The Institute of Science & Technology

The Journal

Spring 2015

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The Journal

The Official Journal of The Institute of Science & Technology

Spring 2015

The Professional Body for Specialist, Technical and Managerial Staff

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Editor's welcome

Welcome to the spring 2015 edition of the IST's Journal.

I hope that you enjoy this edition equally as much as you tell us, in our recent survey, that you enjoyed our previous ones. Your views and the suggestions that you fed back to us from that member's questionnaire came across as emphatically positive. There was an excellent response rate, and with it, some great feedback. It was really good to read so many constructive comments and ideas. They have been really very useful to me and to the IST Executive.

We asked you what you thought about the Journal and how useful you found it. The overwhelming answer that came back to us was that you enjoyed its format, its varied content, and that you looked forward to receiving it twice a year. Many of you were very positive about how useful you found it.

"I always enjoy receiving the journal. It keeps me up to date with current news and developments in the sector."

"The articles in the journal are rich and educative I hope you will continue with this tempo."

"I like the journal there is always something interesting to read."

"I find the journal top quality in terms of topics and papers presented and a nice quality journal to read."

"The Journal can be 'dipped into' for a quick read or a more detailed review because of its current format."

These are just a few of the many positive comments that we received.

The strength of that feedback has given us the confidence to continue with the present format and to maintain a wide and varied content. We will continue with two printed editions per year for the immediate future, but if costs become too prohibitive, we may have to look at the option of one full printed edition and one web based edition per year, as many of you have suggested.

From this year, when the Journal goes to print, we will also be publishing it straight away on our members section of our web site. So make sure that the IST Office has your current email address.

Our postage costs have escalated, especially overseas postage costs. In particular sending out the Journal is very expensive, so to keep membership costs down we may have to look at how we might reduce this. However, we will keep everyone informed and let you know well in advance if we plan to change anything.

We know, because many of you keep telling us, that the IST offers not only a unique support platform for technicians, but also gives exceptional value for money compared to the fees of many other professional institutes.

The IST's executive and Officers are all unpaid honorary positions. So it's really rewarding for us to see that membership is continuing to grow strongly, and that despite costs in the UK continuing to rise, our hard work to keep our membership fees affordable, whilst also growing our member services portfolio, is paying off.

In 2015 we will be running a one day IST conference (with workshops) for our members, and we plan to run this each year going forward. So keep an eye on your emails and our web pages for further details.

This will be in addition to our continued proactive support for technician professional registration in 2015. This year we will be upping our involvement in offering practical individual and group support to technicians through workshops, presentations, training days, advice, guidance, and assessment for RSciTech, RSci, and CSci.

Lastly, I'm pleased to report that the Leading Your Technical Team (LYTT) and Building on Your Leadership Skills (BYLS) series of training courses is now underway. In January the LYTT course ran in Nottingham, specifically for a large group of technician delegates from the Engineering Faculty of Nottingham University. LYTT will be running again in York on February 12-13th and is fully booked. BYLS is the follow up to LYTT and is running in March (when I checked at the time of writing this in January there were still a few places available).

Here's looking forward to another successful year for you and your IST.

Ian Moulson
Editor

By the way, I was introduced to a rather interesting word the other day that I hadn't come across before. Technicism – it's evidently a descriptive term used in philosophy to describe a reliance or confidence in technology as a benefactor of society. Taken to extreme, technicism is the belief that humanity will ultimately be able to control the entirety of existence using technology. In other words, human beings will someday be able to master all problems and possibly even control the future using technology. Some, such as Stephen V. Monsma[1] connect these ideas to the abdication of religion as a higher moral authority.

Mmmm!

[1]Monsma, Stephen V. (1986). Responsible Technology. Grand Rapids: W.B. Eerdmans Pub. Co. ISBN 0-8028-0175-7.

Chairman's view

First of all a big thank you to our teams who have been up and down the country promoting the importance of engaging with the National Professional Technical Registration Scheme and the need for members to celebrate their professional contribution to the sector in which they work and to UK PLC. Also to our volunteers who have been providing hands on workshops to help registrants through the process; a vital part of the support provided by the IST to the technical community. Also to those experienced volunteers who have been providing support and mentoring to members on issues from career development to networking with colleagues in similar work environments. This support is just one example of member benefits.

However, we still need more champions to represent the IST up and down the UK from the Industrial Sectors to Government Agencies to the Education Sector. Now is the time to push forward as more professional technicians, specialists, analysts and managers are getting on board with the Professional Registration Agenda. Full training and support will be provided. The IST and the technical community need **YOUR** help. Please contact the office at **office@istonline.org.uk**

On behalf of the IST and our members I would like to warmly welcome on board colleagues from the Environment Agency's National Laboratory Service where we have formed a partnership to promote the National Professional Technical Registration Scheme for their laboratory staff in Exeter, Leeds and Nottingham.

We will also bring our expertise in developing career pathways, training and development, CPD, and support in related areas of professionalisation. The partnership was launched at an event at their Starcross Laboratories in Exeter on 27th January 2015. The event concluded by celebrating the award of RSci to Jackie Tucker who is their Microbiology Team Leader and is the first member of this group to be registered by the IST.

With more and more companies, agencies and institutions engaging with Professional Registration the IST has created these "specifically tailored" working partnerships to these groups to provide them with this professional support they need to achieve their specific goals for their support staff.

If your company, agency or institution wants help or support in professionalising their technical community and related staff in any way then please contact me directly at **t.croft@istonline.org.uk** today.

In 2015 the IST will be delivering many events from workshops and presentations to regional events. The teams will continue with their busy diary of events promoting the National Professional Technical Registration Scheme (my sincere thanks go to the Gatsby Charitable Foundation for their continued support for this IST initiative). So if you want the team to come and visit you in your workplace and tell you and your colleagues about this key national scheme and how it benefits your and their roles and careers then please contact the office at **office@istonline.org.uk**.

The IST is there to support you and the technical community. Further information is available on our website **www.istonline.org.uk**

The highlight of the 2015 calendar will be the IST Conference that will take place in Leeds on the 10th September (more details to follow). The conference will focus on technical skills, networking and knowledge transfer. So get the date in the diary.

Remember this is **YOUR** professional body run by technicians for technicians so get involved and make a difference.

With sincere thanks
Terry Croft
Chairman

IST members' news

We welcome Christoforos Pambou to the IST's Education Board

Chris Pambou MIScT RSci

Chris kindly tells us a little bit about his background

I began my career as a science laboratory technician in 1977 after leaving school with a number of 'O' levels at an Inner London School. Soon after I enrolled at the then Paddington College for the City & Guilds science laboratory technicians courses on day release.

Nine years later and after completing City and Guilds Science Laboratory technicians Part 1 & 2, BTEC HNC and a number of other qualifications and now a member of IST, I got my first post as a senior science technician at another London school.

Four years later I joined Hackney Community College as Chief Science Technician and in 2003 joined City and Islington College as the Chief Science Technician where I am until today. I run a team of five technicians in a suite of nine fantastic laboratories and preparation rooms where we cater for over 700 students studying AS and A level in physics, chemistry, biology and electronics, aiming to gain a place at university or employment opportunities.

City and Islington College is a fantastic institution that encourages staff development and offers opportunity for success. While at the college I worked with the University of York on the Salters Horner's A level physics course, initially on the development and then contributing materials for both AS & A2 books.

City and Islington College also allowed me the time to work on projects in training science laboratory technicians and teachers in Ghana. This has been a fantastic experience that not only benefits those that I have trained in Ghana but made me a better technician, a better trainer and gave me the opportunity to continue the training of technicians here in the UK through the science learning centre consortia.

City and Islington College is also one of the few members of HEaTED and together with David Swinscow we have delivered our first course on basic electronics with more to follow.

I developed the Labexpert UK **(www.labexpert.co.uk)** Chemical & Equipment Stock Control Software specifically for science technicians and am proud that it is now widely used in schools, college and universities not only in the UK but worldwide.

Last year I applied through the IST for professional registration and was proud to be awarded an RSci.

Chris in Ghana

Building relationships with Tongji University

Geoff Howell MIScT

Tongji University (based in Shanghai) and The Faculty of Engineering at The University of Sheffield have a lot of areas of common interests; including areas of research collaboration and a desire to train and develop technical staff, so on the 13th October 2014 Dr Malcolm Butler, Faculty Director of Operations, and Geoffrey Howell MIScT, RSci, Technician Training Programme Manager, were invited to visit Tongji University for four days to explore ways that both institutions could work together.

While they were there, their aims were to see the facilities, to build relationships with the key staff and to start working up proposals for collaborations.

They visited Tongji's extensive facilities including,

- The Engineering Practice Centre where students are trained in practical engineering skills, including 3D printing and control systems
- Multifunctional Shaking Table Array, the largest research array for earthquake research on buildings and bridges
- Shanghai Automotive Wind Tunnel Centre, an environmentally controlled wind tunnel capable of holding full scale vehicles
- Architecture and Urban Planning School
- Key Laboratory of Road and Traffic Engineering of the Ministry of Education.

Tongji University is very enthusiastic about building a successful relationship with The University of Sheffield and the IST. There are clear opportunities for research collaboration and to help train their technical staff, and for the IST to support technical registration. UoS and IST are looking forward to developing these links over the coming months and to welcoming some of the members of staff from Tongji University when they come to visit the Faculty in 2015.

IST The Institute of Science & Technology

IST's Special Interest Groups

Conference News

Newcastle University is delighted to be hosting the Technical Managers in University (TMU) and Chemistry Higher Education Mangers (CHEM) Joint Conference from Wednesday 25- Friday 27 March 2015.

