journal of the Institute of Science Technology*, Spring 2007, 12-13.

[25] John Rylands University Library. Special Collections ref: JRL/HUT/A3.

Lecithin based organogels: "green chemistry" applied to pharmaceutical research

Raffaele Conte

Abstract

Green chemistry is an area of research that is developing from scientific discoveries about pollution awareness, and it utilises a set of principles that reduce or eliminate the use or production of hazardous substances in synthetic processes. Researchers and pharmaceutical industries can reduce the risk to human health and the environment by following all the valuable principles of green chemistry. This study analyses the production of soy lecithin organogels as a simple and direct way to apply green chemistry in pharmaceuticals through the use of eco-friendly solvents for the synthesis of drug delivery formulations.

Introduction

During the last century chemistry changed the way people lived. Many of the greatest benefits for pharmaceutical industries came with the development of organic medicinal molecules. Pharmaceutical chemistry uses reagents, solvents, catalysts and almost all types of organic reactions for synthesis of bioactive molecules. Unfortunately, chemicals and synthetic processes can be hazardous or toxic. Green chemistry is designed to reduce or eliminate negative environmental impacts. This discipline is not a particular set of technologies, but rather an emphasis on the arrangement of chemical products and processes. It is defined by the Environmental Protection Agency as "the design of chemical products that reduce or eliminate the use of hazardous substances". Nowadays society has a greater expectation on greener and more sustainable chemical processes, with a trend that is likely to grow over the next decades[1]. Drug delivery is the method or process of administering a compound to achieve a therapeutic effect in humans or animals[2]. It is delivered with appropriate devices or formulations. Such an approach applies for both food and medical applications[3]. Typical routes for delivering formulations are nasal, buccal and parenteral. This implies an unavoidable contact with body tissues. It is therefore important to use biocompatible materials and reagents for vectors production. Currently the most diffused biocompatible carriers are liposomes, micro and nano spheres, or capsules made of biodegradable polymers (e.g. poly(lactic-co-glycolic) acid; polycaprolactone), albumin micro and nanospheres, soluble synthetic polymers, nanofibres, protein-DNA complexes, protein conjugates, erythrocytes, virosomes, dendrimers, and hydrogels. Unfortunately, their production often requires the use of organic solvents with high toxicity[4]. Organogels, are semi-solid formulations having an external solvent and apolar phase immobilised within a three dimensional networked structure made of biocompatible gelators along with apolar and polar eluents, and are viable "green" alternatives for existing carrier systems, aimed to avoid their inherent toxicity[5].

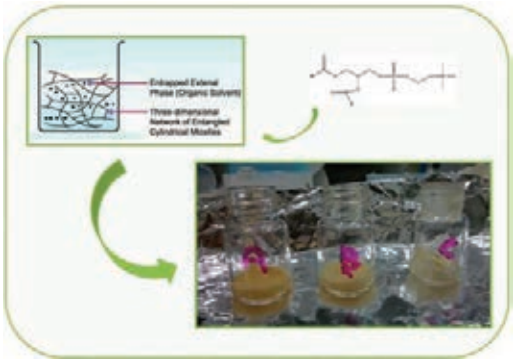

Fig. 1 Organogels schematic structure

Organogels

Organogels are a class of gels composed of a liquid organic phase within a three-dimensional, cross-linked network. Organogel networks can be characterised by two gelation parameters, the "gel point" and the "gelation time". Gel point is the transition point from a polymer solution to gel and is a function of the extent of reaction. Gelation time is the time interval between the onset of reaction and gel point. Specifically, the first formation mechanism is the gel network formation via polymerization. This process converts a precursor solution of monomers with various reactive sites into polymeric chains that grow into a single covalently-linked network. At a critical

concentration (the gel point) the polymeric network becomes so large that the solution starts to exhibit gel-like characteristics[6]. The second way is when low molecular weight gelators form gels via self-assembly through secondary forces, such as van der Waals or hydrogen bonding. These interactions cause monomers to cluster into a non-covalently bonded network that retains organic solvent. As the network grows it exhibits gel-like physical properties[7]. Both of the gelation mechanisms lead to the formation of products with gel-like physical properties: an extensive continuous solid network, no steady-state flow, and solid-like rheological properties. The gelation mechanism greatly influences organogel's properties. Precursors, with multiple functional groups, polymerise into networks of covalent C-C bonds, while gels formed by self-assembly are less stable[8]. Organogels used for drug delivery applications should be thermo-reversible using the physical interactions amongst the gel components[9-10]. Proper organogel vectors are thermodynamically stable below their gelation temperature, but possess viscoelastic properties. This feature can be tailored by incorporating water within the structure[11]. Then varying the composition of organogels makes it possible to alter drug release profile. This peculiarity explains the increased interest on organogel based controlled drug delivery systems[12]. However, many questions such as the specific molecular requirements guaranteeing gelation still await definite answers. Organogels use in drug delivery is still quite limited by the limited toxicology information available on organogelators, and by the lack of pharmaceutically-accepted solvents used in gel systems[13].

Fig. 2 Soybean plant

Soy lecithin as a "green" organogelator

The soya bean (Glycine max), is a species of legume native to East Asia, widely grown for its edible bean[14]. The plant produces oilseed and has many applications in food products. Fat-free soybean meal is a significant and cheap source of protein for animal feeds and many packaged meals. Soybean products, such as textured vegetable protein (TVP), are ingredients in many meat and dairy analogues[15]. Traditional non fermented food uses of soybeans include soy milk, from which tofu and tofu skin are made. Fermented foods include soy sauce, fermented bean paste, natto and tempeh. Chemically the beans contain significant amounts of phytic acid, alpha-linolenic acid, and isoflavones along with the mixture of compounds classified as lecithin. This is a combination of acetone-insoluble phosphatides which consist mainly of phosphatidylcholine (PC), phosphatidylethanolamine (PE), phosphatidylserine (PS), and phosphatidylinositol (PI) combined with various amounts of other substances such as triglycerides and fatty acids. Lecithin is used in a wide variety of pharmaceutical applications as dispersing, emulsifying, and stabilizing agent and is included in intramuscular and intravenous injectables, and parenteral nutrition formulations, as well as topical products. Structurally lecithin appears as a combination of zwitter ionic phospholipids with two alkyl tails which forms either spherical or ellipsoidal reverse micellar structures when added to oil[12]. Addition of water into these apolar solutions results in the many-fold increase of viscosity[16] and, if the composition of the formulation is correct, in the formation of a tri-phasic system that remains as a liquid mixture[17]. This system is composed of micellar aggregates that overlap, interpenetrate, and entangle forming a temporal three-dimensional network in a jelly-like state[18]. Overall, lecithin organogels are viscoelastic, thermo-reversible, and have a gel-to-sol transition of ~40°C [19]. Lecithin organogels are widely used in everyday life, including human and animal food, medicine, cosmetics, and many industrial applications due to the formation of the lipid matrix which plays a key role in the cellular metabolism[18].

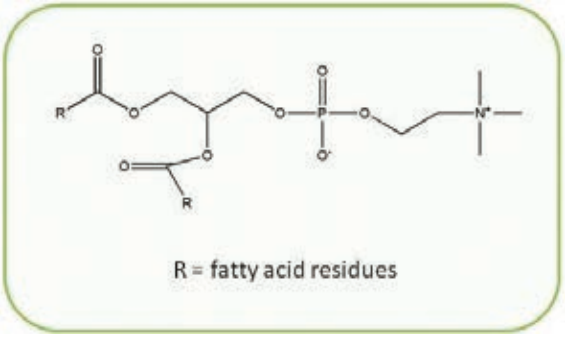

Fig. 3 Lecithin structure

Lecithin-based organogels

Different polar solvents such as glycerol, formamide, and ethylene glycol added to water have been studied for their ability to induce lecithin-based organogel[20]. The same applies for organic solvents e.g. ether, linear, branched and cyclic alkanes, esters, and amines that have been used with lecithin in order to form organogels[20-21]. Recently however, due to the toxicity of these solvents oils such as palm oil, sun flower oil, soybean oil, and mustard oil have been used to form organogels[22]. These natural oils have triglycerides as a major component along with a

small amount of monoglycerides and free fatty acids. The presence of lipophilic chains able to reticulate makes vegetable oil apolar solvents suitable for the preparation of organogel[23-24]. The biocompatibility and the environmental safety related to the use of vegetable oils raised the research on lecithin based organogels as drug delivery systems. In addition such a system has easy and noninvasive administration, enhanced transdermal penetration, avoidance of local gastrointestinal toxicity, and delivery benefits[25]. Lecithin organogels are particularly suitable as vectors due to the existence of aqueous and organic phases, large surface area, a well defined structure, entrapment of solutes within the gel matrix, and the ability to form micelles[26].

Preparation of "green" lecithin-based organogels

Preparation of lecithin-based organogels can be conducted by fluid-filled fibre mechanism and solid fibre mechanism[27]. In the first case accurately weighed soy lecithin (surfactant) is dissolved in a specified weight of vegetable oil at a temperature of 70°C. A determined amount of double distilled water is then added drop-wise to the lipophilic solution under magnetic stirring in order to obtain a homogeneous mixture. Finally, the preparation is allowed to cool at room temperature. Lecithin-based organogels can be developed varying the proportions of soy lecithin, vegetable oil, and water, obtaining gels with different viscosities and colours[27]. In order to be entrapped into the organogel matrix lipophilic active particles can be dissolved in the apolar phase and hydrophilic substances into the double distilled water. In the solid fibre mechanism the mixture of vegetable oil and solid organogelator is heated to obtain an apolar solution of the organogelator that, once cooled at room temperature, precipitates out as fibres which undergo physical interactions amongst each other forming three dimensional networked structures able to immobilise the polar solvent[27]. The active substance can be solubilised in both the hydrophilic or hydrophobic phase. The proper variation of the volume of the phases, along with the use of sonication, produces nano sized lecithin based organogels. Such synthesis is under investigation by the nanotechnology group of the Institute of Biosciences and BioResources in Naples.

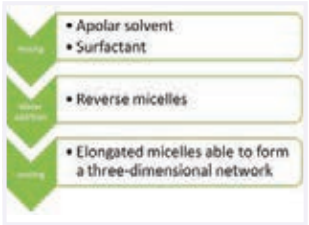

Fig. 4 Method of preparation of lecithin-based organogels by fluid-filled fibre mechanism

Fig. 5 Method of preparation of lecithin-based organogels by solid fiber mechanism

Characterisation of lecithin-based organogels

The characterization of soy-lecithin organogels as drug delivery systems requires the evaluation of organoleptic properties, stability, microstructures, drug loading, and biocompatibility[28]. Regarding the organoleptic characteristics, lecithin-based organogels are usually from cream to brown in colour while the emulsions are light brown. Their consistencies are improved with the increase in soy lecithin concentration. Lecithin-based organogels are oily to touch and possess a pleasant odour. Stability tests consist of the freeze-thaw method, disintegration studies, and gel-sol transition. In the freeze-thaw method the gels are incubated alternately in a water bath at hot and cold temperature for 15 minutes each. This procedure is repeated for five cycles and after each cycle the gels are inspected for any signs of destabilisation[29]. Disintegration studies are conducted leaving the organogels in two fluids that simulate gastric (SGF; 0.01 N HCl, pH=2.0) and intestinal (SIF; phosphate buffer saline of pH=6.8) conditions at 37 ±1°C respectively. The total time taken for the complete dissolution of the organogels is the disintegration time[30]. Gel-sol transition temperature is obtained by incubating the organogels in a water bath with a temperature varying from 27 to 50°C. The temperature at which the gels started to flow is noted as the gel-sol transition. The microstructures of the gels are studied in detail by FTIR spectroscopy, bright field microscopy, phase contrast microscopy, and scanning electron microscopy[31-32]. In FTIR spectroscopy the scanning is done in the range of 4000 cm^{-1} to 500 cm^{-1} in order to analyse the functional groups of the gel components. The microscopic observations are conducted on xerogels derived from the lecithin-based organogels[33]. Drug loading investigation is conducted on an accurately weighed portion of the organogel left in a chamber with dissolution medium. Such liquid is removed after determined periods of time and analysed (through UV absorbance or HPLC) in order to obtain a release curve. Drug loading derives from the sum of the obtained values. Finally, the biocompatibility of the organogels is assessed through the measure of the pH, hemocompatibility studies, and antimicrobial assays. The pH of the developed organogels formulations must be checked to be in the range of 5.6 to 5.75, similar to the normal pH of the human skin. The hemocompatibility study on the other hand, gives information on the extent of hemolysis of the blood cells in the presence of the leachants from the developed organogels. Specifically, the leachants are incubated with goat blood and the percentage of hemolysis of these cells is analysed[34]. Antimicrobial assay is performed treating bacteria such as Bacillus subtilis (gram positive bacteria) and Escherichia coli (gram negative bacteria) with drug-loaded organogels. Then the zone of inhibition after 24 h of contact at 37 ± 1°C is measured[34].

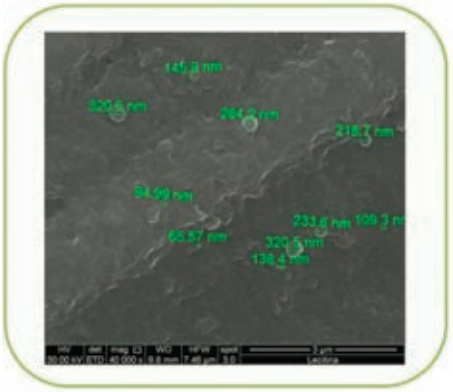

Fig. 6 Scanning electron microscopy (SEM) image of nanosized lecithin-based organogels obtained by FEI Quanta 200 FEG instrument at the "Electron microscopy facility" of the "Institute for Polymers, Composites and Biomaterials" in Pozzuoli

Applications of lecithin-based organogels

Transdermal delivery

Many formulations of lecithin-based organogels are developed for transdermal delivery. For example, broxaterol, scopolamine, and nicardipine loaded gels are synthesised. Histological studies showed that these organogels have no harmful effect when applied to the skin for prolonged periods. Moreover, they have high stability. Loaded drugs have higher efficacy compared to the aqueous solution of the substances at the same concentration. Preliminary results showed that transdermal transport is also successful with amino acids and peptides[35-36]. Similarly, methimazole and dexamethasone are loaded into pluronic-lecithin organogels. Model animals received the drugs either orally or transdermally. Their blood samples revealed a peak of drug serum concentration for transdermal administration while oral administration did not result in significant serum concentrations. The transdermal administration of aromatic tetra-amidines loaded lecithin organogel was able to reduce the tumour cell growth in nude mice xenografted with the highly tumorigenic cell line. The methyl nicotinate incorporated within lecithin gel showed almost complete percutaneous absorption in experimental human models. Finally, the percutaneous delivery of the bioactive agents may further be improved upon by using compounds known as permeation enhancers such as terpenes (e.g. linalool, cineole, limonene, farnesol)[39].

Dermal delivery

Lecithin-based organogels are an efficient matrix for dermal administration of many bioactive agents. The lecithin itself provides skin protection against UV and shows additive effects along with incorporated bioactive agents against skin aging. A wide variety of guest molecules, either hydrophilic or lipophilic in nature, such as vitamins A and C, hormones, NSAIDS, peptides, amino acids, local anesthetics, and antifungal agents are reported to be effective topically delivered by lecithin organogels. No toxicological manifestations are present upon the prolonged application on the skin. Lecithin organogels provide an effective permeation through the skin by fluidising the membrane lipids as well as by a hydration mechanism. The occlusive nature of lecithin organogel provides smooth feel on dermal application[40]. Shaikh et al. reported that lecithin organogels are more effective and safer for delivery of aceclofenac when compared with hydrogels[41]. Fujii et al. performed experiments on rat skin revealing that the permeation of indomethacin is greater with lecithin organogels[42]. Zia et al. developed lecithin-stabilised microemulsion-based organogels for topical application of ketorolac tromethamine using soya lecithin as surfactant and isopropyl myristate as oil. It was also observed that lecithin organogels solubilised higher concentrations of ketorolac tromethamine and that its release rate is enhanced[43]. One of the marketed products of J.A.R. Pharmaceuticals, Ltd. (Edmonton, Alberta, Canada) is Phlojel® Ultra, a lecithin organogel with cosmetic properties. It is non-greasy and improves skin penetration of incorporated active ingredients. After application to the skin it is rapidly absorbed without any residue. It was accepted as a superior vehicle for delivering drugs across the skin barrier[44].

Oral delivery

An example of the use of lecithin based organogels for oral delivery of bioactive agents is the use of 12-hydroxystearic acid as organogelator for the development of organogels with soybean oil as apolar phase. The drug Ibuprofen was incorporated within the gelled structure. The release studies indicate that the increase in the organogelator concentration lead to the decrease of the release rate of the organogels. Such vehicle resulted not toxic in In vivo studies in rats[45].

Nano-sized delivery

Lecithin biocompatibility and its favourable physicochemical properties lead to the search for nano dispersions that can be used as nano-carriers for siRNA delivery. The careful selection of lecithin lipids and formulation strategies eliminate toxicity and potential adverse effects. Cui et al. for example proposed the use of lecithin for the design of small interfering nucleic acid delivery systems. Lecithin nanoparticles were coated with a positive charged surfactant to improve the link with the nucleic material. This vector achieved significant stability and safety. Moreover, this system was able to successfully transfect a plasmid adsorbed onto the surface of the lecithin nanoparticle[46]. Similarly, Pérez et al. reported the synthesis of unmodified nano-sized water lecithin dispersions to deliver siRNA. They showed that it is not necessary to add other components like cationic lipids or surfactants, which can be toxic, to improve siRNA loading capacity. Instead this efficiency was reached by means of the optimisation of critical parameters such as pH and ionic strength[47]. Lecithin

nanoparticles are also used to deliver active principles enclosed into their structure. For example, Yanasarn et al. engineered spherical nanoparticle formulation encapsulating Docetaxel from lecithin-in-water emulsions. The resultant vectors were stable when stored as an aqueous suspension and were able to effectively release Docetaxel. These nanoparticles were more effective in killing tumour cells in culture than free docetaxel. Furthermore, they did not cause any significant red blood cell lysis or platelet aggregation in vitro and did not induce detectable acute liver damage when injected intravenously into mice. Finally, compared to free docetaxel the intravenously injected docetaxel-nanoparticles increased the accumulation of the active principle in a model tumor in mice by 4.5-fold[48].