Theme: The Sustainability Challenges facing Universities Today

Event Information

http://webstore.ncl.ac.uk under Conferences & Events - Faculty of Science, Agriculture & Engineering – SAGE Faculty Office.
For enquiries please contact:
Ashleigh Gibson, Conference Event Co-ordinator:
ashleigh.gibson@ncl.ac.uk

Description This is an annual conference, which is organised by a different host university each year, with the aim to build networks, establish relationships, and enhance the calibre of technical managers working in universities across the UK.

Conference Audience:

For example below are just some of the areas where current members work: Aerospace; Automotive technology; Manufacturing; Bio technology; Biomechanics; Chemistry; Chemical Engineering; Computer Science; Civil & Structural Engineering & Technology; Electronics; Electrical engineering; Fuel Technology; Geotechnical Engineering; Materials Technology & Engineering; Manufacturing & Design; Mechanical Engineering & Technology; Nanotechnology.

A little more information about these IST Special Interest Groups:

TMU, Technical Managers Universities (previously known as EMU), and CHEM (previously known as UCLAS) are two voluntary associations of Managers and Supervisors working with Chemistry, Technology & Engineering to support a wide range of disciplines in universities throughout the United Kingdom. The broad term 'Technical Manager' encompasses a wide range of activities, employment categories and job titles in HEIs. But such a person will normally have some responsibility for managing resources such as a technical service, a facility, or laboratory where they provide technology or engineering support to academic teaching and/or research. This area of technical support can be found in and across an enormously diverse range of disciplines.

Aims of the TMU & CHEM Associations are to:

- Foster a corporate and collegiate spirit across its membership
- Enable sharing of best practice
- Add to individual and corporate knowledge
- Broaden understanding of the profession
- Act as a focus for feeding legitimate and common concerns with respect to their support for teaching and research in Higher Education Institutions (HEIs) to the Institute of Science and Technology, of which TMU and CHEM are registered Special Interest Groups

In celebration of our long-standing members

Terry Croft

The IST Executive and I want to extend our heartfelt thanks to our long-standing members who have supported the IST as a member for over 50 years. We really do appreciate your long-standing commitment.

When the Executive and I set about reviewing our membership profile in 2014 the results threw up some very interesting and slightly surprising data. It showed us that we are continuing to grow our membership at an increasing rate, and that a high percentage of those new members are young people at the beginning of their career. This in turn has obviously begun to reduce our average age profile. But what we could also clearly see is that we still have a wonderful section of long-standing members, many with continuous membership for 50 and more years.

We are pleased that many of you agreed for us to include your photograph in celebrate of your long-standing membership and recognition of your support.

In 1951 George Otto Gey propagated the first cancer cell line, HeLa. And in that same year the IST welcomed:

Sheila Spence MIScT
joined 28-Jun-51

James Cheyne MIScT
joined 05-Oct-51

In1953 Crick and Watson discovered the helical structure of DNA, the basis for molecular biology. And the IST welcomed:

David Doig MIScT
joined 24-Jul-53

Ronald Miller MIScT
joined 24-Sep-53

1954 saw the invention of the Solar Battery by Bell Telephone scientists, Calvin Souther Fuller, Daryl Chapin and Gerald Pearson capturing the sun's power. The first practical means of collecting energy from the sun and turning it into a current of electricity. And we welcomed:

Margaret Goodman MIScT
joined 22-Oct-54

In 1955 the intermodal container (freight container) was developed by Malcom McLean. And in that same year the IST welcomed:

Maurice Gross MIScT
joined 27-Mar-55

Derek Sayers FIScT
joined 23-Jul-55

Geoffrey Swayne MIScT
joined 29-Oct-55

1957 saw the first PC used by one person and controlled by a keyboard, the IBM 610 was invented. And we welcomed:

Simon Fairnie FIScT
joined 26-Oct-57

Maida Davidson FIScT
joined 14-Dec-57

In 1961 we witnessed the first human in space and Valium was invented. The IST also welcomed:

John Burns FIScT
joined 29-Mar-58

Marie Hallsey-Lindars MIScT
joined 13-Oct-58

1958-59 saw the co-creation of the integrated circuit by Jack Kilby and Robert Noyce. 1958-60: The LASER. And the IST welcomed:

John Potts FIScT
joined 02-Dec-61

Richard Walker MIScT
joined 20-Oct-62

In 1963 Lawrence Morley, Fred Vine, and Drummond Matthews claimed paleomagnetic stripes in ocean crust as evidence of plate tectonics (Vine-Matthews-Morley hypothesis). While in the same year the IST welcomed:

Leslie Spencer MIScT
joined 24-Apr-63

Donald Ralph MIScT
joined 04-May-63

John Austin MIScT
joined 13-Nov-63

Janette Lober MIScT
joined13-Dec-63

In1964 the existence of the charm quark is speculated by James Bjorken and Sheldon Glashow. Also in1964 Arno Penzias and Robert Woodrow Wilson's detection of CMBR (cosmic microwave background radiation) provided experimental evidence for the Big Bang. The IST welcomed:

Paul Durkin FIScT
joined 14-Apr-64

Robert Hughes MIScT
joined 05-Dec-64

Stuart McEwen MIScT
joined 05-Dec-64

It is indeed heartening to see such a strong backbone of our membership, who have supported the institution over such a remarkable timescale, and continue to support us today. You have been with us as we went through what were sometimes quite difficult changes to restructure our institute for the 21st Century. We are now in a strong position and doing well. We know that we couldn't have got here without your unwavering support.

For that IST thanks you.

New members and registrations

New members February 2014 – July 2014

Mem No.	Name	Grade
T15256	Miss O O Akeredolu	AssocISCT
T15257	Mr D A Wengraf	MISCT
T15258	Miss Kolawole	AssocISCT
T15259	Mr M J Roe	MISCT
T15260	Miss K Okurowska	MISCT
T15261	Mr N Rustogi	MISCT
T15262	Mr R P Stockley	AssocISCT
T15263	Mrs V P Aderinokun	MISCT
T15264	Mr K S Dogo	AssocISCT
T15265	Mr M J Roe	MISCT
T15266	Miss H Gregson	MISCT
T15267	Mr S Atkin	MISCT
T15268	Mr R V Stacey	AssocISCT
T15269	Mr S J Broadhead	AssocISCT
T15270	Mr T Templeman	AssocISCT
T15271	Mrs O Ajiboye	MISCT
T15272	Mr O S Akinola	AssocISCT
T15273	Mr Bello	MISCT
T15274	Mrs J Bingham	MISCT
T15275	Mrs Nkom	MISCT
T15276	Ms R Bhardwaj	MISCT
T15277	Dr R H M Cornock	MISCT
T15278	Mr A U Onoja	MISCT
T15279	Mr T G Akanni	MISCT
T15280	Miss P Onyema	MISCT
T15281	Mrs O A Adelani	MISCT
T15282	Mr S T Ogunmoroti	MISCT
T15283	Mr A Chakravartty	MISCT
T15284	Mrs O T Eduzobe	MISCT
T15285	Miss E P Emiya	AssocISCT
T15286	Mr U E Ubi	AssocISCT
T15287	Ms J M Tucker	MISCT
T15288	Mr J Orchard	MISCT
T15289	Mrs R E Okao	AssocISCT
T15290	Mr A Sophocli	AssocISCT
T15291	Ms J R Barkans	MISCT
T15292	Mts T L Edmonds-Tibbett	MISCT
T15293	Mr S T Musa	AssocISCT
T15294	Mr G C Nwafor	MISCT
T15295	Mr M Doxey	MISCT
T15296	Dr Moorehead	MISCT
T15297	Mr T C Azeez	MISCT
T15298	Mrs O H Oifoghe	MISCT
T15299	Miss A Liabot	MISCT
T15300	Miss I Eregbowa	AssocISCT
T15301	Mrs C J Heldreich	MISCT
T15302	Mrs M K Uwabor	AssocISCT
T15303	Miss O R Akhabue	AssocISCT
T15304	Miss D V Lefley	MISCT
T15305	Miss I V Adun	AssocISCT
T15306	Mr S Musa	AssocISCT
T15307	Miss I Egbe	AssocISCT
T15308	Dr H Walker	MISCT
T15309	Dr K S Palmer	MISCT
T15310	Mr M N El-Guindy	MISCT
T15311	Mrs E C Nwogalaku	MISCT
T15312	Mr D P Smith	AssocISCT
T15313	Mr P J Gallimore	MISCT
T15314	Dr B Patel	MISCT
T15315	Mrs O A Olu-Lawanson	MISCT
T15316	Mr J A Trout	MISCT
T15317	Miss E Boswell	MISCT
T15318	Miss M A O'Brien	MISCT
T15319	Miss R L Howard	MISCT
T15320	Mr O D McIntosh	MISCT
T15321	Mr J-P Ashton	MISCT
T15322	Mr J F Odedina	MISCT
T15323	Mr A S Dawson	AssocISCT
T15324	Dr K Seunarine	MISCT
T15325	Mrs A Edokpolor	AssocISCT
T15326	Mr E K Omorogieva	AssocISCT
T15327	Dr K Kansara	MISCT
T15328	Mr M Rees	AssocISCT
T15329	Mrs A O Ikoko	MISCT
T15330	Mr M D Dunstan	AssocISCT
T15331	Mrs M L Villegas-Montes	MISCT
T15332	Dr P W Lemon	FISCT
T15333	Mr M B Jaji	MISCT
T15334	Ms L J Soraya	MISCT
T15335	Mr A K F Green	MISCT
T15336	Mr P Hodza	MISCT
T15337	Dr B T J Dyer	MISCT
T15338	Mr D R Gardner	MISCT
T15339	Mr P J Kimber	MISCT
T15340	Mrs E O Eromosele	MISCT
T15341	Mrs E O Joel	MISCT
T15342	Mr O M Awodu	MISCT
T15343	Mr M Wagner	MISCT
T15344	Miss C S Taylor	MISCT
T15345	Mr S O Fawole	AssocISCT
T15346	Mr E E E Francis	MISCT
T15347	Mrs D Klisch	MISCT
T15348	Mr E S Igbineweka	MISCT
T15349	Mr G I Egharevba	MISCT
T15350	Mr R A Wischhusen	AssocISCT
T15351	Mr P J Mills	MISCT

T15352	Dr A Vijay	MIScT
T15353	Mr E Wallis	MIScT
T15354	Mr M O Obasigie	MIScT
T15355	Mr E W Ojo	AssocIScT
T15356	Mr A F Walster	MIScT
T15357	Mr P Emanuel	MIScT
T15358	Mrs D Jones	MIScT
T15359	Ms V S Affleck	MIScT
T15360	Mr R Warhurst	MIScT
T15361	Mr G Mehton	MIScT
T15362	Mrs Babalola	AssocIScT
T15363	Miss J Malle	MIScT
T15364	Dr McDonald	MIScT
T15365	Mr M O Akioyamen	MIScT
T15367	Mr J J Giddings	MIScT
T15368	Mr M D Bell	AssocIScT
T15369	Mr M M Leitch	FIScT
T15370	Mr J O Osifo	MIScT
T15371	Mr L J Moore	MIScT
T15372	Mrs A Blake	MIScT
T15373	Miss S A Raines	MIScT
T15374	Mr P Crosby	MIScT
T15375	Miss K M Lis	MIScT
T15376	Mr A Townshend	MIScT
T15377	Mr T Dennett	MIScT
T15378	Mr U J Uwadia	MIScT
T15379	Mr P H Low	MIScT
T15380	Mr M B Gilpin	MIScT
T15381	Miss A Haase	MIScT
T15382	Miss R L Gaskell	MIScT
T15383	Mrs O L Aluede	MIScT
T15384	Mr J Van Rooyen	MIScT

Total: 128

Reinstated Members

Mem No.	Name	Grade
T14749	Dr G Abbas	FIScT
T14726	Miss A Yeo	MIScT

Total: 2

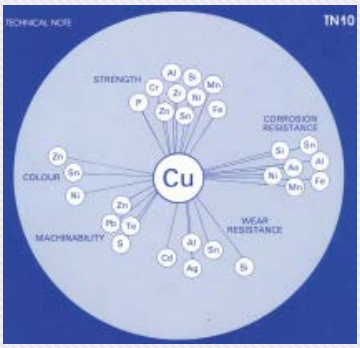
Science Council Registrations

Mem No.	Name	Grade
T15197	Mrs J F Moulton	RSci
T15175	Mr S Richards	RSci
T15184	Mr T Blake	RSci
T15108	Mr A P Krupa	RSci
T15166	Miss C Bradshaw	RSci
T15247	Mr J A Marston	RSci
T14897	Mrs D A Henderson-Holding	RSci
T15248	Dr K Whitley	RSci
T14823	Mr K Oxley	CSci
T15222	Mr P F Baker	RSciTech
T15225	Miss A D Gilday	RSciTech
T15234	Mrs P J Scholes	RSci
T15239	Miss C Brannigan	RSci
T15257	Mr D A Wengraf	RSci
T15219	Mr A Lee	RSci
T15202	Mr I Khan	RSci
T14955	Mrs Y Stephenson	RSci
T15215	Mrs I Campbell	RSciTech
T14877	Mr J Milner	RSciTech
T15118	Miss H Salih	RSci
T15287	Ms J M Tucker	RSci
T14879	Mr B Wadsworth	RSciTech
T15243	Miss A Storey	RSciTech
T15321	Mr J-P Ashton	RSci
T15335	Mr A K F Green	RSciTech
T15338	Mr D R Gardner	RSci
T15310	Mr M N El-Guindy	RSci
T15198	Dr S Myers	RSci
T15288	Mr J Orchard	RSci
T15359	Ms V S Affleck	RSci
T15358	Mrs D Jones	RSci
T15357	Mr P Emanuel	RSciTech
T15301	Mrs C J Heldreich	RSciTech
T15119	Miss K J Taylor	RSci
T15334	Ms L J Soraya	RSciTech
T15360	Mr R Warhurst	RSci
T14935	Mr A Grundy	RSciTech
T14851	Mr C Gouveia	CSci
T15332	Dr P Lemon	CSci

Total: 38

Whatever happened to Batterium alloy?

Alan Gall, IST Archivist



From the front cover of Copper & Copper Alloys, a 1986 publication by the Copper Development Association

The obvious purpose of making an alloy is to create a material with properties not found in the constituents on their own. Desirable features may be hardness, corrosion and wear resistance, malleability, lightness, strength, good electrical conductivity (even colour), or some combination of these at the expense of others. Ever since the discovery that bronze made a much better sword than copper on its own the search has been on for that magic mix with enhanced characteristics.

Around the start of the 1930s a number of publications began describing a new aluminium bronze "with remarkable properties" called Batterium. Corrosion tests were performed by the Royal Aircraft Factory, chemical resistance studied at the Royal Technical College in Salford, and an examination of physical properties made by the National Physical Laboratory.

The idea of the metal arose from the desirability of offering a commercial brand of lead-acid stor age batteries with terminals that would not sulphate. We do not know how much "brain storming" went on before the inventors came up with the name Batterium! There were obvious applications in other areas for an acid-resistant metal, notably in the construction of chemical plant.

Batterium was marketed by Batterium Metal and Vislok Ltd (an associated company of Tungstone, one of the largest British battery manufacturers in its heyday). At the helm of these firms stood Walter Haddon, a joint patentee of Batterium and a respected figure in the printing industry.

The name of Tungstone is still in use but Batterium seems to have quietly faded away shortly after its introduction.

Copper	89%
Aluminium	9%
Nickel and other metals	2%
Specific gravity	7.67
Melting point	1035°C
Tensile strength	35 - 45 tons in^{-2}
Thermal coefficient of expansion	0.0000162 per 1°C
Brinell hardness number	158 -168
Electrical resistivity	13.21 microhm cm
Relative electrical conductivity	15.21% of copper
Electrical temperature coefficient	0.08% per 1°C

Composition and properties of Batterium[1]

Walter Haddon

An obituary in *The Engineer*[2] and an autobiography as part of a Haddon genealogy[3] chart the life of Walter Haddon. He was born on 31 December 1864 at Clipstone, near Market Harborough. He obtained an apprenticeship in the printing trade at a firm in Great Grimsby and exercised his writing talents as a correspondent for various papers like the *Lincolnshire Chronicle* and the *Hull Times.*

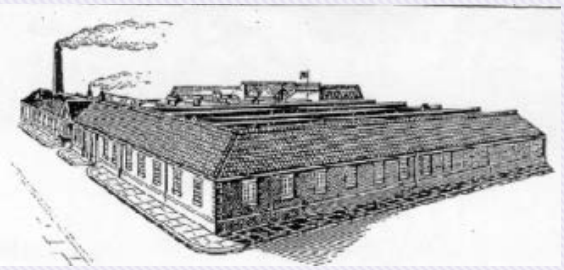
A portrait of Walter Haddon from the Illustrated London News 19 July 1924

On 1 February 1885 Walter relocated to London where he found employment with various printers, eventually starting work at John Haddon & Co, also printers, in 1888.

One might have easily concluded that the move to London was planned with the specific intention of exploiting the family connection. But according to his own account, Walter's side of the Haddons had lost contact with the branch that had started John Haddon & Co in 1814. The combination of his training, new location and the need of a job were purely fortuitous factors that led to Walter's discovery of John Haddon & Co and then early ownership of the firm.

Despite the seventy plus years that the Haddon enterprise had been operating, the business was comparatively small and Walter set about expanding the range of activities into publishing and advertising. One of the publications, *Phil May's Illustrated Winter Annual*, featured a story by Arthur Conan Doyle in 1892: "Dr Conan Doyle is the writer of an exceedingly powerful story".[4]

In 1897 he established a printing-type foundry at Market Harborough. His ideas on standardising the size of typeface brought him into conflict with other manufacturers in the industry.



The Caxton Type Foundry at Market Harborough (The Times 10 September 1912)

"Amusement was caused by his statement that the hands [at the Caxton Type Foundry] are paid each Thursday, the Saturday afternoon and evenings thus avoided, and the wife having her full share of the wages."

A report in the *Western Daily* Press 3 December 1902 of a talk given by Walter Haddon on "How Type is Made".

A particularly interesting connection is the partnership between Walter Haddon and Gugu Constantinesco (generally known as George). The pair met before the First World War and as a result collaborated on developing machines exploiting Constantinesco's new theory of wave transmission (which he called sonics). In essence, this was the transmission of energy using the compressibility of liquids. As far as many applications are concerned, liquids are incompressible. However, they are elastic enough for some purposes.[5] An important result came about by applying "sonicity" to the problem of firing machine gun bullets between the rotating propeller blades of fighter aircraft.

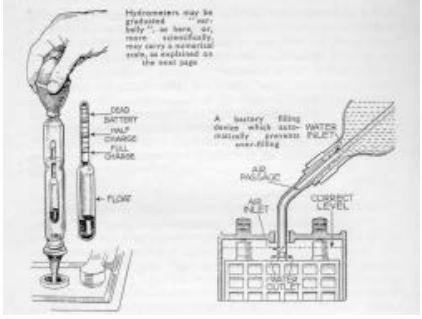
Development work was carried out at the Haddon Engineering Works[6], Honey Pot Lane (now Mount Pleasant), Alperton and at premises in West Drayton. A number of military personnel gave assistance, including Arthur Clifford Hartley[7] and Clarence Christopher Colley[8]. When in service, the device was known as the C.C. (from Constantinesco & Colley) Interrupter Gear. Over 30,000 were produced by W. H. Dorman & Co Ltd of Stafford. As Walter owned a controlling interest in Dorman, many of George Constantinesco's inventions were produced there.