Conclusion

This study reports the development, characterisation and applications of soy-lecithin based organogels. These vectors act as potential carriers for bioactive agents thanks to the positive characteristics of easy preparation and thermal stability. Lecithin based organogels can be used either as a controlled release system or as a quick release system, depending on the composition of the gels. The developed organogels have good spread ability and a long viscosity profile to be highly biocompatible. Soy-lecithin based organogels are used as case study in order to show how "green chemistry" can successfully affect the field of pharmaceutical chemistry. By using green chemistry procedures, is possible to minimise the waste of materials and prevent the use of hazardous chemicals. This work aims to encourage researchers and pharmaceutical companies to consider the principles of green chemistry while designing their processes.

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Instrumentation in titanium electro-synthesis

Charles Osarinmwian

Historically, manufacturing leadership has depended on leading new technology paradigms combined with new process and business models [1]. Thus, innovating and developing the electro-deoxidation of TiO_2 in molten $CaCl_2$ [2-6] to drive forward practical step changes in production and efficiencies, such that the environment and its resources are safeguarded, requires fundamental understanding of instrumentation technologies in process development. Herein the limitations and advantages of new and existing techniques used in the field of electro-deoxidation are outlined.

Electrochemical Reactor

Herein the electrochemical reactor comprised a vertical tubular reaction vessel, within a programmable electrical furnace (Carbolite GVA 12/300, max. 1200 °C), and an air-tight stainless steel lid equipped with feed ports for the cathode, anode and ceramic thermocouple rod as well as argon-gas inlet and outlet. The schematic in Fig. 1 shows a vertical electrode design in which TiO_2 is the material of choice because it is considered as a model system for many metal oxides and has helped to improve materials and device performance in many fields [7]. The cathode design minimizes settling, ordering and alignment by random packing in a consistent and predictable way, promotes fluid and current flow through the cathode bed, mitigates significant pressure drop over the depth of the bed thereby avoiding fluidization, and facilitates fluid draining and titanium recovery after electro-deoxidation (Fig. 2, [8]). The novel horizontal electrode design (Fig. 2) has recently been demonstrated for the electro-deoxidation of TiO2 powder [9].

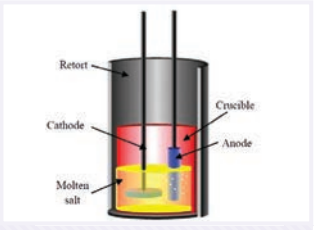

Fig.1. Electrochemical reactor: Schematic of a porous TiO_2 cathode pellet against an anode rod immersed in molten $CaCl_2$.

The electrolyte used to electro-deoxidize TiO_2 in electrochemical reactors is molten $CaCl_2$. On the technical side, Ca is a very electropositive element while CaO is more stable than the oxides of titanium.

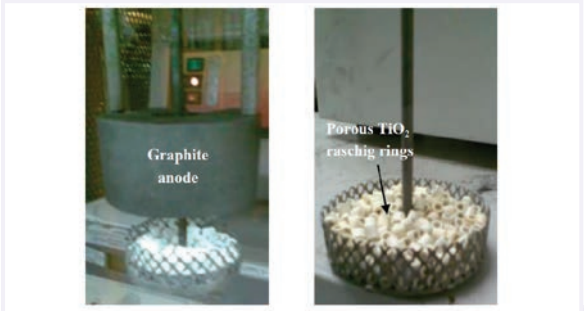

Fig.2. Horizontal electrode design: Random-loose packing (35-90% free space/cm^3) of low-aspect ratio, near-net-shape TiO_2 cathode facilitates free fluid and current flow through the bed. Commercial Al_2O_3-doping of TiO_2 pigment enhances photochemical stability while maintaining electronic nature because lattice-site occupation of Al dopants suppresses colour pigmentation [7].

On the commercial side, $CaCl_2$ is inexpensive, a waste product of the chemical industry, highly soluble in water and of the same toxicity as common salt for environmentally friendly disposal. Herein, dihydrate $CaCl_2$ salt ($CaCl_2 \cdot 2H_2O$) (LP Chemicals Ltd) was placed in alumina crucibles in 800 g batches. The hygroscopic nature of the salt inevitably retained trace quantities of moisture that generated the following species in molten $CaCl_2$:

$$CaCl_2 + H_2O\ (g) \leftrightarrow CaO + 2HCl\ (g) \quad (1)$$

$$CaCl_2 + 2H_2O\ (g) \leftrightarrow Ca(OH)_2 + 2HCl\ (g) \quad (2)$$

Thus, high-moisture content CaCl[2] salt would cause severe oxidation of the crucible leading to compositional variations in molten CaCl[2]. Attempts to remove CaO and $Ca(OH)_2$ by bubbling Cl_2 or HCl gas would lead to toxic gas emissions. Therefore, each batch of $CaCl_2$ salt was initially preheated at 120°C for 4 h in air and then transferred to a melting furnace (Falcon, FL3.65) for further heating: (1) 200°C to 900°C at 80°C h^{-1} and hold for 6 h, (2) 900°C to 200°C at 4 L min^{-1} in a high-purity argon gas stream. This dehydration regime ensured that the salt was sufficiently dry (i.e. < 1500 ppm moisture content) prior to melting in the electrochemical reactor. During electro-deoxidation, the inert atmosphere inside the reactor was regulated at an argon flow of 2.0 L min^{-1}.

Acid-base Titration

The CaO content in molten $CaCl_2$ needed to be controlled to satisfy the transport of oxygen ions from the cathode to the anode as well as minimizing current inefficiency by electronic background current [4,10]. The quenched $CaCl_2$ sample retrieved from the electrochemical reactor [5] was placed into a 100 mL volumetric flask and dissolved in 75 mL of 0.1 M HCl acid (Fisher, J/4350/21). The dissolved sample was then titrated with 25 mL of 0.1 M NaOH (Fisher, J/7660/21) in an Auto-titrator (Mettler Toledo, T50). This device had been calibrated with fresh buffer solutions of pH 4.01, 7.01 and 10.01 and quality-control checked with 0.1 M HCl acid prior to use. The end point was detected potentiometrically at the equivalence point of the neutralisation reaction:

$$HCl + NaOH \rightarrow NaCl + H_2O \quad (3)$$

This equimolar chemical reaction allowed the volume of HCl acid that reacted with NaOH to be determined along with the volume of un-reacted acid. The reaction of HCl acid with CaO in the CaCl2 sample is

$$2HCl + CaO \rightarrow CaCl2 + H_2O \quad (4)$$

CaO concentrations were calculated by assuming that the only alkaline species present in the sample was CaO. Although titration is widely used in quantitative chemical analysis, a single drop of NaOH just before the end-point of titration can change the pH significantly due to the logarithmic nature of pH curves; this form of error in the indicator is indeterminate. Also, solidified $CaCl_2$ must be fully dissolved to form solution because reactants must be in a liquid phase. It is important to note that an optimal CaO content is not feasible because the initial current flow through molten $CaCl_2$ is strongly dependent on the total amount of TiO_2 and electrochemical reactor design [10].

Mass Spectrometry

Mass spectrometry (Thermofisher, Prima ὸB) was used to monitor the mass-to-charge ratio (m/q) of charged species in exhaust anodic-gas streams (Equation 8) from the electrochemical reactor; exhaust gas steam was set at 30 L h^{-1}. To prevent ions with excess energy from reacting with residual gas molecules the mass spectrometer was operated at near vacuum conditions as this prevented ions from colliding with residual gas molecules during transport from the ion source [11]. Ions were accelerated by electromagnetic fields from the ion source into the mass analyser where they were separated according to their mass-to-charge ratio. They leave the mass analyser and strike Faraday collector plates within Faraday cups; these cups shield the detector from electrical noise. Collector plates at the base of these cups are angled steeply with respect to the path of positive ions to prevent the escape of reflected ions and secondary electron emissions on impact. The ion current generated was amplified and recorded as data on the mass-to-charge ratio of charged species which is displayed as concentration profiles in a mass spectrum [4,5].

Although the mass spectrometer was operated with an internal circulation of calibration gas, the spectrometer was limited by its inability to detect neutral molecules and hysteresis caused by magnetic field perturbations. Theoretically, ions are produced by the loss of electrons which occurs by the collision of gaseous atoms or molecules with electrons (i.e. electron ionization):

$$M + e^- \rightarrow M^{+\cdot} + 2e^- \quad (5)$$

where M is a gaseous atom or molecule and $M^{+\cdot}$ is a positive radical ion of a gaseous atom or molecule. It is important to note that electronegative atoms or molecules can attract an electron in a covalent bond during electron ionization:

$$M + e^- \rightarrow M^{-\bullet} \quad (6)$$

where $M^{-\cdot}$ is a negative radical ion of a gaseous atom or molecule. These charged ions may dissociate into smaller ionic mass fragments if the energy of impact during electron ionization is sufficiently large:

$$M^{+\cdot} \rightarrow F^+ + R^\cdot \quad (7)$$

where $R^\cdot$ is a radical and F^+ is an electron fragment of $M^{+\cdot}$. The Lorentz force law and Newton second law of motion govern the dynamics of charged species in an electromagnetic field within the spectrometer:

$$m\mathbf{a} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B}) \quad (8)$$

where **a** and **v** are the acceleration and velocity vectors for a charged ion respectively, **E** is the electric field intensity, **B** is the magnetic field intensity. Equation 8 is valid for non-relativistic charged ions. Monitoring anodic gases is crucial to the scale-up of electro-deoxidation given the stringent CO2 emissions for limiting global warming to below 1.5°C by 2100 [12].

Ex-situ Microanalysis

The partially reduced cathode was dried and then slowly sectioned using a hand drill. Sectioning was performed slowly to avoid excess heating at the sectioned surface as zones of heat-induced deformation around a cut could locally alter sample density. This segment was immersed in epoxy resin (Struers) and placed in a vacuum degasser. Lowering the pressure to vacuum in the vacuum degasser allowed resin impregnation into the pores of the sample. The sectioned surface was prepared for surface imaging by polishing in a TegraPol-11 device (Struers) [4]. However, preparation-induced artefacts in microanalysis from incomplete removal of polishing compound residues and the smearing of metallic

phases across partially reduced phases are limitations. A detailed microstructure analysis of a partially reduced cathode cross-section (Fig. 3) was performed using a scanning electron microscope (JEOLJSM-6490LV). Energy exchange between the electron beam and sample surface produced signals that were amplified and recorded using specialised detectors. These signals were displayed as variations in brightness on a cathode ray tube and synchronized with the scanned pattern on the sample surface to generate an image of the distribution of brightness intensity.

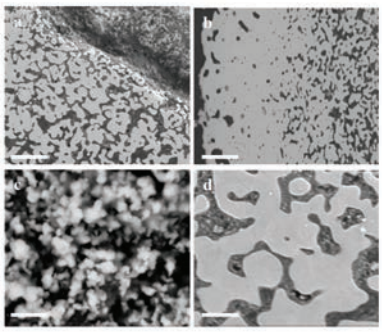

Fig.3. Titanium morphology: (a) 3PI (or quasi-2D interface) [3] *separates titanium from partially reduced core. (b) Vacancy condensation generates Kirkendall pores* [3]*. (c) Very small low-energetic spherical and nodular particles are thermodynamically more favourable during initial nucleation and growth. (d) Phase-field morphology of titanium. Scale bar: 50 µm (a, b), 10 µm (c, d).*

In-situ Analysis

After cooling and washing the cathode sample, ex-situ microanalysis is performed and compared with in-situ voltammetric or amperometric data. However, upon cooling any number of crystallographic changes or chemical reactions may occur while washing could remove water-soluble species. Conceptually, installing an electrical impedance tomography system [13] around the electrochemical reactor would produce a map of electrical conductivity distribution in the cathode during electro-deoxidation. Although the cost of this system is low compared to other on-line monitoring systems, several limitations include imaging anisotropic materials, difficulty of quantifying the reliability of tomographic images, and voltage sensitivity to both the current source and receiver positions. It is important to note that ex-situ computed X-ray tomography demonstrates the utility of tomography in electro-deoxidation (Fig. 4). However, this is limited by huge memory capacity for data collection, segment-alignment with the X-ray source during image reconstruction, precise passage of the electron beam through the centre of a circular magnetic lens for optimal image quality, and ensuring that the segment remains fully irradiated in the field of the electron beam during imaging.

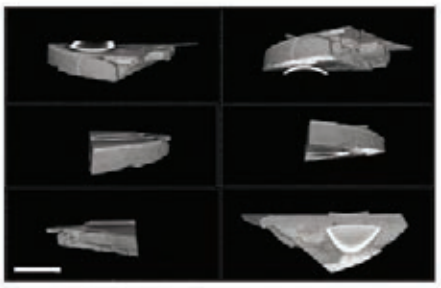

Fig.4. Computed X-ray tomography: 3D Images of partially reduced cathode segment are observed using an X-ray source, a series of detectors (which measure the attenuation of X-ray intensity along multiple beam paths), and a rotational imaging system (Nikon, XTH225). Scale bar: 5 mm.

Scaled-up TIMET reduction cells for titanium production exhibited difficulty in maintaining high current efficiency throughout the *lifetime* of a cathode. The inability to identify $CaCl_2$ complexes, oxide ions, Ca metal and dissolved CO_2 using in-situ Raman spectroscopy (where pulse-gating eliminated any interference from black-body radiation and other stray light) in these cells limited understanding of the relationship between these species and current efficiency [14]. Alternative techniques such as elemental mapping using electron spectroscopy on carefully quenched cells and advanced in-situ ac or dc electro-analytical methods could contribute to understanding the molecular structural factors and compositional issues that affect current efficiency. To date, white beam synchrotron X-ray diffraction has been successfully used for in-situ phase characterisation during electro-deoxidation [15].

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How far can behaviourist learning theories be applied to science & technology teaching?

Kevin Fletcher

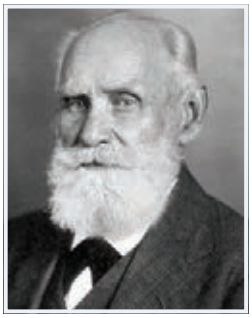
Introduction

In this brief discussion I hope to consider one of the classical models of Learning known as "Behaviourism" and map the extent to which it can be applied to, and used in, Science & Technology teaching.

My intention is to consider, in future articles, further models of learning such as Neo-Behaviourism, Gestaltism, Cognitivism and Humanism and how far these can be applied to Science & Technology teaching with a view to relating theories to practice in the hope of understanding and improving teaching and learning in the classroom.

Classical Behaviourist Theories of Learning

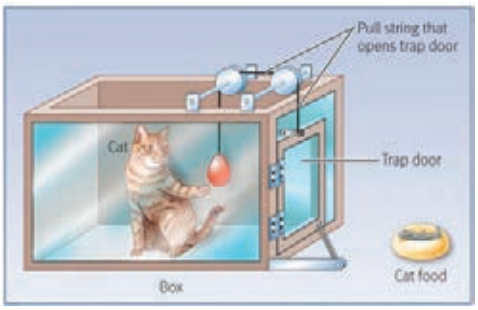
In the early 20th century, it was thought that human learning could be predicted and explained by the behaviour of animals. The essentials of the work involved animals responding to stimuli with little conscious thought beyond reflex actions.



Ivan Pavlov, a Russian psychologist working with dogs, linked a ringing bell with the provision of food.

Initially only the food would cause salivation but because the presentation of food was linked with a ringing bell, after time, the bell could cause the dogs to salivate as they had "learnt" there was a link between a ringing bell and food.

Another early worker, Edward Thorndike who worked with cats, showed in experiments that pleasurable experiences tended to reinforce stimulus response bonds and `discomfort' reduced these bonds. The classic example of Thorndike's S-R theory was a cat learning to escape from a "puzzle box" by pressing a lever inside the box. After much trial and error behaviour, the cat learns to associate pressing the lever (S) with opening the door (R). This S-R connection is established because it results in a satisfying state of affairs for the cat (escape from the box).



There are clear links to rote learning when Thorndike said that there was a need to maximise the strength of a bond. To do this, he suggested that the number of times and duration of the link should be maximised. Also associated with this work was the fact that an external reward was seen as being effective, whereas punishment was less important.

Both Pavlov and Thorndike have been criticised for extrapolating the results of their work with animals to predict human behaviour.

The behaviourist learning theory suggests that we learn by receiving a stimulus that provokes a response.

So long as that response is reinforced in some way that response will be repeated. As a science and technology teacher we may direct this process by selecting an appropriate stimulus (say, teaching method) and by reinforcing the `correct' responses while discouraging the `wrong' responses. Behaviourists say that learning is brought about by association between the response and reinforcement.

Applying classical behaviourist learning theories to science and technology teaching

The behaviourist theory stresses the active role of the teacher with the student often seen as passive.

But, how can we apply behaviourist theory in the science and technology classroom? The following guidelines show potential of stimulus response theory:

1. Use reinforcement to strengthen behaviour that you want to encourage. For example to encourage effective remembering:

. (a) when students are learning factual materials, give feedback frequently and quickly

. (b) when students are learning to understand and apply factual information, use delayed feedback to encourage trial and error learning so assisting the understanding process

. (c) use several kinds of reinforcers (e.g. praise, marks, and prizes as far as practically possible in the science and technology classroom) so that each keeps its effectiveness

2. Take advantage of the different schedules of reinforcement to encourage the learning process. For example:

. (a) when students first attempt a new kind of learning, supply frequent reinforcement, but, at a later stage, supply rewards less often

. (b) if you want to encourage spurts of activity, use a fixed interval schedule of reinforcement

3. Use programmed learning approaches by describing the terminal behaviour; i.e. objectives, organising what is to be learned, and finally provide feedback. For example:

. (a) in the introduction to your science and technology lessons, list and tell the students exactly what you want them to learn by the end of the lesson; i.e. objectives

. (b) arrange the materials to be learned into a series of steps

. (c) provide feedback to each of the steps so that correct responses will be reinforced and students will be aware of correct responses

4. When students lose motivation, use special forms of reinforcement to motivate them to persevere. For example:

. (a) negotiate a contract with a student for the work to be completed to earn a particular reward

. (b) use short term, frequent, immediate rewards

Conclusion

Superficially, it would appear that classical Behaviourist Models of Learning can offer us some insights into effective science and technology teaching. It appears to give us a model by which we can deliver a teaching strategy to ensure effective learning. It provides an apparently straightforward methodology to obtain the desired responses from our students.