The contents of a memo from Walter Haddon on the subject of cost saving annoyed Charles Parker, a fellow director of W. H. Dorman & Co Ltd. In the presence of the chief designer, Parker brandished a revolver saying he would "pot" Haddon. Later, in court, his defence council explained that "... this was only his picturesque way of expressing his determination to fight out the issue between himself and Mr Haddon". Parker was bound over to keep the peace.[9]

Tungstone Batteries

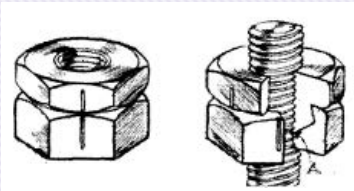
The origin of Tungstone as a brand name has been reported in a number of publications.[10] Walter, so the story goes, received a walking stick made from the evergreen tree called greenheart (Chlorocardium rodiei). This wood was so superior in strength that the polar exploration ships used by Amundsen and by Shackleton were clad in greenheart to help resist the crushing force of ice. Walter adopted it for making "printer's spacers" and derived the word Tungstone: as hard as tungsten and sinks like a stone in water.

Early battery manufacture used wooden cases to house the lead plates, with wood as plate separators. Carpentry and lead moulding were two well-developed processes at the Caxton works so when existing business started to dry up it was a comparatively easy step to begin battery manufacture. The Tungstone Accumulator Co Ltd offered a 3 amp-hour battery, apparently without using wood for plate separators. Storage batteries then had other common domestic uses, such as powering radios.



The hydrometer was once a common piece of equipment for car-owners. This illustration is from The Autocar of 1941

Production started in the mid-1920s, also a tough time for battery sales. In 1923 the manufacturer C. A. Vandervell & Co Ltd[11] reduced the price of its standard battery for Ford cars from £4 10s to £3 10s. Tungstone weathered the trade depression of the 1920s to become a major producer for many years after.



The Vislok safety lock-nut became popular in the aircraft industry. This drawing is from Flight magazine 9 July 1915

On 8 June 1910, Walter Clay Peters submitted an application to the Patent Office for a fastener that became known as the Vislok safety lock-nut. It was similar in principle to the use of two nuts tightened against each other except that the parts were interconnected and the construction allowed a firmer grip. In conjunction with Walter Haddon, a company called Vislok Ltd was formed to market the product. With the arrival of Batterium it became Batterium Metal & Vislok Ltd.


NEW ACID RESISTING COPPER-ALUMINIUM NICKEL ALLOY OF BRITISH ORIGIN.

BATTERIUM METAL

NON-CORRODIBLE NON-FERROUS

BATTERIUM'S CHEMICAL AND PHYSICAL CHARACTERISTICS

Tungstone is the Only Car Battery in the World sold with a free Guarantee that its Plate Terminals made of Batterium will not Sulphate or Corrode.

Works and Sales Offices:— MARKET HARBOROUGH ENGLAND.

BATTERIUM METAL

NON-CORRODIBLE NON-FERROUS

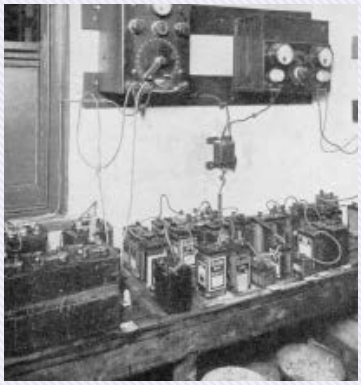
One of a series of advertisements that appeared briefly from about 1930 onwards (The Times, 15 July 1931)

Batterium and the press

Reports of Tungstone batteries reached far-flung parts of the British Empire. *The Examiner* of Launceston, Tasmania, gave coverage with the comment: "The entire absence of small hisses and crackles, always present in a dry cell battery, was remarkable."[12]

A Tungstone advertisement, humorously pretending to be written by the battery itself, appeared in newspapers around the early 1930s: "My plate terminals are made with my new Metal Batterium which is guaranteed not to sulphate ... the malignant germs of sulphate cannot become permanently fixed into my Plate to weaken the electrical efficiency or shorten its working life." Those were the days when batteries could be returned for cell re-plating and when an eight-horsepower model Y Ford, or Morris Ten, might be referred to as a "Pleasure Car".

On other fronts, Batterium made its début at the British Chemical Plant Exhibition of 1931 as one of the materials used in an acid-pumping system. It also managed to get a mention in a number of books and journals.



Battery charging from a DC mains supply[13]

A new metal has recently been discovered and put on the market ... under the name of 'Batterium'; it has somewhat remarkable properties for electrical and other purposes (The Practical Electrical Engineer[14]*).*

The new acid-resisting copper-aluminium-nickel alloy, Batterium metal, has proved to be very useful in constructing chemical plant subjected to corrosive liquids. It has exceptional tensile strength and ductibility [sic], and can be easily welded or machined (Modern Chemistry: The Romance of Modern Chemical Discoveries[15]*).*

A great advantage of this Battery [marketed as a range under the name Tunganite] is in the use of a new proved Acid resisting Metal - Batterium - for all the metal parts other than lead parts of the Battery. This alloy was invented by the TUNGSTONE ACCUMULATOR Co., who are to be congratulated on their enterprise and sucess [sic] (Motor Sport[16]*).*

Still in humorous vein, a 1934 advertisement in the Dundee Courier proclaimed: "You cannot overcharge a Scotsman but he can continuously overcharge a TUNGSTONE". There was no mention of Batterium.

Batterium under test

The metallurgical department of the Royal Aircraft Establishment (RAE) received a half-inch diameter rod of batterium to be evaluated as a material for accumulator terminals. A chemical analysis revealed the composition to be 89.8% copper, 8.8% aluminium, 1.07% nickel and 0.43% manganese. This fits in with British patent 329361 "An Improved Non-Corrodible Metal", applied for by Walter Haddon and Jacob Winfield in 1929 and accepted 16 May 1930. In this patent: " The proportions of the constituents admit of some variation[;] the copper may vary between 88.5%, aluminium from 7.5% to 10%, the nickel about 1%, and the manganese in all cases being 0.25 to 0.4%."

The RAE decided on comparing Batterium with a selection of copper alloys, all screwed to lead cylinders.

Three conditions were also represented: terminals unprotected, terminals coated with petroleum jelly, and lead plated. Initially, the specimens were placed in a battery charging room but after five months there was insufficient corrosion present to give a decent comparison. The samples were transferred to a glass chamber and subjected to a mist of sulphuric acid (specific gravity 1.27). Observations were made after three months and six months.

Material	Composition
Batterium metal	Cu 89.8% Al 8.8% Ni 1.07% Mn 0.43%
Bronze to BS specification B2	Zn 1.75-2.25% Sn 9.75-10.25% Pb less than 0.5% Other impurities less than 0.15% balance Cu
Brass to BS specification B6	Cu not less than 61% Sn not less that 1% impurities less than 0.75% balance Zn
Bronze to BS specification B8	Sn not less than 10% P not less than 0.5% impurities less than 0.5% balance Zn
Brass to BS specification B11	Cu 78-82% impurities less than 1.25% balance Zn
Brass to BS specification B13	Cu not less than 55% Pb 1.75-3.0% impurities less than 0.75% balance Zn
Copper to BS specification 12A	Cu not less than 99.2% As 0.3-0.5%
Duralumin to BS specification 3L1	Cu 3.5-4.5% Mn 0.4-0.7% Mg 0.5-0.7% Fe less than 0.75% balance Al

Materials tested by the Royal Aircraft Establishment[17]

The RAE report found that with the petroleum jelly treatment " ... no marked difference in the behaviour of the various materials was observed ... " For uncoated and lead coated terminals, Batterium and Brass to BS specification B11 were superior to the rest but Batterium did not perform any better than the B11 brass. In addition, B11 brass had better electrical conductivity.

So what happened to Batterium? The RAE tests, as far as resistance to sulphuric acid corrosion is concerned, do not endorse the idea of an exceptional product. It may have been simply uneconomical for use in storage batteries and not significantly better than existing alloys for other purposes. Whatever the reason, advertisements for the material in any application seem to cease after 1933.

Postscript

The last battery to be produced by Tungstone (in 2003) is housed in Harborough Museum, Market Harborough. Tungstone is now a registered trade mark of Platinum Batteries (Europe) Ltd.

A Walter Haddon Memorial Pensions Fund for printers was established shortly after his death on 5 April 1938 aged 73.

For viewing the activities of George Constantinesco at the Sonic Works, West Drayton, see the British Pathé newsreel:
www.youtube.com/watch?v=yDNwo9aEfL0

New alloys with "remarkable properties" continue to be developed. Recently announced (December 2014) is a nanocrystalline alloy formed from aluminium, lithium, magnesium, scandium and titanium ($Al_{20}Li_{20}Mg_{10}Sc_{20}Ti_{30}$).[18] The main attribute is claimed to be a higher strength-to-weight ratio than any other metallic material found so far - as strong as titanium and as light as aluminium. Titanalum?

Acknowledgements

Thanks are due to:
Tony Haddon
Phil Jones of the Dorman Association
(see http://dorman-association.webplus.net/)

Further Reading

Tony King, "Haddon and the Introduction of the American Point System" at
www.britishletterpress.co.uk/category/presses

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[4] Reported in the *Aberdeen Evening News* 28 November 1892. The story, "Jelland's Voyage", appeared in several other publications. Before taking up writing for a living, Conan Doyle was a doctor in General Practice.
[5] The theory of sonics (or sonicity) concerns the transmission of power through vibrations. The subject became a branch of continuum mechanics.
[6] Ian Constantinesco describes the acquisition of "some disused stables and cowsheds in Honeypot Lane" which were converted into George Constantinesco's laboratory. https://web.archive.org/web/20020320163410/http://fluid.power.net/fpn/const/const002.html [accessed 18/01/2015].
[7] In 1917 Arthur Clifford Hartley (1889-1960) was a Second Lieutenant in the Royal Flying Corps, based at the Air Board's Technical Department, Strand, London. He later became President of the Institution of Mechanical Engineers and, just before his death, President of the Institution of Civil Engineers.
[8] Clarence Christopher Colley, a Major in the Royal Artillery, held joints patents with Hiram Maxim (of Maxim machine gun fame) concerning improvements to the operation of machine guns.
[9] "Highly-Coloured Sayings. Manager's alleged threat to "Pot" chairman", *Hull Daily Mail,* 7 Feb 1922 and "Co-directors and a revolver. Charge of threats at Stafford", *Lichfield Mercury,* 10 Feb 1922.
[10] The story giving the origin of Tungstone as a brand name was published in an article a week after the announcement of Tungstone Batteries' closure. *Harborough Mail* 30 August 2002.
[11] C. A. Vandervell & Co Ltd was taken over in 1926 by the well-known dynamo makers Joseph Lucas.
[12] *The Examiner,* 25 August 1926.
[13] Roy Frost in *Electricity in Manchester (Manchester:* Neil Richardson, 1993) records that consumers could have both direct and alternating current supplies. Phasing out of DC in Manchester started in 1927 but by 1948 there were still some users, mainly in the city centre. The battery charging station shown here is from Edward Molloy (ed), *Practical Electrical Engineering Volume III* (London: George Newnes, c1930), 1152.
[14] The Practical Electrical Engineer (London: George Newnes, c1923).
[15] Frederick Prescott, *Modern Chemistry: The Romance of Modern Chemical Discoveries* (London: Ampson, Low, Marston & Co, 1932), 138.
[16] "Improvement in Battery Design", *Motor Sport,* November 1929, 47. The same wording also appears in other periodicals.
[17] Royal Aircraft Establishment Report M1876. National Archives reference AVIA6/8616 C639656.
[18] Khaled M. Youssef et al., "A Novel Low-Density, High-Hardness, High-Entropy Alloy with Close-Packed Single-Phase Nanocrystalline Structures", Materials Research Letters [online journal], 9 December 2014. http://www.tandfonline.com/doi/full/10.1080/21663831.2014.985855#.VMNotS5WXs0 [accessed 24/01/2015].

Positive dielectrophoresis in ac electric fields

Charles Osarinmwian

Abstract

Aggregates are formed with viable yeast cells *(Saccharomyces cerevisiae)* and bacterial cells *(Escherichia coli and Micrococcus luteus),* and are assembled in an interdigitated-castelled microelectrode using positive dielectrophoresis[i] with an alternating current sinusoidal voltage of 2-20V peak-peak at 1MHz. The height of *S. cerevisiae* aggregates were increased by the addition of the ampholytes N-[2-hydroxyethyl] piperazine-n'-[2-ethanesulfonic acid] (HEPES) or ε-aminocaproic acid (EACA) due to the resulting rise in permittivity of the aqueous solution. The mean height of *S. cerevisiae* aggregates in the presence of 1 M HEPES was 25.7 % higher than achieved in an ampholyte-free solution.

Introduction

The progress of dielectrophoresis as a novel and rapidly growing field has led to many significant advances in a wide range of diverse applications. Dielectrophorsis arises from induced dipoles in neutral particles exposed to a non-uniform electrical field. In the case of biological cells, the dielectrophoretic force experienced by a cell depends on intrinsic electrical properties such as membrane capacitance and conductance, both of which change with cell type. In tissue engineering, dielectrophoresis can be used to characterise artificial tissues and form artificial tissue-like materials by either assisting in the formation of the artificial extracellular matrix or by the micromanipulation of cells[1]. This is important since hydrated extracellular polymeric substances in nature protect organisms in a biofilm in adverse environments while permitting intense interactions, including cell-cell communication among the cells within a biofilm[2].

The use of dielectrophoresis in bioanalytic microsystems could result in multifunctional platforms for basic biological insights into cells and tissues as well as cell-based sensors with biochemical, biomedical and environmental functions[3]. In this work, the influence of the applied voltage and the presence of ampholytes on the aggregation height of *S. cerevisiae, Escherichia coli* and *Micrococcus luteus* in an aqueous-based solution within an interdigitated-castelled microelectrode are investigated.

Experimental

To obtain cell aggregates, an alternating current sinusoidal voltage of amplitude in the range 2-20V peak-peak was applied. A single cell suspension (consisting of 6-8µm *S. cerevisiae, M. luteus* or *E. coli cells*) was injected on top of the interdigitated-castelled microelectrode assembly using a syringe and then covered with a microscope slide coverslip. *S. cerevisiae* was grown overnight, harvested and washed 4 times in deionised water by repeated centrifugation whereas *M. luteus* and *E. coli* were used without further treatment. When the cells in the suspension settled in the microelectrode assembly an alternating current sinusoidal voltage was applied at a frequency of 1MHz. This frequency induces a Maxwell-Wagner-type polarisation leading to a strong positive dielectrophoretic force because the cell membrane surrounding the cytoplasm has a low conductivity and permittivity[4].

To investigate the effect of changing solution properties on aggregation height, 50µL of HEPES (Sigma Aldrich, H4034) or EACA (Sigma Aldrich, A2504) in solution was pipetted into the cell suspension, gently stirred and then covered with a microscope slide coverslip. Aggregate heights were measured using a standard technique that can be found elsewhere[4].

Results

Figure 1 shows that increasing the applied voltage increases the electric field strength around microelectrodes and therefore increases the height of cell aggregates. *M. luteus* has lower cell wall conductivity than *E. coli* leading to a slightly complex cell permittivity that lowers the positive dielectrophoretic force[4] and hence lowers the aggregate height (Fig. 1). *S. cerevisiae* has the lowest cell wall conductivity and so the lowest aggregate height. The continuity of the displacement flux density across the interface between these cells

and solution controls the initial temporal response to the applied electric field due to perturbations of bound charges at the atomic scale[5]. This cell size independent phenomenon may dominate over small variations in cell size despite the positive dielectrophoretic force dependency on the cell size *d* by a factor d^3. Increasing the permittivity of the solution by the addition of ampholytes (i.e. HEPES or EACA) increased the aggregate height (Fig. 2, 3); the mean height of *S. cerevisiae* aggregate in the presence of 1M HEPES was 25.7 % higher than achieved in an ampholyte-free solution. The negative effect of the increase in conductivity on the aggregate height is weaker than the positive effect of the increase in permittivity.

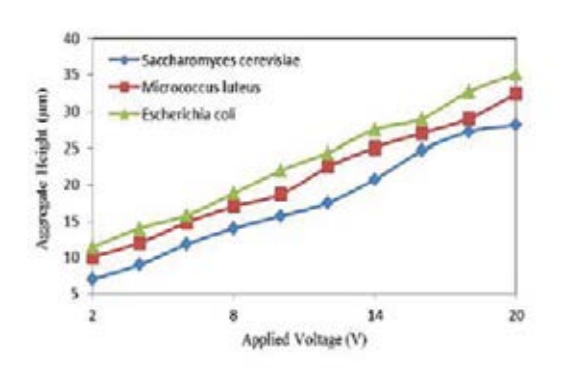

Figure 1: Effect of applied voltage on the aggregate height of different cells.

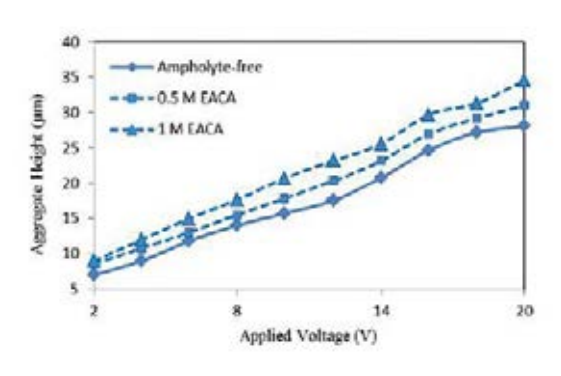

Figure 2: Effect of EACA addition on the aggregate height of S. cerevisiae.

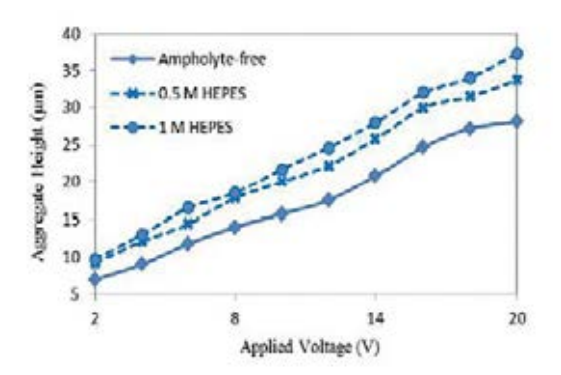

Figure 3: Effect of HEPES addition on the aggregate height of S. cerevisiae.

The dielectrophoretic force acting on a spherical cell in a non-uniform electric field is dependent on the strength of the effective polarisation of the cell (measured by the Clausius-Mossotti factor). In terms of electrostatic energy, a positive value for the real part of the Clausius-Mossotti factor indicates that work is required to withdraw a cell from the highest field region (i.e. positive dielectrophoresis) in which the conduction losses in the cell exhibit an electrical conductivity associated with mobile ions in the cell structure[5]. It is important to note that increasing the applied voltage is an effective method of increasing aggregate height[4].