What we should not lose sight of, however, is that the work of Pavlov and Watson revolved around animals and the results were extrapolated to explain human behaviour, which is far more complex. Behaviourist theories therefore, although seemingly straightforward, are limited by this fact.

In future articles, further models of learning such as Neo-Behaviourism, Gestaltism, Cognitivism and Humanism and how far these can be applied to Science & Technology teaching will be considered.

I will be considering Neo-Behaviourism and Science & Technology in the next article.

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“Everything has a cost” – The effect of the recent tuition fee rise, and subsequent fears and expectations of new students

Timothy Haycock

The student tuition fee is at an all-time high, British students are faced with a £27000 bill for their degree programme. This leads to the question, are they ready for the huge monetary burden facing them? There seems to be so much negativity toward the cost of an undergraduate degree that it is overshadowing the brilliance of the subject matter.This requires address.

An insight to the whole student tuition fee must be understood if one is trying to establish how the current fee was created. September 1998 saw a first cost to the under/postgraduate degree, the Conservative government at that time (1996) commissioned an inquiry into the future of funding in higher education for the next twenty years (Dearing report-23/7/1997). This report made 93 recommendations, concerning the funding, expansion, and maintenance of academic standards. It also estimated that education would require approximately 2 billion pounds additional funding over the next twenty years to expand student enrolment, provide more support for part-time students, and to ensure an adequate infrastructure.

The most radical change the report produced was to ‘means test’ students on their ability to pay, recommending that students pay a flat rate of 25% via student loans, this being implemented by 1998-9. Following publication of the report, and a government change, the education secretary David Blunkett MP announced the tuition fee of £1000 per year to students after the means test (The Teaching and Higher Education act 1998); declaring higher education would still be free for students from lower income families. The £1000 fee was approximately a quarter of the actual amount for the taught programme. What did this means test actually quantify? Any family with a combined income of less than £23000 would be exempt from charges, £23000-£35000, would be charged the percentage stated, all families with an income above £35000 would be charged the full fees of £1000 per annum.

This Act was met with concern by other members of the Labour Party, Ken Livingstone saying the party had “whipped away the ladder of opportunity his members had already climbed” The act signalled the end in principle to free education within the higher education sector.

January 22nd 2003, the Labour education secretary Charles Clarke published a white paper proposing that universities be able to set their tuition fees up to a cap of £3000.This in itself was very controversial, the same party in their election campaign stated they would not introduce top up schemes. One other point the white paper introduced was the ability to pay back the student loan.This would only be apparent after the graduate was earning in excess of £15000, and also the student debt would be written off by the government after 25 years. In 2004 the Education act was passed, stating that fees could be raised up to £3225 per annum from 2010, the difference being the student loan would not be means tested, being paid on behalf of the student, directly to the University involved, the student then repaying the loan after earning an income of more than £15000 per annum.

The Browne Review. This review was announced by Business secretary Peter Mandelson, November 9th 2009. Undoubtedly the most radical change to the tuition fee we have ever witnessed.

The budget allowed for the report was £120000, but only £68000 was used in formulating the results. There was one unpublished survey, where most of the budget was spent. Surprisingly, only 80 school pupils, 40 parents, 40 early year students and 18 part time

students from different backgrounds were asked their opinions on university funding. Questions were posed about an upper limit of fees of £6000 per annum.

This in itself seems frugal when considering the fate of the national university fee structure; one would imagine a much more involved, larger audience participation enabling a much more satisfactory conclusion.However, 12th October 2010 saw the findings published, these were:

- Removing the current £3290 per year cap on tuition fees, so there would be no cap on the amount universities could charge
- The government would provide loans for both tuition and living fees
- Students would only repay the loan once they were earning over £21000, at 9% of any income above that amount, any debt still left outstanding would be written off by the government after 30 years
- Part time students would also be eligible for loans, not having to pay upfront tuition fees.

The government announced on 3rd November 2010 that they were incorporating many of the Browne report's recommendations, but made the new proposal that an absolute cap of £9000 per annum for any student studying on or after 2012/13 academic year. The fee can be misleading. It has to be said that the £9000 equates to less than 50% of the actual cost of education, the other coming from Government. In the number of students the university recruit, the universities also compete for student funding from industrial partners and research grants, alumni awards and other contributions.

The proposal was the catalyst to the student marches in London that November, leading to the unforgivable riots and malicious damage witnessed across the country, a subject that has to be mentioned, but be omitted further in such a paper. The cap fee of £9000 has seen many universities charging the maximum amount; one would assume the high ranking "Russell group universities" (24 research-intensive institutions) would be able to charge such a fee, based on historical performances, and others charging less, but it appears most of the universities, both red brick and former polytechnics are charging the maximum amount regardless of their positions in the academic rankings.

It seems to be what they offer the student in relation to skills obtained, employability and quality of their teaching methods that the student will experience whilst attending the degree programme that enables the fee to be structured at this level, allowing the end product to be career ready.

In the Budget of 2015, the Chancellor George Osborne announced further reforms to the system, allowing universities to increase their fees in line with inflation from 2017/18 academic year. Student Loans by the Government are of course from the tax payer, any rise in the fee will have an obvious effect and pressure on both the students and the working public. The independent Commission on Fees (**http://www.independentcommissionfees.org.uk/**) have recently published a report stating that fees could reach £10000 by 2020 based on a 3% compound interest. They say that debt is still a big issue and that under the current system, nearly three quarters of students will fail to pay the whole debt before the thirty year cut off term, and a large proportion will still be paying the debt off into their 40s.

This could have a huge impact on any student thinking about studying a degree, and even more so for the lower participation backgrounds, who are unaware the time scale it will take to pay off the debt. Universities and Government should be physically advertising this point to enable transparency and the long term re-payments that will be with any degree student. There is the element where one has to factor in these payments in their future lifestyle. Many will have not even considered these; it must be clearly shown that £27000 is a colossal financial burden to bear, alongside living costs from property and personal costs for leisure etc. By balancing one's own outgoings to include this payment has to be more clearly understood before embarking on the degree programme.

The Commission also point out that the anticipated gains to the treasury will be wiped out because of these non-payments, and advises the Government be extremely wary about lifting the cap off tuition fees altogether.

Student fear and pressures when entering Higher Education

Can it be said that a student enters higher education with absolutely no thought toward the huge cost implications? The tuition fee for British students is currently £9000 per year, as well as the cost of living when at a university. Are the individuals ready to take on £27000 of debt, do they realise the implications of the tuition fee before,

during and after graduation? Results from a previous study of further education and "A" level students (Callender,Jackson 2004) showed the following statements being observed, namely;

- Owing money is basically wrong
- There is no excuse for borrowing money
- You should always save up first before buying anything
- Borrowing money to pay for a university education is a good investment
- Student loans are a good thing because it allows students to enjoy university life
- Students do not worry about debts while at university because they will get well paid jobs when they graduate
- It is not worth getting in debt just so you can get a degree

These show that students are systematically thinking of such debts and pressures when embarking on a taught degree programme, the fee had made a significant impact on the student when choosing whether or not to attend a university. Social class composition has to be included. The paper showed that students from the lower income social groups had a stronger aversion to debt than those of the middle/higher social backgrounds. However, the costs and benefits were not statistically different in each group when considering the whole university scenario. The study outlined that aversion to debt is a negative factor with regard to becoming a student in the lower social groups, where the thought of such a vast amount of debt could actually stop a talented individual from entering H.E, whereas the middle/higher social groups were able to ignore the cost implications because of their economic standing.

According to an estimate from the UK's National Union of Students (NUS), the average annual cost of living in England (excluding London) for students is £12,056. This includes £4,834 for rent, £1,956 for food, £316 for household goods, £42 for insurance, £2,074 for personal items, £1,524 for travel and £1,310 for leisure.

In London, you should expect to pay £13,388 for the same breakdown of goods and services. The major difference in the cost of living in London compared to the rest of England is in rent, which is estimated at an average of £6,143 per year, and insurance at £65.

The Independent commission on fees (http://www.independentcommissionfees.org.uk/) have reported that the fee has had no detrimental damage to the numbers of students attending university, but it goes on to say;

There is still an "unacceptably high" gap between the numbers of disadvantaged sixth-formers going into higher education, especially selective institutions, and a widening gender gap between poorer students, with 14.7% of boys from the poorest neighbourhoods studying for a degree in 2014, compared to 21.8% of girls – a gulf of seven points, compared to five in 2010.

It raises concerns that there has been a significant decline in the number of mature and part-time students because of the fee increase. These individuals will think twice about taking on such debt for no clear incentive, the majority of mature and part-time students are studying for their own development, rather than gains in future (although the acquired degree can always be used for career development).

By charging such a fee, there may be the emphasis toward the younger student, where the time taken to repay the debt is less of a responsibility (but not ignoring the huge burden) to that of older part-time and mature students who will be paying off the debt later in life and also may have bigger committed financial burdens. Anyone is entitled to study if they meet the criteria, but thought has to be given to the extra financial burdens of these individuals who may not be an 18+ year old with their entire career ahead of them.

It is a fact that any student when leaving university will have a huge debt. Does this deter students from entering universities? (Sutton Trust 2010) Well as can be seen in the applications (2014/2015) universities were over- subscribed so the debt seems to have little or no implication to the decision making of the individual. As one of the earlier statements raised, wage gains associated with a degree will see students not be deterred from going to university (Greenaway, Haynes, Goodman and Chapman 2003). This is mainly for younger students who are at the start of their career, however, mature and part-time students will definitely be affected by the increase as they will more than likely be already employed, happy in their work with little thought to career progression, there are many who want to study because they feel they need to, without any reward in the future, so this will lead to them making a very big decision and saying to themselves is it really worth the cost.

The degree is now sought by any social group, the individual who has attained the level of entry can enter H.E with the aid of the tuition fee, and it does show that the forward thinking of these students in obtaining higher earnings after the degree out-weigh the initial debt that could have seen them not enter the degree programme. (Dearden, Lorraine, Fitzsimons,Wyeness, Gill 2007)

During the last two decades, funding for university degrees has shifted from the state to the individual, partly due to economists and politicians and partly to the growing pressures on public budgets (Wilkins, Shams,Huisman 2013). Demand for H.E has trebled since the eighties (Shattock 2010) however studies in the USA have consistently stated that an increase in tuition fee has reduced student enrolments (Hemelt, Marcotte 2008). This seems to contradict the results here when we are seeing over subscription to our universities. The initial pressures of students can be categorised into three areas.

- Students are willing to take on the debt
- The chance to earn higher salaries after graduation
- The timescale and percentage rate of the payment

The question has to be raised about our UK students and the tuition fees. Why aren't more of our home students choosing to study abroad where the costs can be considerably less (dependant on country). The answer lies simply with our students language skills hindering their choices for studying abroad (King, Findlay,Ahrens 2010). The fear of another language deters the majority of UK students from studying overseas. Then there is the choice of university. Factors concerning the entertainment value also come into play (Wilkins, Shams,Huisman 2013) surveyed a number of students with regard to decision making when choosing a university degree. They found that financial burdens were the most important factors when considering a degree, rather than institutional quality and entertainment and quality of life while at university. This is rather contradictory, as conversations I have had with other university academics that the degree is not just the case; it is where the degree was studied that is the important matter. There has to be the acceptance that students are willing to take on the financial burden to gain the qualification, and they see past the cost of their education.

The major factor when considering burdening oneself with such a debt is that the tuition fee is not payable up front, but only after graduation, where the loan is at zero interest rate until the individual earns more than £21000 per annum.Then if the debt has not been cleared after 30 years from graduation, it is written off by the government.

The Browne review stated that a student's background does not affect their ability to participate in a degree course. An experiment (McGuigan,McNally,Wyeness 2010-2012) for 14 and 15 year old school pupils was conducted to see the perceptions of these individuals with regard to the tuition fees and their awareness of the financial contract they would be signing up to. At the time of this experiment the government trebled fees to a maximum of £9000, and the results showed that students were put off from H.E because of this one obstacle. They showed the students fees could be paid off for years to come after the degree. Results showed that despite the Browne review statement of background not stopping the ability to participate, there were still social class divides that proved the message was still not getting through correctly. Those from lower social backgrounds were hesitant to enrol, whereas the middle/higher social groups didn't factor this into the scenario. There are so many factors when considering the H.E degree, the tuition fee being the most important, but other factors being raised also.

Findings and conclusion

There are a number of findings regarding the initial thought "Everything has a cost"

- The fee, even though it has nearly trebled in recent years does not create lack of interest in the degree programmes, last year's applications, even though at £27000 for a three year degree programme, far out-weighed supply.
- There is no evidence that individuals form lower income socio-economic groups are not attending University, even though they initially have a strong aversion to the debt, they still apply and attend degree programmes. The only difference between the groups is when they repay the debt, the lower income groups may use the payback method offered by the Government, rather than paying it off in full.
- According to The Independent Commission on Fees, the current system of pay-back will see nearly three quarters of students failing to repay the loan before the thirty year cut off, and also this could lead to any monetary gain for the treasury being diminished.
- There is a significant decline in mature and part-time applicants because of the fee rise.

- Fears seem to be less significant once the degree course has started, the initial perceptions can be quickly diminished by the way the University designs and implements degree courses with the thought of the individual's Student learning experience.

We have witnessed the changing fee structures and the resultant pressures they have brought about. From the free to learn system adopted years past, right through to the current fee structure we have in place, we now know just how important the fee is to any student at university. We also know the one thing that is constant, disregarding the monetary amounts, and that is the desire of students to learn. The most important word of the university – Learn. Whatever discipline we choose to study, at whatever level, learning is the thing we do daily. Learning has no thought toward money or fees, it disregards anything other than what it describes, our predecessors did not think of such financial burdens, nor should our present and future students. This word is understood in every language, respected in every culture, and has no barriers or limits to the achievements of its staff and students. It welcomes new ideas, while not forgetting the ideas past. It forges business and academia together, and it provides a forward thinking environment for all. Finally, it's been around for hundreds of years, and with the help of our brilliant workforce, I'm sure it will be here to stay.

Students will have a debt of £27000 after graduation. Most will not realise this figure as it has been virtual until repayment, but the cost must be acknowledged as a way of facilitating one's future cause. Without it we will not get the quality of education we expect and deserve. The future is unknown, but what we do know, is that there is one overwhelming factor that keeps the University alive, Learning. Let's not think of the student fee as a heavy chain around our necks, but as a returnable payment for our future success. No one can predict by how much the student fee will rise, or fall, but what we can do, is ensure our universities are ready for the changes ahead.

Everything has a cost? It is official, yes it has, it's been shown, any student, from any socio-economic group will come and pay for their education, and they see it as a necessary first step payment to a very rewarding future.

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Operations management in titanium production

Charles Osarinmwian

Titanium production can be simple, inexpensive, and environmentally friendly (using the Metalysis process) relative to the pyrometallurgical Kroll process (Fig. 1 and 2; [1-3]). Developing semi-continuous electro-deoxidation in titanium production offers mining companies a further option to insulate themselves against the cyclical nature of the commodities markets by entering new and related markets. For instance, the need to produce titanium ingots for grinding operations could be obviated thereby lowering the buy-to-fly ratio of 10 to 1 (i.e. 9 kg of Ti purchased makes 1 kg aerospace flying part) to 2 to 1. Herein a detailed roadmap of operations management relevant to next-generation titanium production is outlined.

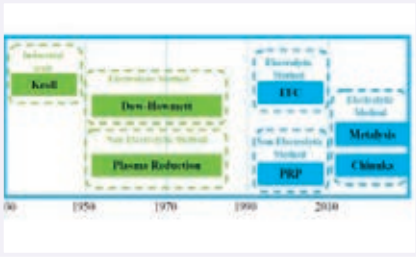

Fig. 1: Historical roadmap of titanium production. Titanium is currently produced at an industrial scale by the Kroll process.

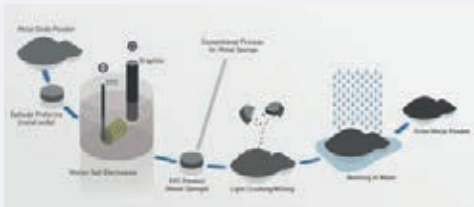

Fig. 2: Aerospace and industrial grade titanium powders produced by the FFC process. High value metal produced at annual volumes of ~170,000 tonnes in a market worth over $10 billion (Source: Roskill ITA SMR, 2014).

Operation of a £3 million high purity titanium pilot production plant with an annual 10 ton capacity and a future £70 million commercial-size titanium production plant with an annual 5000 ton capacity [4] requires understanding of operations management. Continuous improvement adopts the approach to improving performance which assumes more and smaller incremental improvement steps whereas lean manufacturing moves towards the elimination of all waste in order to develop operations that are faster, more dependable, produce higher quality titanium products and services and operate at low cost. Census data shown that U.S. and foreign produced titanium prices varied between 2003 and 2012 because of the relationship between product design, operating costs and titanium production capabilities in different countries [5].

Continuous improvement and lean manufacturing improve competitive advantage and profitability, generate higher productivity (which translates into lower operating costs), and enhances performance by improved employee commitment and involvement. In a titanium plant environment, applying the continuous plan-do-check-action (PDCA) cycle, where the Plan phase requires extensive investigation of certain problems, involves asking and answering 3 fundamental questions:

- What data is available and how is it analysed?
- What is the consequence of this data?
- What are the improvement plans for the problem that has been identified?

The *Do* phase implements the plan while the *Check* phase monitors implementation. The *Check* phase requires a team to implement corrective actions and ensure that the outcome of corrective actions actually solve the problems addressed in the *Plan* phase. Finally, the *Action* phase reviews the effects of the implementation thereby allowing observations of whether corrective actions have created new problems.

To supplement the PDCA cycle, training sessions in waste identification (e.g. cause-and-effect analysis) provides a platform for open engagement in continuous improvement and lean manufacturing. Improvements in titanium product development provide a source of competitive advantage for outperforming competitors (stainless steel and aluminium) in new product designs. Successful introduction of new product designs is perceived as highly focused while demonstrating a clear understanding of customer needs. This could make expansion of operations within novel titanium product lines a real possibility.