Discussion

The ease of scaling electric fields and developing multifunctional platforms in the next-generation of microelectrode designs may create opportunities for exploiting dielectrophoresis in a range of microsystems. The interdigitated-castelled microelectrode used in this work offers relatively high values of electric field strength at modest applied voltages while allowing for simultaneous observations of both positive and negative dielectrophoresis. However, the shortcomings, in terms of collecting cells at microelectrode edges rather than along a microelectrode, have been addressed using very fine microelectrodes and small working volumes in a zipper-microelectrode[6]. This would require the formation of extracellular polymeric substances between levitated cells (in regions of negative dielectrophoresis) and aggregated cells (in regions of positive dielectrophersis) in order to immobilise the cells into synergistic microconsortia[2]. The current state of affairs indicates that the next-generation of dielectrophoresis technology warrants novel microelectrode designs[7] such as the zipper-microelectrode.

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Teaching glass technology at Berufliches Schulzentrum Wertheim, Germany

Christina Moraitis

Where is Wertheim situated?

Wertheim is the most northerly town in the state of Baden-Württemberg in southern Germany. It is situated on the delta of the river Tauber flowing into the river Main.

Wertheim was founded between the 7th and 8th century. In the Middle Ages doings and dealings in Wertheim benefited from its location on the river Main as a central traffic connection between east and west. Still today the *Burg Wertheim* (castle) is the landmark of the town, and Wertheim has a medieval town centre with half-timbered houses and small streets. When in 1806 Napoleon with a single stroke of his feather defined the river as the border between Bavaria and Baden, the former residency turned into a quiet border town of the Grand Duchy of Baden. Only after the Second World War a dynamic development started, to which Wertheim owes its current importance. From 1972 onwards fifteen communities were incorporated with Wertheim; due to this incorporation of surrounding communities, Wertheim reached the 20,000 population mark in 1975 and became a *Große Kreisstadt* ("major district town") – a centre of authorities and administration, and – even more – an industrial location in the country with a port connecting it to the major sea lane Rhein-Main-Donau, and economic centre of the Main-Tauber District with a focus on glass industry – and: schools of all educational facilities.

Figure 1: Wertheim – view of the town with the river Main and the river Tauber

Figure 2: Wertheim – market square in the historic centre

What is so special about our system of vocational education?

Because of the federal structure of our country the responsibility for the German school system lies primarily with the states (we call them *Bundeslaender*) while the federal government plays a minor role. That means: the system varies throughout Germany because each state (or *Bundesland*) decides its own educational policies.

My school – Berufliches Schulzentrum Wertheim – is situated in the state of *Baden-Wuerttemberg*. That is why I will write about the system of vocational education in *Baden-Wuerttemberg* – in other German states it might be slightly different.

Baden-Wuerttemberg is the third largest of Germany's sixteen states in terms of both area and population, with an area of about 35,700 square kilometers and 10.7 million inhabitants. The state capital is *Stuttgart*, which is also the state's largest city. Although *Baden-Wuerttemberg* has relatively few natural resources compared to other regions of Germany, the state is among the most prosperous and wealthiest regions in Europe with a generally low unemployment rate historically. A number of well-known enterprises are headquartered in the state, for

example Daimler AG, Porsche, Robert Bosch GmbH (automobile industry), Carl Zeiss AG (optics), and SAP AG (largest software enterprise in Europe). In spite of this, *Baden-Wuerttemberg's* economy is dominated by small and medium-sized enterprises. Although poor in workable natural resources (formerly lead, zinc, iron, silver, copper and salts) and still rural in many areas, the region is heavily industrialised. The state has the highest density of academic institutions of any territorial state in Germany. It is home to some of Germany's oldest, most renowned and prestigious universities, such as the universities of *Heidelberg*, *Freiburg*, and *Tuebingen*.

Adhering to *Baden-Wuerttemberg´s* basic principle *"Every graduation must have a continuation"*, the chance of achieving a higher educational level is not only offered in general education, but also in the vocational sector. This improves the young people´s chances at work or entitles them to study at a university. The fact that about one third of all the entrance qualifications into university are acquired in a vocational school indicates the importance of the vocational schools for upward social mobility. Vocational education, with its combination of practical and theoretical competences, prepares students for life-long learning and a successful professional career. In the vocational school system of *Baden-Württemberg* two types of school can be identified: the **part-time** vocational schools with in-company training in the dual system and the **full-time** vocational schools without in-company training.

The majority of young people in Germany start their vocational education with a training in the dual system ("apprenticeship") – VET = Vocational Education and Training.

The dual system is open to all students who have finished their general school education. The entry requirement for studying within the dual system is a contract as an apprentice with a company. Today the dual training system extends to over approximately 350 state-certified, thus officially recognised, professions in nearly all branches of the economy, ranging from trade and industry to the service sector, and including the high-tech field. Due to its unique position linking the systems of education and economy, it is both an essential factor in reducing unemployment among young people and a successful means of meeting the employers' demand for skilled personnel.

A great deal has changed in recent years within the dual system due to technological and social changes. Professions have changed tremendously, thus demanding new approaches to teaching methods. New professions have been created or have been modernised completely. In addition, vocational content is taught in a new way, replacing the general subjects and optional subjects.

Learning units are no longer taught according to traditional vocational subjects, but according to vocational competencies (*"Lernfelder"*). Vocational competencies are oriented toward practical job-related procedures in accordance with the so-called "Complete Action Model" (getting information, planning, decision-making, execution, checking, and evaluation).

Within a given field of learning various abilities and skills are taught using holistic methods.

Despite all these changes, the basic idea has remained the same. Professional training still takes place at two locations: in the company or workshop and at the vocational school. While the company takes over the practical training, the vocational school communicates mainly the theoretical knowledge, in addition to expanding and deepening general knowledge, that is necessary to practice a profession.

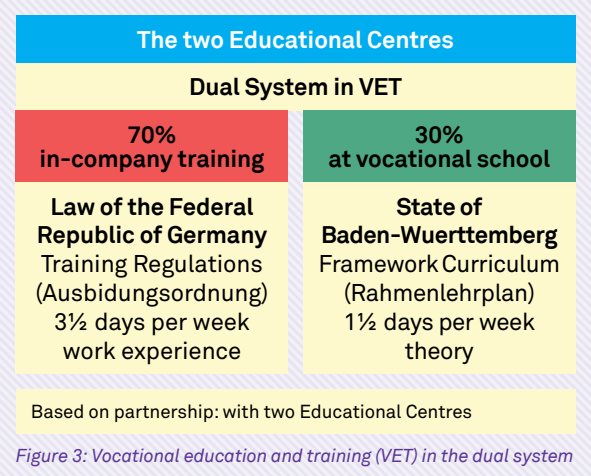

Figure 3: Vocational education and training (VET) in the dual system

A fact which is widely unknown outside Germany is that the trainees sign a contract with the company. Thus, the companies are able to choose the candidates with adequate profiles, giving them career prospects in their companies far beyond the training period. In addition, the apprentices obtain an apprenticeship payment, which enables young people with a modest financial background to start a training widely acknowledged and respected in German society.

During the first year of training the apprentices acquire a broad knowledge of the overall vocational field. This forms the basis for later specialization and ensures that "the same language is spoken" in the various professions within a given vocational field. This foundation is becoming increasingly important, because many professions are ever more closely interconnected. In many trades the basic level is taught full time in the 1st year vocational school.

During the second and third years of training (levels I and II of specialisation) the foundations are supplemented.

The apprentices specialise according to the actual profile of the profession. Parallel to the job-related skills, general education continues to be promoted in the vocational school as an important condition for professional competence.

Vocational school training ends with a final examination. Those who have completed this successfully receive a vocational school diploma. In connection with the successful completion of their in-company training (the so-called Certificate of Apprenticeship = National Vocational Qualification, awarded by the Chamber of Industry and Commerce or the Chamber of Crafts), young people without a lower secondary school diploma acquire a diploma equivalent to it. Provided that the grades they achieved are sufficient, the apprentices may also be awarded a diploma equivalent to the intermediate secondary school diploma following the completion of their training. In particular, admission to study at a university is possible following additional professional qualification (for example as a master craftsperson).

At present, more than 1000 students attend Berufliches Schulzentrum Wertheim. Of these, 120 students do their vocational school training in the glass sector as scientific glassblowers (25), thermometer manufacturers (5), flat glass mechanics (60) or process mechanics in the glass industry (30). In close cooperation with the training companies and workshops, our partners in the dual education system, the trainees of the various glass professions receive a broad theoretical knowledge and, in addition to that, specific job-related skills as described above. Since the majority of our students come from outside of Wertheim, the schooling is done in block form in three annual sections of 3-5 weeks (12-13 weeks per student per school year). The following photographs are taken in the school's own glass workshop:

Figure 4: Anja from BUECHI GLAS, Flawil, Switzerland during her professional training as scientific glassblower

Figure 5: Waldemar from DURAN GROUP, Wertheim, during his professional training as scientific glassblower

Figure 6: Tobias from LUDWIG SCHNEIDER, Wertheim during his professional training as thermometer manufacturer

Figure 7: Thomas and Jan from FIRST GLAS, Berlin, during their professional training as flatglass mechanics

Another 120 students do their vocational training in the mechatronics sector as industrial mechanics (90), construction mechanics (20) or milling and turning mechanics (10). These students are from Wertheim and the surrounding area, so that the schooling is done as described in Figure 3: 3 ½ days per week they do in-company training, 1 ½ days they attend vocational school. Their school subjects are classified into two groups: the general subjects (four lessons per week: German, social studies, job-related English and religious education) and job-related subjects (eight lessons

per week: mechatronics with focus on component manufacture, analysis of information flow in complex mechatronic systems, start-up, troubleshooting, and maintenance and repair). For the approximately 200 students attending the economic vocational school to become industrial business management assistants (60), shopkeepers and retailers (100) or sales assistants (40) the general subjects are the same. In the job-related sector they focus on business administration, monitoring and controlling, macroeconomics, data processing and project competence.