Sustainable Model

Process technology

Use fully integrated vision systems and guidance capabilities to coordinate the integration with a robotic palletizer to handle titanium products; Use flexography technology during printing operations as it offers superior flexibility when compared with gravure technology [6] on product packaging; Develop an environmentally-sustainable waste recycle program involving solvents and inks from wash-up systems, and purchase recycled cores and reusable pallets.

Grief model

The magnitude of wastes from titanium production operations and the opportunity to make improvements around them should identify 8 categories [7]. Fundamentally, each employee is tasked with asking 2 questions about their work: "Does it add value?" and "Is there a better way?"

Solectron model

This model is a combination of lean manufacturing principles from Toyota and Quality attributes of Six Sigma [8]. In short, daily continuous improvement events with cross-functional teams (preferably 8-12 people per team) identify and reduce waste to ensure continuous improvement in the titanium supply chain and manufacturing operations. Also, promoting the use of visual cues allows production floor operators to monitor performance leading to problem identification and corrective action:

- Sequencing boards: A control tower for operators and management to view current status of the production floor in terms of customer demand and titanium availability.
- Production Andon: Electronic displays reflect real-time performance and track titanium productivity. The floor supervisor monitors shift efficiency by focusing on daily shift production goals.
- Lookout towers: Supervisors view the production floor to identify inefficiencies.

The lead time of value-added production streams should be defined as the time and cost of all materials and processing actions and activities pass through the titanium supply chain. With regards operations that consume resources, failure to add any value to a titanium product would tend to generate products that are unacceptable to the customer. Hence, it is important to adopt continuous flow U-shaped production lines:

- Reduce titanium handling: An operator completes work on a 3D-printed part, this part continues onto other operators until complete. This eliminates the need for batches to be moved from one operator to the next and thus the potential for titanium loss.
- Improve quality: By working on one part at a time, operators immediately detect problems thereby improving quality as well as saving on titanium costs.
- Use less Work In Progress: Move from a Push to a Pull method. Titanium used for assembling a product is pulled at the point of consumption, not based on sales forecasts, according to Kanban cards.
- Ensure faster changeovers: Apply lean manufacturing principles when switching from one product to another so that changeover times are reduced.

Safety climate intervention

Safety climate needs to be addressed in order to qualitatively measure shared employee perceptions, attitudes, and beliefs about the operational nature of safety management in titanium production. In practice, this measure relies on results from confidential questionnaire surveys from employees and management; it is important to note that management tends to display positive views of themselves, and their commitment and responsibility to safety [9]. Continuous improvement is needed so that safety performance in these surveys exceeds the 50-60 % baseline [10]. This baseline, derived from behavioural safety, is a percentage safe score that indicates deviations from acceptable safe working practices and conditions. The link between safety climate and safety behaviour is dependent on the perception of the importance of safety training.

Developing a continuous improvement programme for managing operations in a titanium production plant (Fig. 3) provides a framework for attaining favourable levels of behaviour and practice within a reasonable timeframe [11]. Negative perceptions of job communication and work environment are predictive of high-accident organizations, unsafe behaviours, and negative safety cultures [9]. Improving safety climate in particular areas in the production plant should improve employee safety climate due to the inter-dependence between behavioural areas. Training employees to develop safety knowledge permits reinforcement of previously learned knowledge to solve practical job-related problems. This has been found to be positively related to areas such as compliance and safety systems [12]. Also, the use of reward systems is one of the most important ways to foster motivation, safe behaviour, and personal accountability.

Fig. 3: Implementation plan and milestones for managing operations in a titanium production plant (Adapted from Ref. [11]).

Safety Mandate

Historically, economic studies of the impact of industrial safety legislation and the occupational health and safety act (OSHA) are dominated by the frequency with which accidents occur. A high accident prone environment in titanium production would lead to high total production costs due to increased lost time, employee compensation and lost workdays; manual materials handling injuries are a major source of lost time and compensation claims. Thus, investment in training and safety equipment should prevent significant costs associated with accidents thereby minimizing accident prevention costs according to OSHA mandates. Compliance with such mandates and efficient internal safety systems should provide safety equipment for production operations according to that mandated. The purpose of ergonomics training should focus on enabling employees to more effectively match the requirements and demands of their job role to their abilities and limitations.

HR Management

Training groups of 8-12 people develops interpersonal skills and builds more positive relationships between different groups within a titanium production plant. Group discussions concerning employees' personal experiences relating to plant safety culture with the aid of easy-to-read fact sheets could effectively solve case-based problems concerning low scoring areas in an employee safety climate. Each group could then present their conclusions to the entire workforce for feedback and further discussion; this approach focuses on the learning and experience of employees. This should encourage employee involvement in discussions about safety, and allow them to make a greater contribution to the decision-making process. Investing in manual handling and ergonomics training should promote positive employee attitudes, improved job satisfaction, and lower ergonomically-related injuries on the plant.

The concept of continuous improvement can be applied to titanium product development in terms of a formalized product development programme. In particular, new product designs should be assessed based on factors such as the level of innovativeness and the type of product differentiation in relation to stainless steel and aluminium. Following this a description of the types of markets that new product designs could target should be identified in order to gain a feel of market size and opportunity as well as their product life cycle phase. Clarity about production operating conditions used in new product design needs to be identified to determine whether titanium products are concentrated or diversified. The performance of a product development program can be assessed on following basis:

- Percentage of current plant sales made by new products over the last 5 years.
- Success and failure rates of new products within the last 5 years.
- Extent to which the program meets its performance objectives over the last 5 years.
- Importance of the program in generating sales and profits.
- Extent to which profits derived from new product design exceed programme costs.
- Success of the programme relative to programmes related to stainless steel and aluminium.

Operational efficiency is established through employees' sharing ideas and concerns within a culture of positivity. An additional incentive for improving perceptions of job communication is the resulting improvement in titanium productivity. The role of HR staff should focus on the interaction between employees, employee empowerment through delegation of authority by management, and their participation in the decision-making process[10]. In contrast to focusing on how satisfied employees are with their performance, larger numbers of HR staff should be avoided as they could create an internal environment and culture in which their own group standards may become more prominent than employee standards.

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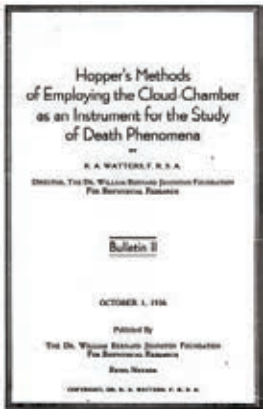
From the archives

Alan Gall, IST Archivist

Soul searching and the International Institute for Psychical Research



Introduction

An advertisement headed "DO WE SURVIVE DEATH" in *The Times* newspaper of 7 April 1934 carried an announcement about the formation of an institute for "investigating on scientific lines" the possibility of an afterlife. Donations to fund the work were solicited. Eminent persons, including several Fellows of the Royal Society and a number of titled gentlemen were listed in various official capacities.

Alarmed by the general tone of *The Times* article, and the lack of consultation over its contents, some of the scientists on the committee immediately resigned and others followed shortly after. An inauspicious start!

One of the first projects to be undertaken by the IIPR involved attempts to duplicate the findings of Raymond Watters, who claimed to have photographed the departing souls of creatures at the moment of death. Dr Watters was outraged when the investigator appointed by the IIPR failed to obtain corroborating results. He retaliated with a detailed criticism of what he saw as flawed attempts to match his own techniques.

The IIPR was short lived but the name of one of its founders, James Arthur Findley, is still associated with spiritualism.

Psychic manifestations

The prestigious magazine *Scientific American* invited Harry Houdini, magician and escapologist extraordinaire, to write articles on spiritualism. This he declined to do, but later agreed (in 1922) to join a committee overseeing an award offered by the magazine for any spirit medium who could produce genuine psychic manifestations, subject to rigorous testing. Most claims were easily dismissed. One case

The case of Margery, the Boston medium. a. Houdini, b. J. Malcolm Bird, an associate editor of Scientific American. c. Margery (Mrs Mina Crandon). d. Orson Munn, publisher of Scientific American

that was more difficult to settle concerned "Margery, the Boston medium".[1] A positive account reached the journal *Nature* under the title "Evidence of Survival of a Human Personality", by a credible witness to several of Margery's séances, entomologist Robin John Tillyard FRS. *Nature*'s editor expressed reservations and was correct in doing so. Houdini was able to explain the tricks used to produce the manifestations.[2] This helped to demonstrate how some exceptionally talented individuals were able to deceive sceptical observers, and the need to apply the most robust tests.

The International Institute for Psychical Research

An article in *Nature* on 23 December 1933 expressed the desirability of establishing a scientific body to rigorously examine "abnormal psychology" and psychic phenomena. A month later the same journal reported on the formation of the International Institute for Psychical Research. The identity of the president (Professor Grafton Elliott Smith, an eminent anatomist) passed without comment but the chairman, in the person of James Arthur Findlay, had already been judged on the basis of his book, *On the Edge of the Etheric*. The comments of *Nature*'s reviewer were: "But from reading Mr Findlay's records the scientific method might be thought not to exist. He seems to have no appreciation of the implications underlying many of his remarks; no desire to see the phenomena described in accurate and scientific terminology."[3] This, and other hostile views expressed in *Nature*, no doubt gave cause for concern to the scientists associated with the Institute.

The Executive Committee at formation consisted of the founders, J. Arthur Findlay, Mrs Dawson Scott and Shaw Desmond, and ten others. A notable inclusion was the prolific inventor Archibald Montgomery Low who controversially adopted the style of Professor Low without the usual credentials. He was certainly a man of many parts: consulting engineer, a founder member and later president of the British Interplanetary

Society, editor of *Armchair Science*, chairman of the Auto-Cycle Union (ACU), author of many popular science books and involved in a number of failed business ventures. It is said that he developed the first guided missiles while at the Royal Flying Corps experimental works during World War One. Before the war he had demonstrated an early version of television that was never developed further.

The makeup of the Consultative Committee added respectability with a bevy of professors. Unsurprisingly, there was physicist Sir Oliver Lodge, well known for his interest in psychic phenomena. A full list of the office-bearers is given in the appendix.

Unfortunately, the Institute's manifesto appeared in the press the day before the scientists themselves had a chance to check the contents. Annoyed by the lack of consultation, and what were seen as un-scientific pronouncements, those with reputations to protect reached for their pens and wrote letters of resignation. *The Yorkshire Evening Post* reported on 28 June 1934 that the departing members were: Professor Sir G. Elliot Smith, Professor Julian Huxley, Sir Oliver Lodge, Professor William Brown, Professor C. Lovatt Evans, Professor A. F. C. Pollard, Dr D. F. Fraser-Harris, Professor E. W. MacBride and Sir Ernest Bennett (Assistant Post-Master General).

The London Spiritualists Alliance (LSA) edited *Light: A Journal of Psychical, Occult and Mystical Research*. Reports on the IIPR that were published in *Light* have been reproduced in the electronic newsletter *Psypioneer* (later *Psypioneer Journal*) by Leslie Price and Paul Gaunt in their articles on the history of the IIPR. Passages from *Light* used in the following account have been taken from *Psypioneer*.

Light first gave news of the new Institute on 5 January 1934, formed "through the initiative of the Survival League". By the issue of 25 May the president, Grafton Elliot Smith had already departed "acting on the advice of his physician". The Institute initially established its base at 16 Queensberry Place, London SW7, already home of the LSA.

Although, reportedly, laboratories had been established, Professor Fraser-Harris did not regard the facilities in the shared building as anywhere near adequate. Indeed, a joint statement by three ex-Consultative Committee members, professors Huxley, Schiller and MacBride, made no bones about it.

We would also like to record our strong disapproval of the treatment accorded to Dr. Fraser-Harris. After ten months without any remuneration except reimbursement of postage expenses, he was offered a small sum for one year and asked to "get to work" in the séance-room of the London Spiritualist Alliance (!), no mediums or scientific apparatus being provided, much less the laboratory originally proposed.

A damning assessment of the Institute followed on from these comments.

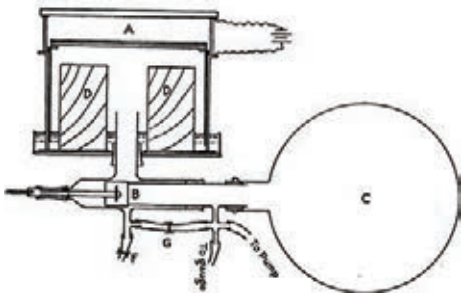
They appear either to have no idea of what constitutes scientific method, or to have thought that they could obtain a dummy committee of scientific workers to confer scientific respectability on a propagandist enterprise.[4]

One of the problems, shared accommodation with the LSA, was resolved by a move to 21 Harrington Road, London SW7. A few months later, *Light* reported on the official opening (27 October 1934) when the Institute's photographer gave a demonstration of infrared photography. "Everyone agreed that the torture of white flash, which gave Mediums such shocks, will henceforth be a thing of the past."

The report also gave a brief mention of plans for "the duplication of the famous intra-atomic quantity experiment."

The cloud chamber

This work of C. T. R. Wilson, proceeding without haste and without rest since 1895, has rarely been equalled as an example of ingenuity, insight, skill in manipulation, unfailing patience and dogged determination. Those who were not working at the Cavendish Laboratory during its progress can hardly realise the amount of work it entailed[5].



Wilson's cloud chamber. Vessel C is evacuated and pressure reduction in the cloud chamber is controlled via valve B. Inside the glass chamber A is a brass cylinder (plunger) running within an outer brass cylinder (expansion cylinder). D is just a wooden cylinder to reduce the volume. An air inlet at F and the clip at G allow control of the initial volume of the cloud chamber. At the base is a dish with about 2 cm depth of water. The battery maintains an electric field (Image from C. T. R. Wilson, 1912)

These words, by Sir J. J. Thomson in his *Recollections and Reflections*, referred to the development of the cloud chamber by Charles Thomson Rees Wilson. Inspired by two weeks spent as relief observer at the Ben Nevis Observatory during September 1894, "CTR" began experiments on cloud formation in the laboratory by the expansion of moist air inside a chamber. In due course he demonstrated that an

ionising particle made a visible track in his apparatus by condensing droplets of water. Particle physics received an instrument of immense value.

CTR's paper "On making visible the paths of ionising particles through a gas" appeared in 1911. Meanwhile, in France, Hippolyte Baraduc had been seeking to make visible the paths of departing human souls. In this endeavour he applied photography, using the deaths of his wife and son to produce evidence. On a smaller scale, Raymond A. Watters attempted to show that the Wilson cloud chamber could track animal souls as well as sub-atomic particles.

1907, Hippolyte Baraduc's wife Nadine, 20 minutes after death. The three cloud-like objects are either the soul or, as suggested by some, a defective camera (Image source: RationalWiki.org)

The Intra-Atomic Quantity

Startling claims were made in a pamphlet entitled *The Intra-Atomic Quantity*, by R. A. Watters, director of the Dr William Bernard Johnston Foundation for Biophysical Research, Reno, Nevada, in 1933. Various small animals were killed inside a cloud chamber. At the time of death, water droplets formed into the very shape of the creature itself and this was interpreted as a manifestation of its departing soul. No such apparition appeared when an animal recovered from a non-lethal dose of ether. The soul was said by Watters to inhabit the space between atoms in the body of a living being. Predictably, the conclusions did not impress the reviewer at *Nature*.

Unfortunately, the few photographs reproduced in the bulletin before us reveal the alleged markings only to the eye of faith; for the rest, the essential experimental details are almost totally wanting. If Mr. Watters wishes his work to receive attention, he should publish a more adequate and a more fully illustrated report.[7]

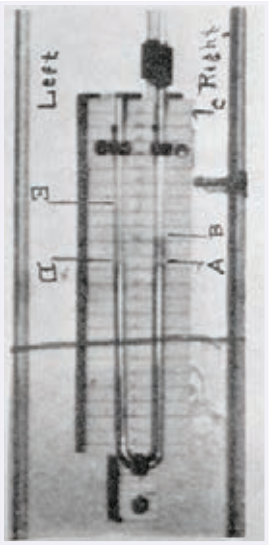
The Institute for Psychical Research was more enthusiastic and *Light* noted that plans were underway to conduct experiments "by a well-known London physicist". The physicist in question was probably Joseph Albert Lauwerys, lecturer in Methods of Science at the University of London. Belgian born Lauwerys held BSc degrees covering chemistry and physics, no doubt a sound choice for the job. Letters passed between Watters and Lauwerys, but for whatever reason the task of conducting the IIPR experiments fell to one Bernard Joseph Hopper, a schoolmaster.

After the resignation of Fraser-Harris as IIPR Research Officer, the position passed to Hungarian psychoanalyst Nandor Fodor. He was assistant editor for *Light* and author of the *Encylopedia of Psychic Science* to be published in 1934. Fodor and B. J. Hopper corresponded with Watters to agree on the experimental details. There were later accusations that Watters had not fully co-operated.

Hopper's cloud chamber results appeared in the third bulletin to be issued by the IIPR,[8] which found no trace of emanations from recently deceased creatures. Unfortunately, Hopper had left himself open to accusations of shoddy experimentation. A preliminary report of Hopper's findings sent to Watters (who declined to offer any comments at the time) contradicted in some respects the final published version. In an experiment of 16 March 1935 using prussic acid to despatch a white mouse, the preliminary report mentions nitrogen being used in the cloud chamber instead of the dust-free air given in the published bulletin. According to Watters there were also discrepancies about the timing of operations and how many experiments were performed.

The emanation from a grasshopper. Watters suggested that the phantom form of the insect shown (the "Intra-Atomic Quantity") is in the process of disintegrating but he identified (a) as the head, (b) as the thorax and the tail portion (d) separated at (c) (R. A. Watters, 1936)

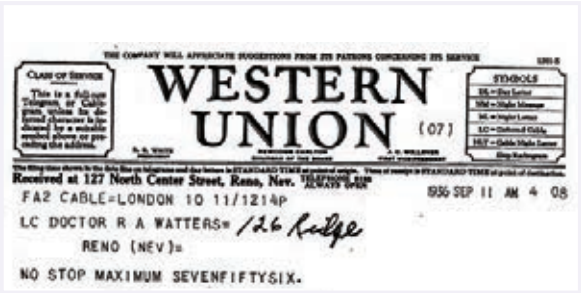
These inconsistencies fuelled Watters' suspicion that other aspects of the work could be called into question. In his possession was a photograph of the IIPR cloud chamber, which also showed the connected manometer. He noticed that dirty mercury had left a section of the manometer tube coated with a dark deposit and calculated that if this section represented the excursion of pressure during the experiments, then it did not correspond to the quoted value of pressure drop given by Hopper. This was not conclusive proof of faulty measurement, as he admitted, but caused him to question the figure of 766.5mm given for barometric pressure on the day of 16 March 1935.



Nandor Fodor sent a photograph of the IIPR cloud chamber to R. A. Watters, who enlarged the section showing the manometer (R. A. Waters, 1936)

On 10 September 1936, R. A. Watters sent a telegram to the Royal Meteorological Society at 49 Cromwell Road, London SW7. The message read "Did barometer read seven

six six point five millimetres at any time during the day of March sixteenth nineteen thirty-five?" No doubt to his great satisfaction, the reply advised that the maximum pressure on that day had been 756 mm. Was this just one example from a catalogue of errors?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NO STOP MAXIMUM SEVENFIFTYSIX.

Cablegram from The Royal Meteorological Society with the maximum barometric pressure reached on 16 March 1935 (R. A. Watters, 1936)

Watters put together a vigorous response, published as *Hopper's Methods of Employing the Cloud-Chamber as an Instrument for the Study of Death Phenomena*, in 1936. The counterattack concluded with 14 reasons "why Mr Hopper failed to demonstrate the Intra-Atomic Quantity."

1. Improperly constructed cloud apparatus.
2. Improperly constructed specimen container.
3. Death improperly induced.
4. Electrostatic field totally omitted.
5. Disregard for adequate temperature control in the cloud chamber.
6. Inferior photographic equipment.
7. Nitrogen as a substitute for dust-free air.
8. Insufficient time given for death to occur.
9. Disregard for correct ratio of expansion.
10. Lack of knowledge on the part of the experimenters of how to photograph, successfully, delicate cloud phenomena, had they been present; and of how to handle, interpret and "process" the negatives, after they were obtained.
11. Improper lighting of the cloud chamber.
12. Cloud chamber improperly "controlled"; its functions should have been controlled with radium, not dust.
13. Insufficient knowledge and experience on the part of the experimenters pertaining to the phenomena of death.
14. For undertaking new and original research, Mr. Hopper conducted too few experiments.

Whatever the truth of Hopper's inadequate methods, further work failed to show the ghostly images that by extension might have proved the existence of the human soul. Life went on in the Earthly realm and opinions are still divided on the subject of afterlife.

As for the International Institute of Psychical Research, it merged with the British College of Psychic Science, as agreed between the two bodies in December 1938, to form the International Institute for Psychic Investigation. Earlier that year, James Arthur Findlay had resigned as chairman and a member of council. He cited as a reason the libel action taken by Nandor Fodor (still the Institute's Research Officer) against the *Psychic News* of which Findlay was the principal owner.

An article Fodor had written for *Armchair Science* (edited by Archie Low, previously mentioned) apparently sparked the affair. In it he stated that there were no mediums in this country whose claims could be verified. The editor of *Psychic News* already held a grudge against Fodor[9] and allowed statements to appear in the paper suggesting that Fodor dismissed evidence that had been fully accepted by spiritualists, and so was unfit to conduct psychical research. Two of four articles in Psychic News were found by the court to be libellous.

At a large gathering of spiritualists in the Royal Albert Hall in 1948, James Arthur Findlay spoke about "the other side".

They have universities, houses, schools, fields, trees, music, clothes, and all the pleasures the mind desires. There is no working for money. It is as substantial a world as this. They have books and they can read them. There is no old age and any deformities in this life are cured in the next.[10]

J. Arthur Findlay gifted his house, Stansted Hall at Stansted Mountfitchet, Essex, to the Spiritualists' National Union and is now operational as the Arthur Findlay College, offering courses in psychic studies.

The International Institute for Psychic Investigation changed name to The Institute of Experimental Metaphysics in about 1945. It was wound up (having been originally formed as a limited company) in November 1947.[11] It had been active until at least 10 July 1947 when members attended a lecture on hypnotism at the Institute's premises, Walton House.[12]

Postscript

The structure of chemical elements came under the scrutiny of mediums Annie Besant and Charles W. Leadbeater, who claimed to have visualised the sub-atomic components directly. Their book Occult Chemistry (1909) shows weird and wonderful shapes, some reminiscent of today's ideas about electron orbitals. Several editions followed, one as late as 1946 (and possibly 1951). The 1919 edition can be viewed at **http://www.gutenberg.org/files/16058/16058-h/16058-h.htm**

Appendix

Officers of the International Institute of Psychical Research on formation, as reported in The Times 7 April 1934.

President
Professor Grafton Elliot Smith, FRS, MA, MD, ChM, DSc, LittD, FRCP.

Vice-Presidents
Shaw Desmond.
Professor Julian Huxley, MA.
Professor E. W. MacBride, FRS, DSc (Lond.), LLD, FZS, FLS.
The Right Hon. Sir Louis Mallet, PC, GCMG, CB.
Sir Richard Redmayne, KCB, MSc, MICE, MIME, FGS.

Executive Committee
J. Arthur Findlay, MBE, JP, Chairman.
Commander John S. Dove, RN (retired) Honorary Assistant Research Officer.
Leslie J. Belton, BA, MSc.
Captain the Hon. Victor Cochrane-Baillie, MC.
Commander Quentin C. A. Craufurd, RN (retired), FRSA, AMIEE, MIRE.
Shaw Desmond.
John Evelyn.
Nandor Fodor, LLD.
Gerald Heard.
A. M. Low, MIAE (Lond.), DSc (Chic.)
Sam Sloan, MD.
William Stephenson, PhD, MSc.
Mrs C. A. Dawson Scott, Honorary Organising Secretary.
Research Officer
Professor D. F. Fraser-Harris, MD, CM, DSc, BSc (Lond.), FRSE.

Consultative Committee
Charles M. R. Balbi, AMIEE.
Sir Ernest Bennett, MA, MP.
William Brown, MD, DSc (Lond.), FRCP.
Professor Hans Driesch, PhD, LLD.
Professor C. Lovatt Evans, FRS, DSc (Lond.) FRCP.
C. C. L. Gregory, MA, FRAS.
J. Arthur Hill.
Professor Julian Huxley, MA.
Sir Oliver Lodge, FRS, DSc.
Professor E. W. MacBride, FRS, DSc (Lond.), LLD, FZS, FLS.
Dr Eugene Osty.
Professor Alan F. C. Pollard, ARCS, AMIEE.
F. C. S. Schiller, DSc, FBA, LLD.
Professor G. Elliot Smith, FRS, MA, MD, ChM, DSc, LittD, FRCP.
William Stede, MA, PhD.
Brunel White.

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Other references are contained in the notes.

[1] Margery's real name was Mina Crandon, née Stinson. See Christopher Milbourne (1975, 192-227) and Harry Houdini's account at http://www.pbs.org/wgbh/amex/houdini/sfeature/margery1.html

[2] At one séance, during the "spirit" levitation of a table in the dark, Houdini released his grip on Margery's hand and placed his own hand under the table. He made contact with Margery's head!

[3] "Science and Psychical Research", *Nature*, 6 January 1934, 18-19.

[4] Julian S. Huxley, F. C. S. Schiller and E. W. MacBride, "Science and Psychical Research", *Nature*, 22 September 1934, 485.

[5] Sir J. J. Thompson, *Recollections and Reflections* (London: G. Bell & Sons, 1936), 419.

[6] Marjory Roy, *The Weathermen of Ben Nevis* 1883-1904 (London: Royal Meteorological Society, 2004), 51.

[7] "Physical Investigation of 'Immaterial' Bodies", *Nature*, 8 December 1934, 877.

[8] The first two IIPR bulletins were *Historic Poltergeists* by Hereward Carrington (1935) and *The Lajos Pap Experiments* by Nandor Fodor (1936).

[9] The editor of *Psychic News*, Maurice Barbanell, a medium himself, had wanted to appear in Fodor's *Encyclopedia of Psychic Science* but to his annoyance did not receive a mention.

[10] "The Dead Walk on at the Albert Hall", *Daily Mail*, 8 Nov 1948, 3.

[11] *The London Gazette*, 12 December 1947, 5881.

[12] Eric Cruddon, "A Note on the Reactions of an Audience to a Simple Experiment with Pendulums", *Journal of the Society of Psychical Research*, 34/639-640, Oct – Nov 1947, 107.

A study of the genetic code of bed bugs reveals that these human blood feeders are adaptive and hardy

An international study involving Rothamsted Research, allows scientists for the first time to read the genetic make-up of bed bugs, and begin to understand genes linked to the insect's adaptive biology and behaviour.

Much like how our eyes scan a sequence of letters to read and understand a sentence of English, scientists have, for the first time, sequenced and annotated the genetic code of the common bed bug (*Cimex lectularius*). This has allowed them to read the bed bug genetic make-up and make big steps in understanding the genes which are linked to evolutionary adaptations in the insect's biology and behaviour. The research, which was carried out by a group of over 80 scientists based across the world, was published in *Nature Communications* in February 2016.

Bed bugs, the very thought of which makes a person shudder and scratch, were nearly eradicated after World War II in most economically and politically stable countries. In the past 20 years however, there has been a recovery in their population across much of the world.

The research involved the rearing of bed bugs to extract DNA from their cuticle, which is what forms the outer protective skeleton of the insect. This was followed by sequencing, automated annotation, and manual analyses of the bed bug genetic code or, what the scientists call, the genome. The research provides a full annotation of the genes which makeup the bed bug genome.

In collaboration with colleagues of the consortium, Rothamsted Research scientist, Dr Jing-Jiang Zhou, who is strategically funded by the BBSRC, identified the collection of genes that are linked to the bed bug's sense of smell (olfaction) and sense of taste (gustation).

"Sense of smell and taste are critical to how bed bugs find mates to reproduce, locate their human hosts to feed, and navigate through the dark environment of a bed. To do all of this, bed bugs use smell (olfaction) and taste (gustation) receptors, and smell (odorant) binding proteins.

The collection of what are called chemosensory genes – in other words genes which response to chemical stimuli – was substantially reduced in the bed bug compared to insects which feed on plants. It is however, similar to the trend noted in the genome sequences of other blood-feeding insects." – Dr Zhou

Other areas of the bed bug genome research included the identification of the genes which are linked to how bed bugs mate, feed, form mutually dependent relationships with bacterial organisms, and become resistant to pesticides.

"Given that bed bugs are associated with humans in the built environment, are active at night and have no wings to fly we expected a collection of genes which were linked to controlling the ways in which this parasite locates and accepts its host, and ingests and digests blood. And also a range of genes linked to how bed bugs have, over time, become resistance to pesticide." – Dr Joshua Benoit, the leading author, from the University of Cincinnati

The research has uncovered underlying characteristics surrounding fundamental questions such as why bed bugs feed only off blood, and how they can survive an entire year without a meal.

"If someone's home is infested and that person leaves the premises for a few weeks in the hope that the bed bugs will go away, that isn't going to happen. The bed bugs will be hungry and waiting for when the 'host' gets back home." – Dr Benoit

The outer protective cuticle of bed bugs plays a significant role in their resistance to pesticides. It's believed that resistance is a result of changes in the expression of cuticle proteins. The researchers identified 273 genes that encode common cuticle proteins, all of which have been associated with pesticide resistance in various other insects.

"Almost certainly humans and bed bugs will remain closely associated for the foreseeable future. As the only British scientist in this study, I am very proud to have contributed to the work. It provides us the genetic resources to study molecular mechanisms of bed bug olfaction and chemosensory specialisation through comparative genomic studies. And is a platform for future research to ask questions such as: what has triggered the current bed bug resurgence and do bed bugs originate from one or multiple sources?" – Dr Zhou

Bed bugs are not vectors in nature of any known human disease. Although some disease organisms have been recovered from bed bugs under laboratory conditions, none have been shown to be transmitted by bed bugs outside of the laboratory.

This photograph [ii] depicts an oblique-dorsal view of a bed bug nymph (Cimex lectularius) in the process of ingesting a blood meal from the arm of a "voluntary" human host.

The common bed bug is found worldwide. Infestations are common in the developing world, occurring in settings of unsanitary living conditions and severe crowding. In North America and Western Europe, bed bug infestations became rare during the second half of the 20th century and have been viewed as a condition that occurs in travellers returning from developing countries. However, anecdotal reports suggest that bed bugs are increasingly common in the United States, Canada, and the United Kingdom.

C. lectularius inject saliva into the blood stream of their host to thin the blood, and to prevent coagulation. It is this saliva that causes the intense itching and welts. The delay in the onset of itching gives the feeding bed bug time to escape into cracks and crevices. In some cases, the itchy bites can develop into painful welts that last several days.

Bed bug bites are difficult to diagnose due to the variability in bite response between people, and due to the change in skin reaction for the same person over time. It is best to collect and identify bed bugs to confirm bites. Bed bugs are responsible for loss of sleep, discomfort, disfiguring from numerous bites and occasionally bites may become infected.

[i]Image 1-This digitally colourised scanning electron micrograph (SEM) revealed some of the ultrastructural morphology displayed on the ventral surface of a bedbug, Cimex lectularius. From this view you can see the insect's skin piercing mouthparts it uses to obtain its blood meal, as well as a number of its six jointed legs.

[ii] Image 2 -Content Providers(s): CDC/ Harvard University, Dr. Gary Alpert; Dr. Harold Harlan; Richard Pollack. Photo Credit: Piotr Naskrecki

(Images courtesy of Wikimedia Commons)

Health and safety in Tudor England

Death by bear-baiting!

Having a job in the 16th century was a dangerous business, with nearly half of accidental deaths happening at work. A new study has documented the various gory ways in which workers met their end whilst driving carts, felling trees or working in mills. It found that even in Tudor England people adopted health and safety measures to make their jobs safer, although they didn't always work as planned.

As part of a research project funded by the ESRC, University of Oxford historian Professor Steven Gunn has been scouring 16th century coroners' reports and researching accidental deaths in Tudor England. Professor Gunn estimates there are some 9,000 accidental deaths in the 16th century to investigate, all stored in The National Archives in Kew.

His findings give a unique insight into what life was like in the Tudor period including all the strange ways in which people died, for example being mauled to death by bears kept for bloodthirsty bear-baiting; drowning in cesspits; and being shot by stray arrows when practising archery.

The findings also shine a light on the working practices of men, women and children at the time, and how these changed over the century.

The study found that fatal accidents were much more likely to take place during the agricultural peak season, with cart crashes, dangerous harvesting techniques, horse tramplings and windmill manglings all major causes.

However, despite the high accident rates workers did adopt health and safety procedures to try to reduce deaths.

For example, when mowing hay at harvest time, men would minimise the risk of hacking each other with their scythes by walking across the field in a staggered diagonal line. This didn't always go to plan though.

On 1 July 1559, Richard Goodall had been mowing hay since early morning. Then late in the morning at the end of cutting a swathe, Richard suddenly got in the way of his colleague, who accidentally struck the back of his right leg with his hay scythe. Richard died three hours later.

Many accidents were caused by tree-felling, which was a vital job in Tudor times as wood was an important building material and fuel.

Another health and safety measure was carried out by fellers who tried to manage risk by directing the tree to fall down in a certain direction. Unfortunately though the trees would often catch on other trees and then the workers wouldn't know what to do. More than one in 10 fatal accidents involved cutting or moving wood.

Falling out of trees when gathering fruit or nuts was also commonplace, and handbooks specifically warning about the danger of climbing trees to get rid of crows' nests were published.

"It might sound like health and safety gone mad, but we found several records of men falling to their deaths doing just this, so perhaps it was necessary." – Professor Gunn, of Merton College

Women and children were also at risk from dying at work. As well as domestic chores, women also prepared sheep for shearing by washing them in fast-flowing mountain streams, with predictably dire consequences.

A simple task such as fetching water often led to disaster, with drowning in rivers, ponds and wells accounting for one in 10 working deaths. Almost 70 per cent of those who drowned fetching water were women and another 12 per cent were boys aged younger than 13.

"Various efforts were made by the Tudors to build safer wells with covers over them, kerbs around them and barrels on which to wind the rope with the bucket at the end up and down, but something could go wrong even after these safety measures were put in place." – Professor Gunn

One of the most dangerous jobs was driving a cart. Many deaths were caused by losing control of the horse, but many also involved drivers or passengers falling asleep and either losing control or falling off and running themselves over. On 2 August 1557 at Pentlow in Essex, Thomas Olyvere was harvesting his barley in "Walnotte Felde" and loading it onto his cart. He stood on the cart to tie up the load of barley, but the cart turned over and fell on top of him, breaking his neck.

"Carters faced all sorts of trouble. Because carts had no brakes, workers were 10 times more likely to have an accident when going downhill than going uphill, but because the two-wheeled carts were so unstable and the roads were so rutted they were even more likely to be injured by the cart overturning." – Professor Gunn

To prevent carts from careering down icy hills and hitting people, men would often walk in front of the cart to stop it sliding, but this just led to more people being crushed.

"Reading about how people died in Tudor times, you might think that people must have been daft to have died the way they did. Actually people did make an effort to work out the risks and minimise them, but these methods didn't always work." – Professor Gunn

Further information
http://tudoraccidents.history.ox.ac.uk

(Images courtesy of Wikimedia Commons)

Body-wide asymmetry

An international team of researchers has discovered a gene in snails that determines whether their shells twist clockwise or anti-clockwise – and could offer clues to how the same gene affects body asymmetry in other animals including humans.

The research, published in the journal *Current Biology* and led by a scientist at The University of Nottingham, is an important step in understanding how our organs are placed asymmetrically within the body and why this process can sometimes go wrong when some or all of the major internal organs are reversed or mirrored from their normal placement in the body.

Dr Angus Davison, an expert in evolutionary genetics at The University of Nottingham in the UK, led the international research project with involvement from scientists at The University of Edinburgh, UK, University of Göttingen, Germany and Tufts University, USA. Using snails that naturally differ in how their shells twist, Davison and his colleagues were able to identify a gene that controls whether snail shells twist clockwise or anticlockwise. The gene makes a protein called formin, which is involved in making the cell scaffold. A defect in formin means that the whole snail is "reversed", a mirror image of others in the same species.