Regarding the full-time vocational schools, in Wertheim we have the vocational preparatory year (*Berufsvorbereitungsjahr*) and the pre-qualifying year work/trade (*Berufseinstiegsjahr*). This is for young people who do not continue their education at a secondary school and do not begin training with a company after they have completed their general compulsory education, and therefore have to be prepared specifically to enter the working world. There is a 2-year full-time vocational school *(2BFS)*, leading to the intermediate certificate of secondary education for students who graduate from general secondary schools. For students who possess their intermediate certificate of secondary education there is a 2-year advanced vocational school *(Berufskolleg)*, leading to the qualification for entrance to a university of applied sciences, and the 3-year vocational upper secondary school *(Berufliches Gymnasium)*, leading to the general university entrance qualification *(Abitur)*. In the advanced vocational schools, students with an intermediate certificate of secondary education acquire vocational qualifications and an advanced general education for occupations which are particularly affected by new developments in technology and economy. The close connection between theory and practice is an essential feature of this type of education. There are eight different types of vocational upper secondary schools: economic sciences, environment engineering, design and media, metal technology and electrical engineering, agricultural sciences, biotechnologies, health and care and social pedagogy.

Figure 8: Chemistry lesson, vocational upper secondary school for biotechnologies

Figure 9: Business economics lesson, vocational upper secondary school for economic sciences

Author

My name is Christina Moraitis. My family emigrated from Greece to Hanover in Northern Germany in 1975, when I was seven years old. After my graduation at school in 1987 I started a vocational training in a glass factory (at that time PLM Glashuette Muender, today Ardagh Glass Bad Muender), which I finished in 1990. In 1991 I decided to study glass and ceramics science and technology at Technische Universitat Clausthal and took my degree as a civil engineer in 1995. During a sabbatical of one semester in 1993 and after my final degree in 1995 I worked in glassworks in Germany, the Netherlands and England (Redfearn Glass, Barnsley) and in a brick factory in Greece. In 1996 I got a grant from the European Union to do my PhD at the Department of Ceramics of Leeds University, but due to a serious illness I had to stay in Germany. In 1997 I started to work as a teacher for glass technology and chemistry at Berufliches Schulzentrum Wertheim in Germany, and since 2009 I have been a member of the management-team of our school.

If you have any questions about my school, our school system, Wertheimberg, or myself, please do not hesitate to contact me:

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Conventional representational measurement

John McCormick

Mathematics is a study which, when we start from its most familiar portions, may be pursued in either of two opposite directions. The more familiar direction is constructive, towards gradually increasing complexity: from integers to real then complex numbers; from addition and multiplication to differentiation and integration, and onwards towards ever higher mathematics.

The other direction which is less familiar proceeds by analysis to greater and greater abstractness and logical simplicity. Instead of what can be defined and deduced from what is already assumed to begin with, we ask what more general ideas and principles can be found , in terms of which, what was our starting point can be defined and/or deduced.

The most obvious and easy things in mathematics are not those that come logically at the beginning, they are the things, that from the point of view of logic and deduction, come from somewhere in the middle. Just as those bodies that are easiest to see are those that are neither very near or far away or very small or great, so the conceptions that are easiest to grasp are those that are neither very complex nor very simple.

As we need two sorts of instruments, the telescope and the microscope for the enlargement of our visual powers, so we need two sorts of instruments for the enlargement of our logical powers: one to take us forward to higher mathematics and one to take us backward to the logical foundations of the things that we are inclined to take for granted. We shall find that by analysing our ordinary mathematical notions we acquire fresh insight, new powers and means of reaching whole new mathematical subjects by adopting fresh lines of advance after our backward journey.

(Adapted from "An Introduction to Mathematical Philosophy", by Bertrand Russell, 1905)

Familiarity with measurement

The passage above penned by the remarkable and renowned English mathematical philosopher Bertrand Russell of course refers specifically to his first and greatest love mathematics. However, the idea that in order to really understand any concept, discipline and/or technique it is necessary to look backward at the fundamental basics is valid in a wide range of areas relevant to anyone involved in science, technology, engineering and mathematics, the STEM disciplines.

In common with Bertrand Russell's comments on mathematics often the most obvious and easy things in any discipline are not those that come logically at the beginning. In terms of the STEM areas this is of course augmented by the fact that although some STEM concepts are extremely esoteric and counter intuitive in the main a scientific approach is often concerned with the bringing of rigour and precision to areas that are encountered in everyday life. Thus, in the course of exercising scientific methods in their work scientists, technicians and engineers are often applying this rigour and precision to common everyday practices.

In any wet chemistry lab the reagents must be provided at the correct molarity, reaction vessels in industrial chemistry must be at the correct temperatures and pressures, in electronic and electrical circuits and networks power and or signals are expected to be delivered at the correct voltages, these are but a few examples of situations where exact quantities of physical agents are required for certain processes to be successfully completed and the fundamental procedure required to ensure that these physical agents are delivered in the correct quantities is an example of the everyday process of measurement.

Of course measurement figures in a vastly wider range of technical areas than those associated with processes. The formal scientific method, from observation to hypothesis and onward to test and confirmation or

falsification is essentially based on the idea that there are measurable predictions from any scientific hypothesis that can confirm the relevance or accuracy of the predictions of the theory. So measurement is the final arbiter in deciding the applicability of any scientific theory. Likewise it is also the final arbiter in deciding the applicability of any engineering solution not based on the dubious method of pure trial and error.

So we can see that the everyday process of measurement with which all types of persons are familiar, refined with rigour and accuracy, is paramount in the all areas of science, engineering and technology. However, our notions of measurement exist long before we begin any formal education or training in any of the STEM disciplines so whereas great effort is placed by trained educationalists to ensure that all of our scientific and technical education starts from the most logical and fundamental ideas, as with mathematics our understanding of measurement starts with those areas with which we are most familiar with in our everyday lives and not those that lie at the basis of the concepts.

Given that we all become familiar with measurement in this everyday sense it is clear that in the STEM areas great efforts over the years have been devoted to the extension of the concept of measurement to many more complex areas of relevance, with ever more ingenious attempts to increase accuracy, precision and sensitivity. Where, entire learned organisations, e.g. The Antenna Measurement Techniques Association (AMTA)[1], devote considerable effort to advance the fields of measurement, sometimes in the general sense and sometimes as per AMTA with reference to specific fields of engineering and scientific measurement. However, considerable insight leading to as yet often unaddressed areas of measurement theory can be gained into the discipline if effort is devoted to looking back to the fundamental logical basis of the concept of measurement and how it represents the state of certain recognisable quantities.

Measurement as a tool for rational cognition, when observations of physical phenomena are designed to extract quantitative information is often defined as,

"The quantitative determination of a physical magnitude adopted as a standard, or by means of a calibrated instrument. The result of a measurement is thus a numerical value expressing the ratio between the magnitude under examination and a standard magnitude regarded as a unit".

A definition originally made popular by Lord Kelvin in the 19th century[2].

However, the passage of years resulting in an increased level of understanding of the physical process of measurement, along with the introduction of systems centred concepts and the development of information theory, has led to a more generalised view of the measurement process. This gives an information conversion definition of measurement as:-

"Consisting of information transfer with accompanying energy transfer. Energy cannot be drawn from a system without altering its behaviour; hence all measurements affect the quantity being measured. Measurements therefore are a carefully balanced combination of physics, (energy transfer) and applied mathematics, (information transfer)".

Both of these definitions can be seen to be applicable and the now virtually universally accepted representational theory of measurement[3] can be

"A measurement is the representation of some recognisable phenomena in a formal structure".

summed up by the statement that:
This statement may seem somewhat imprecise but as will be explained in the following text this somewhat ambiguous statement can be used to define what a measurement actually is.

Representative measurement

All of these statements capture some aspect of the measurement process but are to some extent are ostensive in that they describe examples of the process rather than define it in intensive terms where the properties of the process would be spelled out. In order to grasp the fundamental basis of the concept of measurement it is necessary to be able to define in formal terms what a measurement is. To do this rigorously and at its most fundamental level the definition of measurement must be couched in terms of formal logic.

This requires that a set of propositions, propositional statements, is advanced that can have truth values assigned to them, either true or false. These statements constitute the postulates of an argument and if they are considered to be true then the conclusion will be considered to be valid and sound. The argument put forward in terms of formal logic being, that if the propositions are accepted as true then the conclusion is that the entity under consideration is defined by intention.

Example 1

- **If**
  Po1: proposition 1 X is alive
- **And:**
  Po2: proposition 2 X has four legs
- **And:**
  Po3: proposition 3 X has fur
- **And:**
  Po4: proposition 4 X makes the sound Meow
- **Then**:
  Co1: conclusion X is a cat

Thus, the confirmation that each of the individual propositions is true is a necessary condition for the conclusion but only if all of them are true is this sufficient condition to arrive at the conclusion.

e.g. Po1 could be true if X was an insect but all the others would be false, Po4 could be true if X was a tape recorder but all the other would be false. Only if the truth value associated with all of the propositions is "true" is the conclusion the X is a cat valid.

The conclusion from example 1 is that X is a cat, in formal logical terms this means that X belongs to the class of things that we call cats. Thus, if all the propositions listed are true X is a member of the class of cats, where a class is a set that cannot be a member of itself, e.g. the set of cats is a class as the only members of it are cats; however the set of things that are not cats is not a class as this set is not a cat so it is a member of itself[4]. **Note:** in this article unless otherwise stated all the sets named will assumed to be classes so the words class and set will be used interchangeably.

This means that to define exactly what a measurement is we have to devise a number of propositional statements that are necessary conditions for some process to be considered a measurement and if all the statements are true the conclusion is that the process is a member of the class of measurements.

As is clear from example 1 the propositions relate to properties of X, fur, legs, etc, so the propositions that can be used to deduce if some process is a measurement must also relate to the properties that this process must possess to be considered a measurement.