"While animals tend to be outwardly symmetrical in appearance, they are almost all asymmetrical inside. It has not been clear if asymmetry is an ancient feature, or something that has evolved several times. By identifying a single evolutionary conserved protein that controls asymmetry in both snails and frogs, we have shown that body asymmetry in most

animals, including humans, likely arises from a highly conserved, intrinsic asymmetry of the cells in the early embryo. This research helps to unify our understanding of asymmetry across animals." – Dr Davison, in the University's School of Life Sciences

The scientists first mapped the location of the gene that defines mirror image development in snails, and then used genome sequencing technologies to find the mutation in the formin gene that makes snails develop as an anti-clockwise coiling mirror image.

"We were able to use cutting-edge DNA sequencing and computer analyses to not only sequence the genome of the pond snail very rapidly, but this then enabled Angus to identify the tiny change (one letter in the one billion of the snails' genome) that causes the switch from clockwise to anti-clockwise. The combination of traditional genetics and developmental biology with the new genomics tools has delivered stunning results." – Professor Mark Blaxter, leader of the genome sequencing effort in Edinburgh

To verify the association, the teams mapped where the formin gene was active – in just the right cells in early embryos – and used an anti-formin drug treatment to partially convert normal "dextral" snails (clockwise twist) to mirror image "sinistral" embryos (anti-clockwise).

"Contrary to what was expected, we were surprised to find that asymmetry is present in the very early embryo, from the two-cell stage onwards. By visualising the asymmetric activity of the formin gene in these early embryos, we were provided with stunning supporting evidence of the role the formin gene plays in this evolutionarily ancient process." – Dr Dan Jackson, University of Göttingen, Germany

To understand the link with human development, collaborating scientists in the US used experiments in the frog to successfully show that the gene has a similar function in the early development of vertebrates.

"It is extremely exciting to discover that snails and vertebrates use some of the same internal cell components to establish their left-right axis. This very wide evolutionary conservation between snails and frogs underscores the ancient origin of body-wide asymmetry in the molecular events taking place in early embryonic cells." – Professor Michael Levin, Tufts University, US

The researchers believe that their results provide strong evidence to suggest that this same molecule is likely to be among the earliest "symmetry breaking" components across all Bilateria – animals which have a body-plan with one central axis of symmetry. Both snail and frog embryos derive asymmetry from formin-mediated events occurring inside cells at very early stages of their development.

Asymmetry, they argue, is probably an ancient property of cells, which could be traced back to the common ancestor of all Bilaterian animals.

"The "switch" from clockwise to counter-clockwise snails was one of the earliest inherited markers to be properly described, dating back to the 1920s, but the identity of the gene involved has remained unknown ever since. While living in Japan in 2001, I noticed that the snails around me were the "wrong" kind (anti-clockwise coiling). Ever since then I have wanted to find the gene. After securing funding from the BBSRC, we used new DNA sequencing technologies to find the gene in only three and a half years. This work "solves" a longstanding genetic puzzle, but also shows how work on lesser known laboratory animals can be used with new technologies to help understand aspects of our own development." – Dr Angus Davison added:

The research, Formin is associated with left-right asymmetry in the pond snail and the frog, was principally funded by BBSRC, the Wellcome Trust Sanger Institute in the UK, Ghent University in Belgium, and Tohoku University in Japan.

(Images courtesy of Wikimedia)

Longest-running cohort study in the UK celebrates turning 70

The latest findings from the MRC National Survey for Health and Development (NSHD), a cohort study which turned 70 at the end of February 2016, have shown reason to celebrate – a rise in wellbeing throughout the seventh decade of life.

The MRC NSHD began in March 1946, with the recruitment of thousands of newly born babies, and is the oldest and longest-running birth cohort in the UK. Over 3,000 study members turn 70 this year and together they are some of the most closely medically observed people in the world.

In a cohort study, researchers follow a group of people over time and this long-term assessment helps them make important links between genetics, environment, lifestyle and health.

The MRC invests taxpayers' money in some of the best medical research in the world across every area of health and has been funding the study since 1962. In the UK, a staggering 1 in 30 people (3.5% of the population) are part of a cohort, and the MRC funds 23 of the 41 UK-based cohorts.

To celebrate, the NSHD hosted two birthday parties for its study members, in London and in Manchester. Around eight hundred guests attended the events, with some study members even bringing a parent – who originally signed them up for the cohort when they were born.

Meanwhile, some of the latest findings from the NSHD have shown a rise in wellbeing throughout the seventh decade of life. Participants – when aged 60 to 64 – were asked to rank a 14-item scale with five response categories. The questions covered a range of aspects of mental wellbeing including feeling cheerful, confident, optimistic, useful and relaxed. The new findings show that when the same individuals were asked the same questions at age 69, overall there was an improvement in all 14 items that make up the wellbeing scale compared to their responses in their early sixties. This is in spite of most study members reporting at least one common chronic disease such as arthritis or cancer.

Researchers at the MRC Unit for Lifelong Health and Ageing (LHA) at University College London now plan to study what experiences and circumstances are linked to this increase.

"What we've found is that, on average, levels of wellbeing increased during people's sixties. We found that 1 in 5 experienced a substantial increase in wellbeing in later life, although we also found a smaller group who experienced a substantial decline. The benefit of using a cohort study like NSHD is that we can look at how individuals change over time. We hope this will allow us to pinpoint which common experiences may be linked to an improvement in wellbeing in later life." – Dr Mai Stafford, Programme Leader at the MRC LHA

The findings from this unique cohort have had a major contribution to healthcare, education and social policy for more than 50 years. Thanks to the study, more information than ever is being discovered about what can maintain physical and cognitive function as we age, and what can contribute to the risk of heart disease, cancer, dementia, type 2 diabetes; and much of this has already entered common knowledge.

"NSHD study members have been helping us for seven decades of their lives and we are grateful for their time and commitment to the study. Their contribution to our knowledge about human development and ageing is enormously valuable for science and policy." – Professor Diana Kuh, who leads the MRC NSHD at the MRC LHA

The study is now at a crucial stage, following study members as they get older and providing vital information for those delivering healthcare to older people. Modern science will learn even more than before about healthy and unhealthy ageing, and this knowledge is very likely to lead to new possibilities for prevention.

Past findings from the NSHD

- The finding, in 2014, that more rapid rises in systolic blood pressure during midlife (even if not crossing into hypertension) were related to poorer cardiac structure (published in the European Heart Journal in 2014) has implications for treatment guidelines as it suggests that identification and treatment of people with rapidly increasing SBP, even if they are not reaching the criteria for hypertension, may be beneficial in preventing subsequent cardiovascular disease.

- The findings (published in The Lancet Diabetes & Endocrinology in 2014) suggesting that those who lost weight at any age during adulthood, even if weight was regained later, had better cardiovascular risk profiles than those who remained overweight or obese supports public health strategies that help individuals to lose weight at all ages.

- In 2014, the finding that better performance in tests of physical capability (i.e. grip strength, chair rising and standing balance) in midlife was linked to higher survival rates over 13 years of follow-up was published in the British Medical Journal. This highlighted the value of these simple objective physical tests in helping to identify those people who from at least as early as midlife onwards may require more support than others to achieve a long and healthy life.

- Subsequent work (under review) examining changes in objective measures of physical capability between ages 53 and 60-64 has highlighted that age-related decline may not be entirely inevitable and is potentially modifiable. This work has also suggested that there may be a need to monitor physical capability from at least as early as midlife onwards as opportunities to help some high risk groups may already have been missed if no action is taken until later in life.

- A 2009 report on adult life chances in relation to childhood mental health using NSHD was cited by the government in support of a case for early intervention to build mental capacity and resilience.

- The study's findings of the continuing effect of early life growth and development on health outcomes in adulthood add to the arguments for early intervention of the kind provided by the national SureStart programme.

- The 1999 paper comparing children's diet in 1950 with that in the 1990s ("Food and nutrient intake of a national sample of four-year-old children in 1950: comparison with the 1990s", Public Health Nutrition) had an impact because of its evidence that the quality and nutrient value of infant and childhood diet had declined between 1950 and 1990.

- The study's finding (published in All our Future in 1968) of the extent and inequity of the "waste of talent" – in terms of high ability children who did not continue into further or higher education – added to arguments for improving opportunities for, and expectations of, children from poorer families

- The Home and the School (1964) had a great impact, probably because it provided the first hard evidence that parents and preschool circumstances had a significant impact on ability and attainment at age eight, and so showed that preschool development and experience formed the bedrock on which primary schooling was built

- Press reports that followed the publication of Maternity in Great Britain (1948), which were concerned with the "Need for Better Care and Lower Costs" (The Times), are likely to have influenced the arguments for improvements in the care of mothers and babies

In addition, the NSHD is a member of the Dementias Platform UK, £53 million collaboration between universities and industry established by the MRC in 2014, to transform the best dementia research into the best treatments as quickly as possible. It combines the power of multiple population studies to compare healthy people with people at all stages of dementia.

The NSHD is featured in a new book about cohort studies called "The Life Project" by Helen Pearson, published by Allen Lane, March 2016.

Seaweed offers the solution to transporting stem cells and wound treatment

Alginate is a natural material extracted from seaweed that is used in cosmetics, food manufacturing and more recently in healthcare. Alginate on its own without stem cells is used in wound dressings to keep burns moist.

Publishing in *STEM CELLS Translational Medicine*, Professor Che Connon and Dr Stephen Swioklo describe the low-cost seaweed solution.

Stem cells for healing

There is much scientific evidence showing stem cells from fatty tissue (adipose-derived mesenchymal stem cells) can be used to improve wound healing by reducing inflammation and speeding up wound closure. However, until now the problem has been that these stem cells have had to be stored and handled by experts under specialised conditions – limiting their practical use.

Rather than keeping them at 37 degrees Celsius, in atmospheric oxygen and 5% carbon dioxide, encasing the stem cells in an alginate gel is shown to prolong their life for up to three days at ambient temperatures. This offers an effective and simple solution to many of the challenges of transporting cell cultures.

Stem cells have been put into plasters and bandages to help heal wounds for the first time, thanks to a new technique developed by scientists at Newcastle University, UK.

The method of encasing stem cells in an alginate gel made from seaweed makes them practical to use, adaptable and easy to store – even at room temperature.

"The stem cells are surrounded by an alginate gel which protects them from the environment – a bit like frogspawn. We found them unchanged even after three days at room temperature.

This has lots of advantages and applications. For example, we have used them to make a bandage which contains human stem cells which could be applied to a wound such as an ulcer or burn to speed up the healing process." – Che Connon, Professor of Tissue Engineering at Newcastle University

The study found that after three days at a range of temperatures (between 4 and 21 degrees C) up to 90% of the stem cells were still viable and available for healing. Medically, 70% viability is considered acceptable.

The team think that the alginate encapsulation offers a degree of protection from the environment. They also believe it may be acting like a corset, preventing the stem cell from expanding and being destroyed, a process known as lysing – which would normally occur within a day when unprotected cells are stored in their liquid state.

Stem cell encapsulation method

Using the alginate solution the Newcastle University team have been able to develop stem cell beads and also a gel which can be put into a mould to form a jelly pad or film.

"The stem cells are grown from the standard frozen form and then mixed into the alginate solution. This is extracted from a type of brown algae, a seaweed commonly used in food and medical applications. This can either be dropped into a vial of calcium chloride which forms cross-links making the alginate set, forming tiny beads. Or the gel can be placed into a mould to form a film which sets in a couple of minutes. We have used this to make plasters and bandages.

One circular disc just an inch diameter was demonstrated in our study to effectively preserve a million stem cells and could easily contain up to 10 million." – Dr Stephen Swioklo

The "Stem-gell" bandage has many potential uses from paramedics treating people at the scene of an accident to the army battlefield. Some of the work has been funded by the Defence Science and Technology Laboratory (Dstl), part of the Ministry of Defence.

The study was also funded by the Engineering and Physical Sciences Research Council (EPSRC) and Biotechnology and Biological Sciences Research Council (BBSRC).

Getting "Stem-gell" into the clinic

The Newcastle University scientists say that "Stem-gell" offers many exciting opportunities for therapeutics, for ease of transport, in cell printing, in improving the results with injections of stem cells and for wound healing. They are now working to get "Stem-gell" scaled up and into the clinic for trials.

"With this new technology we are able to put stem cells directly onto an open wound with a stem cell bandage. The gel retains the cells so that they don't leave the bandage – it's the chemicals these cells make that actually do the healing.

The product could also be used for cell printing, for example, a doctor's surgery could purchase a cartridge of stem cells in the alginate gel to keep in the fridge and when needed print tissues providing rapid personalised medicine there and then.

And we're not talking about far into the future – we're looking at this being something we can all be treated with in a few years." – Professor Che J. Connon

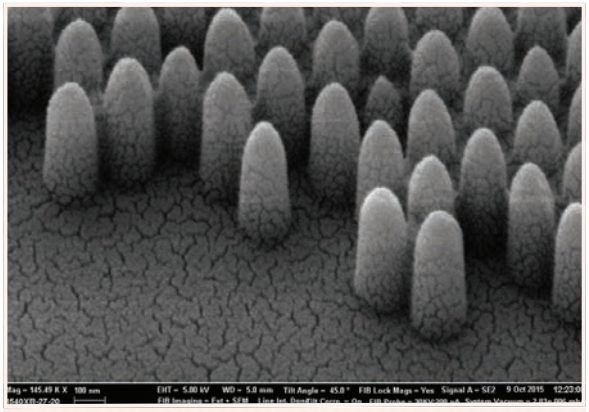
Current distribution solutions for cell cultures involve a combination of complex and high cost logistics, often with limited time windows. This "Stem-gell" technology enables cell cultures to be delivered in an easy to use form, providing considerable cost and time efficiencies.

Stem cell manufacturers are generally limited to either cryopreservation of cells, warm cell shipping (ambient), cold chain shipping (2-8^{0}C), or co-localisation and coordination of manufacture and clinical procedures. Freezing cells leads to loss in cell viability, and adds expense and complications to transport and delivery, e.g. the need to maintain them at a low temperature, and facilities to safely store and thaw the cells at the destination. Cryopreservation also presents a hazard to handlers (asphyxiation risk, risk of cryogenic burns). Warm transport in the absence of hydrogels (alginate beads or gel) drastically limits transport times, is logistically complicated, potentially affects cell viability/quality, and has a higher risk of microbiological contamination. Warm transport is also vulnerable to delays in the distribution chain (flight delay/cancellation, traffic jams, customs hold-ups). Co-localisation of stem cell manufacture and clinical use limits business models and inconveniences patients. Neither of the current distribution solutions is ideal, involving a combination of complex, specialised logistics with high costs, limited delivery windows, and technical challenges.

Injection of stem cells is required for many therapies in development. It has been demonstrated that, during injection, the forces acting on the cells cause membrane damage, and result in loss of cell viability. Encapsulating cells for injection in hydrogel has been shown to protect the cells from injection stresses, leading to increased cell viability.

(Images courtesy of Wikimedia Commons)

Nature inspired nano-structures mean no more cleaning windows



A scanning electron miscroscope photograph shows the pyramid-like nanostructures engraved onto glass: at 200nm they are 100 times smaller than a human hair. Controlling the surface morphology at the nanoscale allows scientists to tailor how the glass interacts with liquids and light with high precision. (Courtesy UCL)

Smart windows clean themselves, save energy and mimic moth eyes to cut glare

A revolutionary new type of smart window could cut window-cleaning costs in tall buildings while reducing heating bills and boosting worker productivity. Developed by University College London (UCL) with support from EPSRC, prototype samples confirm that the glass can deliver three key benefits:

- **Self-cleaning:** The window is ultra-resistant to water, so rain hitting the outside forms spherical droplets that roll easily over the surface – picking up dirt, dust and other contaminants and carrying them away. This is due to the pencil-like, conical design of nanostructures engraved onto the glass, trapping air and ensuring only a tiny amount of water comes into contact with the surface. This is different from normal glass, where raindrops cling to the surface, slide down more slowly and leave marks behind.

- **Energy-saving:** The glass is coated with a very thin (5-10nm) film of vanadium dioxide which during cold periods stops thermal radiation escaping and so prevents heat loss; during hot periods it prevents infrared radiation from the sun entering the building. Vanadium dioxide is a cheap and abundant material, combining with the thinness of the coating to offer real cost and sustainability advantages over silver/gold-based and other coatings used by current energy-saving windows.

- **Anti-glare:** The design of the nanostructures also gives the windows the same anti-reflective properties found in the eyes of moths and other creatures that have evolved to hide from predators. It cuts the amount of light reflected internally in a room to less than 5 per cent – compared with the 20-30 per cent achieved by other prototype vanadium dioxide coated, energy-saving windows – with this reduction in "glare" providing a big boost to occupant comfort.

"This is the first time that a nanostructure has been combined with a thermochromic coating. The bio-inspired nanostructure amplifies the thermochromics properties of the coating and the net result is a self-cleaning, highly performing smart window." – Dr Ioannis Papakonstantinou of UCL, project leader.

The UCL team calculate that the windows could result in a reduction in heating bills of up to 40 per cent, with the precise amount in any particular case depending on the exact latitude of the building where they are incorporated. Windows made of the ground-breaking glass could be especially well-suited to use in high-rise office buildings.

"It's currently estimated that, because of the obvious difficulties involved, the cost of cleaning a skyscraper's windows in its first 5 years is the same as the original cost of installing them. Our glass could drastically cut this expenditure, quite apart from the appeal of lower energy bills and improved occupant productivity thanks to less glare. As the trend in architecture continues towards the inclusion of more glass, it's vital that windows are as low-maintenance as possible." – Dr Ioannis Papakonstantinou

Discussions are now under way with UK glass manufacturers with a view to driving this new window concept towards commercialisation. The key is to develop ways of scaling up the nano-manufacturing methods that the UCL team have specially developed to produce the glass, as well as scaling up the vanadium dioxide coating process. Smart windows could begin to reach the market within around 3-5 years, depending on the team's success in securing industrial interest.

"We also hope to develop a "smart" film that incorporates our nanostructures and can easily be added to conventional domestic, office, factory and other windows on a DIY basis to deliver the triple benefit of lower energy use, less light reflection and self-cleaning, without significantly affecting aesthetics." – Dr Papakonstantinou

"This project is an example of how investing in excellent research drives innovation to produce tangible benefits. In this case the new technique could deliver both energy savings and cost reductions." – Professor Philip Nelson, Chief Executive of EPSRC

A 5-year European Research Council (ERC) starting grant (IntelGlazing) has been awarded to fabricate smart windows on a large scale and test them under realistic, outdoor environmental conditions.

In the UK, buildings currently account for around 33 percent of primary energy used (a proportion that is increasing) with heating & cooling accounting for over 60 per cent of energy consumed indoors. Nano scale refers to very small sizes in the region of 1 nanometre, or a billionth of a metre.

The UCL team that developed the prototype smart window includes Mr Alaric Taylor, a PhD student in Dr Papakonstantinou's group, and Professor Ivan Parkin from UCL's Department of Chemistry.

First gene identified for greying hair

The first gene identified for greying hair has been discovered by an international University College London (UCL)-led study, confirming greying has a genetic component and is not just environmental.

Published in Nature Communications, the BBSRC-funded study analysed a population of over 6,000 people with varied ancestry across Latin America to identify new genes associated with hair colour, greying, density and shape, i.e. straight or curly.

"We already know several genes involved in balding and hair colour but this is the first time a gene for greying has been identified in humans, as well as other genes influencing hair shape and density. It was only possible because we analysed a diverse melting pot of people, which hasn't been done before on this scale. These findings have potential forensic and cosmetic applications as we increase our knowledge on how genes influence the way we look." – Lead author, Dr Kaustubh Adhikari, UCL Cell & Developmental Biology

The findings could help develop forensic DNA technologies that build visual profiles based on an individual's genetic makeup. Research in this field has previously used samples from people of European descent, but these new results could help forensic reconstructions in Latin America and East Asia.

The gene identified for grey hair – IRF4 – is known to play a role in hair colour but this is the first time it has been associated with the greying of hair. This gene is involved in regulating production and storage of melanin, the pigment that determines hair, skin and eye colour.

Hair greying is caused by an absence of melanin in hair so the scientists want to find out IRF4's role in this process. Understanding how IRF4 influences hair greying could help the development of new cosmetic applications that change the appearance of hair as it grows in the follicle by slowing or blocking the greying of hair.

"We have found the first genetic association to hair greying, which could provide a good model to understand aspects of the biology of human aging. Understanding the mechanism of the IRF4 greying association could also be relevant for developing ways to delay hair greying." – Professor Andres Ruiz-Linares, UCL Biosciences, who led the study

The University of Bradford's Centre for Skin Sciences investigated another gene as part of the study, PRSS53, which was found to influence hair curliness.

"An enduring fascination of human evolution has been our peculiarly luxuriant scalp hair, and finding a new variation in the Protease Serine S1 family member 53 (PRSS53) genes provides an important insight into the genetic controls underpinning scalp hair shape and texture. The PRSS53 enzyme function in the part of the hair follicle that shapes the growing hair fibre, and this new genetic variation, associated with straight hair in East Asians and Native Americans, supports the view that hair shape is a recent selection in the human family." – Professor Desmond Tobin, University of Bradford

The scientists found additional genes associated with hair including EDAR for beard thickness and hair shape; FOXL2 for eyebrow thickness and PAX3 for monobrow prevalence.

"It has long been speculated that hair features could have been influenced by some form of selection, such as natural or sexual selection, and we found statistical evidence in the genome supporting that view. The genes we have identified are unlikely to work in isolation to cause greying or straight hair, or thick eyebrows, but have a role to play along with many other factors yet to be identified." – Dr Adhikari

The team collected and analysed DNA samples from 6,630 volunteers from the CANDELA cohort recruited in Brazil, Colombia, Chile, Mexico and Peru. After an initial screen, a sample size of 6,357 was used, at 45% male and 55% female. This group included individuals of mixed European (48%), Native American (46%) and African (6%) ancestry, giving a large variation in head hair appearance.

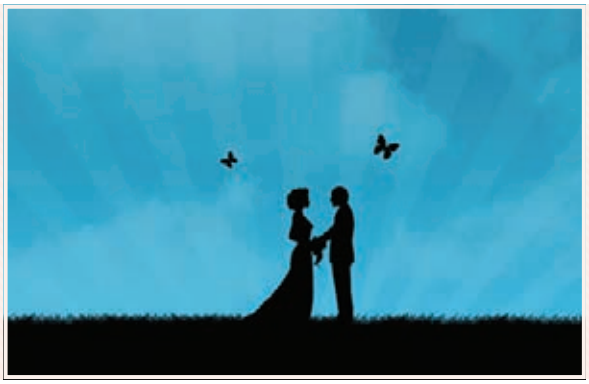
Both men and women were assessed for hair shape, colour, balding and greying, but only men were tested for beard, monobrow and eyebrow thickness. Visual traits for each individual were compared to whole genome analysis results to identify the genes driving differences in appearance.

These were then checked against existing databases of different populations to see if the differences made sense based on previous knowledge and were under selection.

Institutions involved in this work include UCL, Universidad de Oviedo (Spain), Universidad Peruana Cayetano Heredia (Peru), Universidad de Tarapaca (Chile), The University of Edinburgh (UK), Centro Nacional Patagonico (Argentina), National Institute of Anthropology and History (Mexico), Universidad de Antioquia (Colombia), UNAM (Mexico), Universidade Federal do Rio Grande do Sul (Brazil), University of Bradford (UK), University of Melbourne (Australia).

The Leverhulme Trust and Biotechnology and Biological Sciences Research Council (BBSRC) kindly funded UCL's contribution to this work.

Mapping your ancestral Valentines



Ever wondered where your ancestors met their Valentine? Or maybe where in the country you stand the best chance of meeting Mr Hardy, Mr Beckham, Ms Beckinsale or Ms Brook this Valentine's Day?

A new website, Named, (http://named.publicprofiler.org/), developed by geographers at UCL, predicts where lovers met (or could potentially meet) using surnames – you could even use it to see if it can correctly guess where you met your Valentine!

The website, which is part of a wider research project funded by the ESRC, invites users to enter two surnames. It then generates a "heat map" of the geographic concentrations of the two names overlaid on top of one another, thus identifying areas where the couple most probably met.
Professor Paul Longley is leading the project.

"The website is a quirky start of our research project which is looking into whether our surnames are linked to our geographical locations – something which has been long perceived. It is known that many names remain surprisingly concentrated in specific parts of the UK, and this project helps us extend our understanding of name geography to combinations of names too when we enter relationships."

The data used for the website comes from the Consumer Data Research Centre.

Professor Longley said the study so far shows that on average surnames have not moved far in distance over the last 700 years.

"Most Anglo Saxon family names came into common usage between the 12th and 14th centuries, and were first coined in particular parts of the country. What is interesting is that most individuals do not move far from their ancestral family homes and so, 700 or more years later, most names can still be associated with particular localities. So if your Valentine's surname is Rossall, for example, it is still about 40 times more likely that you met him or her in the environs of Blackpool than in Central London.

"This doesn't work for all names, however. The geography of many popular family names (like Smith or Brown) is much more evenly spread, although even popular names like Jones, Williams or Davies still have strong regional connotations.

"Different patterns hold for names imported from abroad over the last 60 years or so. Many of these names remain concentrated in major cities and towns, although the overall pattern of such names is becoming more dispersed as migrants assimilate into UK society.

"With all the current focus on population migration, it is remarkable to see that most individuals and families stay put throughout the generations. As a consequence it is interesting to reflect that names are still often strong indicators of kinship and regional identity."

Users of the website are invited to feedback to the researchers whether they really are able to predict the locations at which romance blossomed.

"The maps on our website make predictions based upon geographic patterning, and we are really interested to learn whether we get things right." – Data scientist Oliver O'Brien, who is part of the project team

The Institute of Science and Technology one day Technical Conference 2016

15th September 2016

Date: 15th September 2016
Venue: Manchester Conference Centre, Sackville Street, Manchester, M1 3BB

This exciting one-day conference and its talks/ workshops offer you an opportunity to update technical knowledge, skills, and further your career development. It will also provide valuable networking opportunities to engage and learn from other technical staff and technical supervisors/managers.

Target participants

The conference will be of specific interest to a wide group of specialist, technical, and managerial colleagues who work in a broad range of environments such as science, engineering, arts, industry, local authorities, schools, FE, HE, research/analytical/ health facilities, and government departments.

The conference also provides opportunities for you to actively participate through poster presentations, and visits to supplier/manufacturer stands.

For professionally registered delegates (RSciTech, RSci, CSci, and also those delegates considering applying for professional registration) the conference and its talks/ workshops will contribute significantly to your professional and personal development (PPD).

A few comments from last year's conference

"I enjoyed meeting like-minded people from other institutions and exchanging ideas and current thinking"

"The talks were very good, suitable length and the presenters clearly had in depth knowledge of their subjects. Held the interest very well"

"It enabled me to gain better understanding of the diversity of our roles"

Conference Programme

Keynote speakers
Travels with a Space Technician
Helen Sharman OBE FRSC, IST President

Technicians for the 21st Century
Professor Malcolm Press, Vice Chancellor
Manchester Metropolitan University

Plus 12 talks/workshops, organised in 3 sessions throughout the day, where you can choose from 4 exciting topics in each session. A few example topics are:

- Working safely with chemicals in a non-science environment
- Proactively manage your personal development – for career benefit
- Safe Beaches' legislation – and an insight into what goes into checking them
- A strategic approach to technical support – redefining career structures and roles
- Laboratory awareness – Thermo Scientific
- Yes, technicians can have a career in academia...!
- How flavours and seasonings are created for electronic cigarettes
- TechNet Technicians Network – by technicians, for technicians
- Think outside the box – VWR International

Plus presentation of IST Awards

Including the prize for the best IST Conference Poster Award.
You have the opportunity to contribute to this conference through our Poster Competition. It's your chance to share your work experiences with others in an informal way, to tell a story in pictures and/or words. Contact the IST Office.

Award for Best Conference Poster

The IST Award for 'Best Poster Presentation' will recognise the most outstanding poster presented during the IST Conference 2016.

This Award category is open to individuals operating within a technical and/or professional community within the last 12 months and who will be in attendance at the Conference.

Joint posters may be presented but a single individual should be nominated as the poster presenter for the purposes of the subsequent Award.

The Awards Panel will be convened by the IST and the decision of the Panel is final.

Eligibility

- There is no requirement that the individual be a current member of the IST
- The individual must have been employed within the technical community or operating within a professional organisation within the last 12 months

Posters

- Posters must be original work, and content should be associated with work or activities within the technical and/or professional community
- Poster titles should be submitted to office@istonline.org.uk before 17:00 Friday 19th August
- Posters will be displayed during the IST Conference
- 2016, with the Award being presented at the Conference, so presenters need to be available to attend the event

Judging Criteria

- Clarity of submitted material
- Novelty
- Visual impact

You have the opportunity to contribute to this conference through our Poster Competition. It's your chance to share your work experiences with others in an informal way, to tell a story in pictures and/or words.

The best poster presenter, as selected by the IST's Awards panel, will receive:1 year's IST membership, iPad mini and Certificate of Achievement

Award for Outstanding Trainee/Apprentice

The IST award for 'Outstanding trainee or apprentice' acknowledges the exceptional contribution that newly-trained technicians are bringing to the technical workforce, and recognises the effort and dedication required to successfully qualify.

This award category is open to people who are currently in a technical apprenticeship or trainee role, or have recently (in the last 12 months) participated in such a scheme.

The Awards Panel will be convened by the IST and the decision of the Panel is final.

Eligibility

- There is no requirement that the nominee be a current member of the IST
- The nominee must be a trainee or apprentice, or have qualified from these positions within the last 12 months

Nomination

- Nomination should be made by the nominee's line manager, training director or senior colleague, and no self nominations will be accepted
- Tell us how the nominee has built up knowledge and skills and used these to progress, and how s/he has shone in the workplace. This could include how s/ he worked as part of a team and as an individual, or how s/ he has pushed her/himself to gain the qualifications needed to be ready for work
- The nomination case should not exceed 500 words and should be sent to office@istonline.org.uk before 17:00 Friday 19th August
- The Award will be presented at the IST 2016 Conference in Manchester (15th September) and the Award winner will need be available to attend the event

Judging Criteria

- Commitment and dedication
- Performance and achievement
- Added value to the employer and/or colleagues

You have the opportunity to nominate one of your trainees or apprentices. It's your chance to gain recognition for their outstanding performance and/or contribution, so don't delay- get nominating!

The best nominee, as selected by the IST's Awards panel, will receive:1 year's IST membership, iPad mini and Certificate of Achievement

Prize for # IST Conference Challenge

The prize for the #ISTConference Challenge acknowledges the value of networking and sharing of skills across disciplines and will recognise the most outstanding individuals commitment to social networking up to, during and following the IST Conference 2016.

The prize is open to individuals operating within a technical and/or professional community within the last 6 months and who will be in attendance at the Conference.

The prize will be judged 7 days after the event by a Panel convened by the IST and the decision of the Panel is final. The winner will be notified immediately following the Panel's decision.

Eligibility

- The participant does not need to be a current IST member, but she/he will need to attend the Conference
- Participants must be following @istonline on Twitter
- Participants must have been employed within the technical community or operating within a professional organisation within the last 6 months

Challenge Activity

- On Twitter, your post must START with @istonline and END with #ISTConference2016
- Tweet – who you are, where you work and what you do, plus Conference views before, during/after the event
- Posts should include a photo or a video of you in your workplace** and photos from the event
- Get as many people to re-tweet and like your post as possible

*** If other people appear in work pictures/videos YOU must make sure you have their permission. The IST accepts no liability for use of such images.*

Judging Criteria

- The level of consistent social activity, tweeting, re- tweeting and liking posts about work/the conference/@istonline/#challenge
- Promotion of the IST amongst colleagues, success in increasing social media reach/ engagement (colleagues tweets should include #ISTConference2016 and your TwitterID)

You have the opportunity to contribute to the IST Conference through social media. It's your chance to share your work and Conference experiences with others in an informal way.

The best social media activist, as selected by the IST's prize Panel, will receive: £150 Amazon Gift Card and Certificate of Achievement

The full programme and booking form is available on our web site: istonline .org.uk

IST The Institute of Science & Technology

To book your place please contact Wendy:
E: **wendymason@istonline.org.uk**
Tel: **0114 276 3197**

Wendy Mason, Administrator
Institute of Science and Technology
90 Rockingham Street
Sheffield

IST Organisation

IST Executive Board Members

President: Helen Sharman OBE, FRSC, FIScT

Helen is the Operations Manager for the Chemistry Department at Imperial College. She started her career with a degree in chemistry from the University of Sheffield before working in industry for GEC and then Mars Confectionery, where she was part of the team that created the Mars Ice Cream. After applying for a job that was advertised as, "Astronaut wanted," Helen trained at the Yuri Gagarin Cosmonaut Training Centre in Star City near Moscow, becoming the first British astronaut when she launched into space on board a Soyuz spacecraft on 18 May 1991. Helen became a science communicator after her space flight. More recently, she has started a new career in management, working at the National Physical Laboratory and at Kingston University London, before moving to Imperial College in the summer of 2015.

Chairman: Terry Croft MBE, FIScT

Terry is the Chairman of the IST and has a passion and commitment to the Technical Community. His work involves promoting the Professional Technician as a career choice. He brings a wealth of experience to the board through his involvement with the wider sector and as Director of the Catalyst Project, titled "Development of Career Pathways for Technicians across the Higher Education Sector."

E: t.croft@istonline.org.uk

Honorary Secretary: Vacant post

Treasurer: Joan Ward FIScT

As Treasurer, Joan's primarily role is to control expenditure on behalf of the Executive and be responsible for ensuring that satisfactory accounts of all monies received and expended are maintained. Further to this, Joan provides advice as to how annual financial performance might be improved, within the context of the IST being a not-for-profit organisation. She carries out any tasks agreed by the Executive to maximise overall financial wellbeing.

E: joanward@istonline.org.uk

Education Officer: Philippa Nobbs BA (hons), MCGI, MIOSH, FIScT

As Education Officer, Philippa maintains knowledge of vocational training and qualifications for technical practitioners and participates in regional and national development programmes. She has a long history of involvement in the development and delivery of technician training and led the introduction of the IST's service to employers to validate their in-house training schemes.

E: education@istonline.org.uk

Marketing Officer: Ian Moulson FIScT

As Marketing Officer, Ian looks at new and existing ways in which the IST markets itself to its members, prospective members, and the science and technology community. Ian is also the Editor of the IST's biannual publication *The IST Journal* and is chair of its editorial panel, which oversees the quality of its articles and other content.

E: i.moulson@istonline.org.uk

Membership Development Officer: Kevin Oxley FIScT, CSci

As Membership Development Officer, Kevin develops strategies for membership engagement with the IST. His role further includes developing, managing and implementing a communication strategy for members. A key element of this is to identify opportunities to recruit new members and upgrade existing ones. Working alongside the Marketing Officer and PR Advisor, Kevin develops the implementation of recruitment and retention campaigns and promotes the benefits of membership to higher education institutions and industry.

E: k.m.oxley@istonline.org.uk

Registrar: Michelle Jackson BSc, PhD, FIScT, CSci

As Registrar, Michelle oversees the registration schemes run through the IST and contributes to the development of associated strategic and operational procedures.

E: michellejackson@istonline.org.uk

Fellowship & Overseas Secretary: Derek Sayers FIScT

As Fellowship & Overseas Secretary Derek coordinates the review of Fellowship applications, setting in place panels of other Fellows for peer review, and advises the Executive on the outcome of the reviews. He also maintains the documentation of those applications. Derek is point of contact for overseas inquiries for organisations wishing to work with the IST; he liaises with such organisations and reports back to the Executive.

E: dereksayers@istonline.org.uk

PR Advisor/Senior Assessor: Natalie Kennerley FIScT, CSci

As Public Relations Advisor, Natalie's role is to represent the IST at events, conferences, exhibitions, and open days. Planning PR campaigns, strategies, and writing and editing marketing material are all key aspects of this role. Natalie is a member of the IST Marketing Board. In her role as Senior Assessor, Natalie assesses applications for Registered Science Technician, Registered Scientist, and Chartered Scientist.

E: n.j.kennerley@istonline.org.uk

China Advisor/Representative: Geoffrey Howell MIScT, RSci

Geoffrey is a member of the IST Education Board and is one of the assessors for Professional Registration. His background is in technical training management, and he is now leading the first International HE technical training programme in China as part of an ongoing IST Project.

E: g.howell@istonline.org.uk

Co-ordinator for HE Regional Champions: John Dwyer FIScT

As Champions Co-ordinator for professional registration (PR), John's aim is to develop a network of Champions around the UK HE Sector and the Environment Agency. A Champions network offers guidance and help with PR and promotes it within their institutions. John is a Fellow of the IST and until recently was a member of the IST Strategy Board as coordinator for Partnerships. One such partner is HEaTED through which he has been actively promoting (PR) of technical staff throughout the UK.

E: j.dwyer@lancaster.ac.uk

Social Media/Engagement Advisor: John-Paul Ashton MIScT, RSci

As the IST Social media/Engagement Advisor John-Paul assists the IST through its Executive in developing its profile/presence on Twitter, Facebook, and LinkedIn etc.He's an IST member and a Registered Scientist (RSci) and works closely with the Technicians Network at TUoS

E: j.p.ashton@sheffield.ac.uk

IST administrator: Wendy Mason
Wendy supports our memberships, registrations, committees and meetings, and manages the IST's office. She deals with all our general enquiries and helps to organise our events, visits, and conference. Wendy manages all our event bookings and is also the Leading Your Technical Team programme's administrator, and coordinates the Institute's annual Higher Diploma Examinations.
E: office@istonline.org.uk

IST The Institute of Science & Technology

Professional Status For Technicians

There are three schemes technicians and scientists can join, awarded by the Institute of Science & Technology, under licence from the Science Council:

- **Chartered Scientist CSci** For staff in senior scientific and leadership roles
- **Registered Scientist RSci** For staff in scientific and senior technical roles
- **Registered Science Technician RSciTech**

The IST believe technicians deserve formal recognition for the work that they do, the experience they've gained and the expertise they have to share. We know that our members are skilled professionals, and now we can give them official accreditation as a Chartered Scientist (CSci), Registered Scientist (RSci) or Registered Science Technician (RSciTech).

By registering, technicians are helping to promote the professional standing of themselves and their colleagues. They are showing that they are making a vital contribution in their fields and achieving a status that makes them a key asset for the long-term.

The University Of Sheffield.

Science Council

GATSBY

The Institute of Science & Technology

Leading Your Technical Team

Leading Your Technical Team Programme set

'Delivering the fundamental and key elements for leading and managing people'

LYTT – Leading Your Technical Team
BYLS – Building on Your Leadership Skills

The **Leading Your Technical Team** programme set of Leading Your Technical Team and **Building on Your Leadership Skills** is geared toward delivering the fundamental and key skill elements for leading and managing people, particularly in a technical team.

The nature of technical support in many universities and higher education colleges is changing. Technicians have become both increasingly specialised and also high impact in terms of directly supporting teaching, research or infrastructure. Recent surveys have shown that high quality technical support is now seen as essential in delivering a high value student experience and quality research.

For many universities one of the key challenges is how to effectively channel, develop and manage their highly valuable technical resource. Increasingly, what has been highlighted when realigning and grouping together technical support is the need to prepare and train technicians to manage, and above all, lead technical teams. We have designed the Leading Your Technical Team programme set to meet this need.

Both LYTT and BYLS are delivered in the context of a higher education technical environment, but they are not aimed at any specific job role or discipline. Our participants come from a very broad range of higher education institutions, and from a very diverse range of academic disciplines and departments or service sections. For example our recent courses have included people from institutions such as Robert Gordon University, University of Manchester, University of Oxford, University of Birmingham, University of Bristol, University College Cork, and the Open University to name but a few. Similarly our participants also have a wide variety of job roles. These ranging for example from Technician, Senior Technician, Laboratory Manager, IT Network Team Leader, Workshop Manager, Geological Facilities Manager, Textile Workshop Manager and Bio-repository Manager.

Leading Your Technical Team has a long and well respected history. It has been running for 30 years with more than 1,200 technicians having been through the programme over this time. The programme content has continued to adapt and develop in line with changes in HE and it continues to be held in very high regard by HE senior managers and staff developers. Its high reputation is maintained through delivering a very high standard of technical management training via experienced HE managers, in a practical context with the reality of managing in a university technical environment.

How the programme works

Both programme follow a similar format, in that the learning is enhanced through informal and highly participative sessions that include active discussion, exchange of ideas and delegate group work. There is no role playing.

There are a strictly limited number of places and applicants are advised to apply early in order to secure a place.

Leading Your Technical Team

Specific programme goals

The programme introduces the fundamental building blocks of management and leadership specifically in the context of technical support in universities and higher education colleges. It provides an opportunity to look at the practical challenges of managing and supervising technical staff from both academic and service areas, as well as examining a range of essential management and leadership skills and techniques. The programme links practical leadership theories to dynamic team leading in context with the reality of managing in a technical university environment.

By the end of the programme participants will have:

- Identified the main management/leadership/ supervisory skills required of them within their own working environment.
- Gained information on key issues, changes in higher education and current initiatives and developments which affect technical staff.
- Reflected upon the practices and processes affecting management and leadership in technical units, sections and departments.
- Practised a number of leadership and management skills and identified ways to develop these skills further.
- Had an opportunity to share with presenters and fellow participants from a wide number of universities and higher education colleges, their views, experiences, expertise etc.

Content

The programme will cover topics including:

- Key issues – roles and responsibilities.
- Management v leadership.
- Motivation and delegation – individuals and team.
- Communication skills & team briefing.
- Influencing skills and analysing your network.
- Managing and leading your team through change.
- People management issues & case studies.
- Positive team leadership

Who should attend

This programme is intended for chief/ principal/senior technicians, laboratory/ workshop/unit managers, recently appointed departmental superintendents or senior colleagues from UK universities and colleges, who might now or in the future, have managerial or supervisory responsibilities and are interested in developing their fundamental management/leadership skills. The programme content will be delivered within the context of working in an university environment and will be applicable to support staff from academic and service areas. It is most important that participants are, wherever possible, residential and therefore available to attend the programme throughout.

Building on Your Leadership Skills

Specific programme goals

The programme builds on the fundamentals learned in Leading Your Technical Team and provides a further opportunity to look at the practical challenges of managing or supervising technical staff from both academic and service areas, as well as examining a range of essential management and leadership skills and techniques. The programme again links practical leadership theories to dynamic team leading in context with the reality of managing in a technical university environment. The programme content incorporates a range of topics that were suggested by attendees on Leading Your Technical Team as areas that they would most like to explore further, e.g. Managing Staff Performance, Dealing with Difficult People and Influencing Skills. Toward the end of the programme we begin to explore the topic of Leadership Intelligences, which introduces you to themes covered in greater depth in more advanced leadership programmes.

By the end of the programme participants will know how to:

- Lead and motivate by identifying the key skills and characteristics of successful leaders and to develop the key people management skills you need to ensure success.
- Improve performance through developing personal strategies for enhancing the effectiveness of your team by using flexibility across the leadership styles.
- Manage performance through developing your team's strengths by setting and reaching both personal and team objectives using delegation and leadership skills.
- Lead a team made up of different personalities and encourage mutual respect and cooperation from all team members and understand how to overcome barriers to communication.
- Work with difficult people through resolving conflict and dealing with difficult people and situations confidently and positively.
- Understand yourself, your influencing environment and your impact and to develop multidirectional influencing skills and an influencing strategy

Content

The programme will cover topics including:

- Leadership & motivation – The differences of motivation, influence and manipulation.
- Managing performance – Where and when to improve team and/or individuals performance.
- Working with difficult people – How to take control & case studies.
- Influencing – Influencing teams & influencing individuals.
- Leadership intelligences – Personality based leadership, leadership and team performance.

Who should attend

This programme is particularly suited to people who have completed Leading Your Technical Team or those who have previously attended similar programmes and have a few years' experience in a technical managerial or supervisory role and want to further develop their management/leadership skills. The programme content will be delivered within the context of working in a university environment and will be applicable to support staff from academic and service areas.
It is most important that participants are, wherever possible, residential and therefore available to attend the programme throughout.

Previous course feedback

Leading Your Technical Team

'I have learned more about the supervisory skills that I require in my job, how to develop these skills and especially in the way I communicate to other members of staff. I really enjoyed sharing views and experiences with fellow participants from other universities.'

'I was able to learn the skills to solve some of the problems which I am facing myself in my leadership role.'

'This course is well structured and presented. It taught me to look at my management technique and to focus my efforts on areas where I can succeed'

'Good course that hits a lot of the main areas and interesting areas regarding management and team leadership. It's motivational to the point that you return to work with more ideas and your own motivation to tackle day to day leadership.'

'For me the course was a positive experience and directly related to my day to day working life.'

'It was useful to find that many people are in the same position with the same worries and the programme provided useful information on dealing with many of our issues.

Building on Your Leadership Skills

'A Different way of looking at the way I respond to my team to improve all our performances. A way of understanding the individual members of my team. A chance to discuss with people from different institutions and areas of work how they deal with difficult members of their teams.'

'Felt I came away from the course feeling better about being a team leader and focusing on management issues.'

'A fun and informative way of helping me explore my leadership skills and how they affect my team.'

'The course was very informative and inspirational with lots of ideas and discussions throughout the sessions. A very useful programme delivered in a fun relaxed environment.'

'A very relaxed and informative course with like-minded delegates; the course was inclusive and challenged delegate with thought provoking ideas and concepts.'

'Interaction and problems experienced between people across the HE spectrum away from your place of work is of great value and should not be forgotten. In-house training is not necessarily the way forward.'

Pogramme Dates and Cost

Leading Your Technical Team
Date: 9th & 10th February 2017
Times: Start 09.30 close at 16.00 Day Two
Venue: Loughborough
wendymason@istonline.org.uk

Building on Your Leadership Skills
Date: 9th & 10th March 2017
Times: Start 09.30 close at 16.00 Day Two
Venue: Loughborough
wendymason@istonline.org.uk

Cost:

£500 IST Members – Residential fees are inclusive of all meals and one night's en suite accommodation

£570 (Non IST members) – Residential fees are inclusive of all meals and one night's en suite accommodation

Extra night accommodation £89

Additional dates, bespoke courses:

We would be happy to discuss running these courses at your host instituion or at a suitable venue, if a number of attendees from a single institution wish to undertake the courses. Please contact Wendy Mason.

Presenter profiles

Kevin Oxley

Kevin is the Programme Director for the LYTT & BYLS courses, which are now run through the Institute of Science & Technology (IST). He is the Resources & Operations manager of the Department of Infection, Immunity & Cardiovascular Disease within the Medical School at the University of Sheffield. He began his career at Sheffield as a trainee Medical Laboratory Scientific Officer over 35 years ago and has subsequently experienced a series of diverse technical roles within the School. Over the last 10 years he has undertaken a range of senior managerial positions, leading technical and support staff teams, under various administrations and has been involved with small and large project teams across the University. As well as helping to redesign and co-deliver the LYTT & BYLS programmes from 2010 Kevin is also actively involved in both promoting and delivering staff development and training at Sheffield.

Lisa Woods

Lisa has significant experience managing large teams in both private and public sector organisations. After graduating from Loughborough University she worked for airport operator BAAplc in a variety of operational, change management and training roles across all the London airports. Whilst with BAA she also gained her MBA from the University of Surrey. In 2000 Lisa moved with her family to the USA where she undertook volunteer work which included the American Red Cross and the Small Business Administration in Texas. Lisa joined the University of Sheffield in 2005 and currently manages a team of 400+ staff in her role as Head of Campus Services.

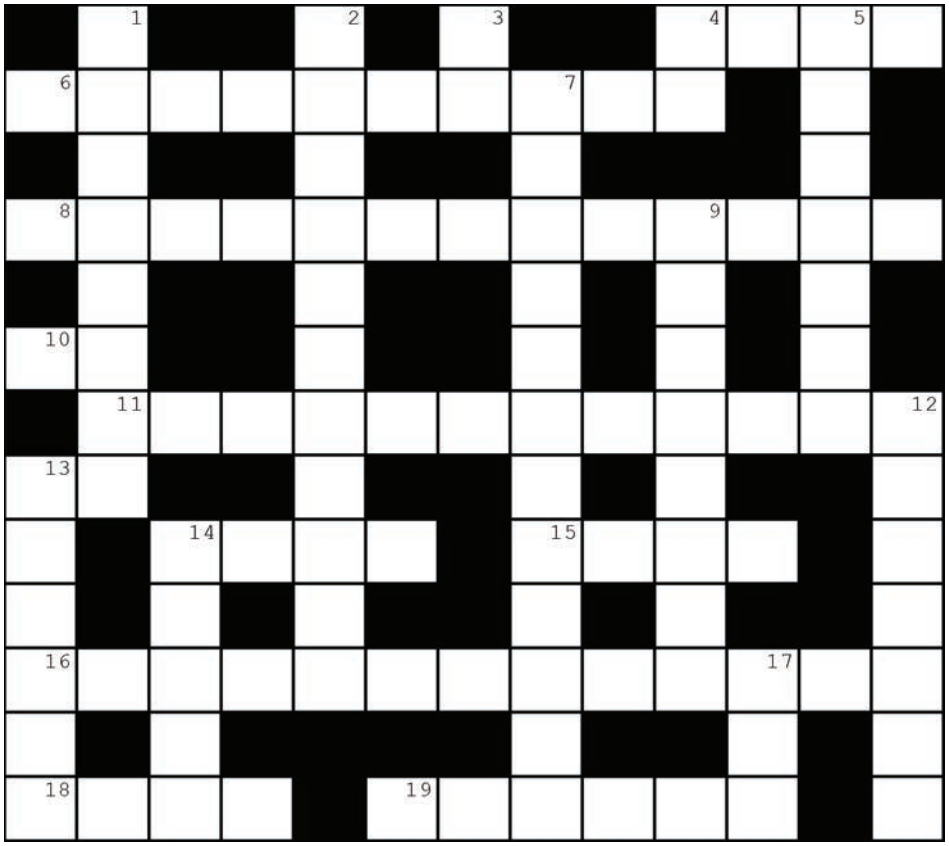
Ian Moulson

Before his retirement in December 2013 Ian was the departmental manager of the Department of Electronic and Electrical Engineering at the University of Sheffield. He was at Sheffield for 40 years, beginning his career there as an electronics technician following a number of years in the electronics industry and an electrical engineering apprenticeship in the steel industry. Throughout his career Ian built up a wealth of experience in managing a diverse range of support staff teams. He has managed technical teams ranging in size from 2 to 40 people as well as small to medium sized administrative and managerial teams. For many years Ian has been actively involved in both promoting and delivering technical training at Sheffield and also more widely since 2002 through the Leading Your Technical Team programmes.

To book a place on either of these programmes please contact:

Wendy Mason,
LYTT & BYLS Programme Administrator
T: 0114 276 3197 e: office@istonline.org.uk

The IST Journal's Quick Crossword



Across

4 A single undivided whole (4)
6 Status of IST's highest membership (10)
8 Biological molecules consisting of carbon, hydrogen, and oxygen atoms (13)
10 Approximately 3.14159 (2)
11 Approximately $3.00X10^{8}$m/s (5,2,5)
13 Morning (2)
14 A core of bone encased in keratinized skin (4)
15 $CO(NH_2)_2$ organic compound (4)
16 A practical explanation of how something works (13)
18 Froth made from soap and water (4)
19 A shaft through which air leaves a mine (6)

Down

1 Development of the dark-coloured pigment in the skin (8)
2 Nerve cell located in the spinal cord, whose fibre projects out to control effector organs (11)
3 North America [abbreviated] (2)
4 Not down (2)
5 Speak or write about with great hostility (7)
7 Acid highly reactive towards glass (12)
9 It happens suddenly or by chance without an apparent cause (8)
12 269 metres long and sunk (7)
13 Positive ends of a group of diodes (6)
14 Condition characterised by a great deal of water vapour (4)
17 This professional organisation (3)

Answers are on our website; **www.istonline.org.uk**

The Institute of Science and Technology one day Technical Conference 2016

Sponsorship Opportunities

Date:
15th September 2016

Manchester Conference Centre

Time:
Start 09.30 and close at 16.30

The IST provides focused, professional support to a wide group of specialist, technical, and managerial colleagues in a broad range of environments such as science, engineering, arts, industry, local authorities, schools, FE, HE, research/ analytical/health facilities, government departments and many more in the UK and overseas.

The 2016 one-day conference and its workshops will focus on updating technical knowledge, skills, career development, and will provide valuable networking opportunities to support technicians and technical supervisors/managers, the majority of whom who either use or purchase your company's product/ services.

This conference will be significantly larger than previous individual events with the scientific supplier exhibition being an integral part of it, and will be located in the Manchester Conference Centre.

We really hope that you will be able to support this initiative; we already have quite a number of suppliers wishing to take part.

The Institute of Science & Technology will formally acknowledge each sponsor's support through its publications, web site, and its bi-annual Journal. The conference papers will also include company logos.

The Conference offers an ideal opportunity for **suppliers of services** to develop new influential contacts, promote their products through sponsorship, and to also reinforce existing relationships. Conference suppliers will be engaging with technical staff who are directly using their types of services and products, and staff who are likely to be recommending or receiving feedback from their own clients.

We expect over 170 delegates from across the UK.

Sponsorship Opportunities 2016

£300
Inclusion of promotional material (up to A4) in delegate packs

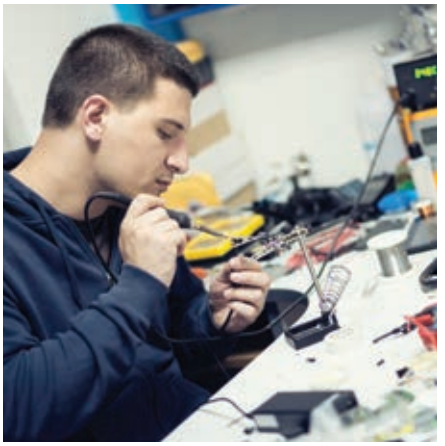
£750
Display/promotional stand in circulation area for duration of the Conference

£1,000
Key Sponsor – Key location of display/promotional stand in circulation area for duration of the Conference plus a 45 minute Workshop plus Company's logos in IST's Journal publication

The sponsorship form is available on our web site: istonline.org.uk

The Institute of Science & Technology

If you are interested in any of the sponsorship opportunities, or want to discuss any of the above opportunities contact Wendy:
Email: **wendymason@istonline.org.uk**
Tel: **0114 276 3197**



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