Properties of a measurement procedure

Measurements concern the magnitude, extent or nature of some recognisable existential phenomena, e.g. mass, length, pH, IQ. As such any measurement process will usually represent this in a formal mathematical structure usually, but not exclusively, numerically via the use of numbers.

For the observable phenomena listed above, mass, length, pH and IQ, a number of possible values exist and there are discernable relationships between the possible values that the observable phenomena can take, e.g. 6 Kg is heavier than 4 Kg, 2 metres is twice as long as 1 metre, a pH of 4 is lower than a pH of 6, and two IQs of 106 are equal.

Stated formally for length, for the set of lengths there exists a set of empirical relationships between the members of the set of lengths, e.g. greater than, less than. Thus, for any measurement procedure the thing that has to be measured, usually referred to as the measurand, must be a member of an extra mathematical set in which the members can be ordered in terms of the relationships between the members, e.g. some member is greater than or less than some other member of the set. Therefore the first proposition in any argument, (Po1) defining a measurement must postulate the existence of such a set referred to as the measured class or physical state set of which the measurand is a member, e.g. the class of lengths or temperatures.

In any measurement procedure it must be possible to represent the measurand via some representative symbol, usually a number. Thus the second proposition, (Po2) must propose the class that will represent the measurand in the measurement result.

Thirdly in order to accurately represent the measurand the representative set must exhibit an equivalent relationship between its members as exists between the individual members of the set to which the measurand belongs. This is the third postulate, (Po3).

Fourthly, it is proposed that it is possible to represent each member of the measured class by a member in the reprehensive set, or more formally can be mapped onto a member of the representational set. This is the fourth proposition, (Po4).

Next it is proposed that from some range in the representational set each individual member of the measured class can only be mapped onto one specific member of the representational set, or formally the mapping from the measured class to the representational set is a homomorphism or surjective mapping, this is (Po5)[5].

Finally, it is proposed that the relationships between the members of the representational set exhibit the same relationships between themselves, (e.g. bigger than, smaller than etc.) that the members of the measured class exhibited. This is (Po6).

If all of the propositions are considered to be true then the conclusion (Co1) is that the triplet of the measured class, the representational set, and the mapping procedure between them constitute a scale of measurement for the measured class.

Therefore the procedures that can be considered to be measurements can be formally defined by the compound propositional based argument that:

- **If:**
  Po1: For a well-defined, non-empty class of extra-mathematical entities Q, there exists upon that class a set of empirical relationships
  R = {R1, R2,----,Rn,}.
- **And:**
  Po2: Further there is a set of numbers N (in general a subset of the set of real numbers Re),
- **And:**
  Po3 There is defined on that set, N, a set of numerical relationships P = { P1, P2,----, Pn, }.
- **And:**
  Po4: There exists a mapping M with domain Q
- **And:**
  Po5: There is a range in N, M: Q→N which is a homomorphism of the empirical relationship system <Q,R>
- **And**:
  Po6: There exists the numerical relationship <N,P>.
- **Then:**
  Co1: The triplet P =<Q,N,M> constitutes a scale of measurement of Q.

It is required that M be a well-defined operational procedure, which is usually referred to as the fundamental measurement procedure of Q. If n is a member of the representational set, (i.e. n ∈ N), and thus the image of q, a member of the measured lass (i.e. q∈ Q), then under the mapping procedure M this will be denoted by n = M(q), therefore n will be called the measure of q on the scale P, with q the measurand, and Q the measured class.

There will in general be other procedures of mapping Q onto N denoted by M' : Q → N such that M(qi) = M'(qi) either for all q ∈ Q or q ∈ Q' where Q' ⊂ Q any such procedure is a measurement procedure Q or Q' on the scale P. Confirming that there will in practice be more than one way to establish the measure of an element q in Q.

This formal argument is probably best illustrated by the figure1 below.

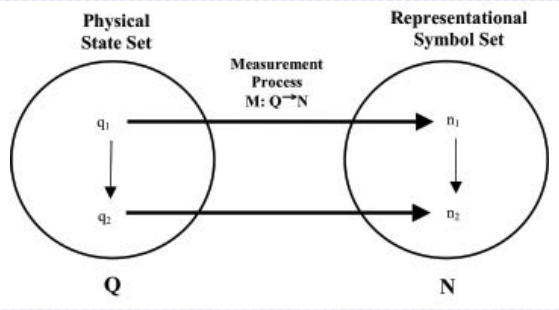

Figure 1: The action of a measurement process

Where, it can be seen that some physical system has a set of values, a state set, that represent the state of the system in terms of some variable, e.g. mass. Two of the possible values of mass are highlighted, these being q1 and q2. These values of the variable can be mapped via the measurement process M to two members of the set that constitutes the representational symbol set, n1 and n2.

This formal definition of measurement often demands that R, a binary relationship of the form greater than or equal to, (→) between members of the physical state set exists, and thus if the mapping M is a homomorphism, as described above, that binary relationship will exist between the elements of the representational set N. e.g. if q2 is a state where the mass is twice that in the state q1 then n2 will be a number twice the size of n1. As will be examined in part two of this article this is an example of measurement at a ratio or rational level.

It should be noted that prior to the advances in physics that produced Quantum theory in the early part of the 20th century, theoretically the mapping M could be consider to be an isomorphism or bijective mapping[6] where the continuously variable physical state could be represented by any real number in the set N. However, in practice any actual measurement system will have a limit of resolution whereby closely adjacent members of Q would be mapped to the same member of N if the variation in representative value defined by the binary relationship is smaller than the resolution of the measurement system.

The revolution in the physical sciences engendered by quantum theory means that in fact physical state sets can only take on a limited number of quantised states. However, except in areas where the interactions of individual particles are of interest, almost invariably the resolution of the measurement systems is such that the assumptions inherent in classical physics with regard to continuity and the possible description of dynamic variables remain empirically valid[7].

Measurement as process

From the definition given for a measurement process and from the clear existence of a mapping from one set to another it is clear that the physical state set can be considered to be the domain of a function and the representational set as the co domain of the same function[8]. Thus, any measurement process can be thought of as a function with a scale mapping relating the element of the domain to the co domain or range. Figure 2 illustrates this in the form of a process diagram showing the input to be derived from the domain, the physical state set, the measurement process to be the mapping and the co domain or output the representative state set.

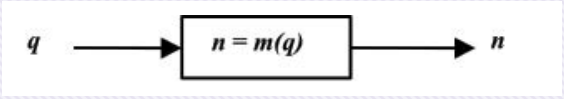

Figure 2: Process diagram showing action of measurement to map measurand, q, onto a member of the representational set, n.

In reality the measurement process will not be perfect, errors, e_q , will be introduced into the process and figure 3 attempts to illustrate where in the process these a errors arise.

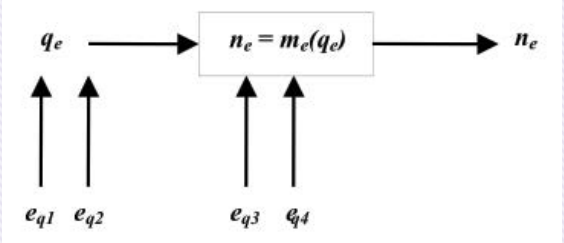

Figure 3: Error sources in the generic measurement process

Firstly errors sources *eq1* and *eq2* imply that errors can be introduced into the system in the input and that the system will not in fact be making a measurement of the variable in the state that it is assumed: e.g. if a measurement is made of the maximum flux density that a lighting fixture can generate for a given input current and applied voltage this measurement would need to be made in an environment where all other possible sources of light pollution were totally excluded. If not the mapping would map the physical state set to a representation that include the effects of the light source plus the additional light pollution within the test environment.

Secondly, as per *eq3* and *eq4*, the measurement process is required to map the physical state set with absolute fidelity onto the representational set if the measurement process is to be completely accurate: e.g. unlimited dynamic range and perfect linearity are two requirements of any measurement system that could actually perform such a mapping.

Therefore, for any practically realisable measurement system where these perfect requirements cannot be meet the level of fidelity will represent a limit to the accuracy of the measurement process.

Both of these types of error sources may be systematic so called type A errors or random type B errors[9]. Type A errors can often be eliminated as a result of their systematic characteristics or accounted for as limits of fluctuation that can be treated as type B error sources. This means that taking account of the random nature of these type B error sources the mapping in any measurement process takes the form of an assignment relation.

This means that q will not be specifically mapped to a single member of the representational set n; it will be mapped to a distribution of members of the representational set with an associated probability of it being mapped to each of those individual members. e.g. if a measurement of a given temperature is made with a thermometer that has a resolution of 0.1 K^0 but the error sources in the measurement procedure are of the order of 0.3 K^0 then if the measurement result was 22.3 K^0 this means that the actual temperature could fall between 22.6 K^0 and 22.0 K^0. This in turn means that the temperature has been mapped to a distribution of representative numbers, these being (22.0, 22.1, 22.2, 22.3, 22.4, 22.5, 22.6). The actual value could be any of these numbers and statistical methods that treat the distribution of possible values as the mapping of a random variable would need to be employed to decide what was the probability for each value being the true measure and what the most likely true value was[10].

Thus, formally as opposed to the expression $q => n$, where $n \in N$, that would be expected in a traditional functional relationship where q, any member of the measured class, is mapped to a specific value n in the representational set via the measurement process.

Now formally:

$$q \Rightarrow \{n, p_q(n)\}$$

Where q is mapped onto a distribution of values of *n* with a given probability $P_q(n)$

This illustrates that, for all theoretical and practical measurement systems, measures are in fact probabilities calculated from mappings of random variables onto a distribution which defines a probability density. Figure 4 below attempts to illustrate this in terms of a process diagram.

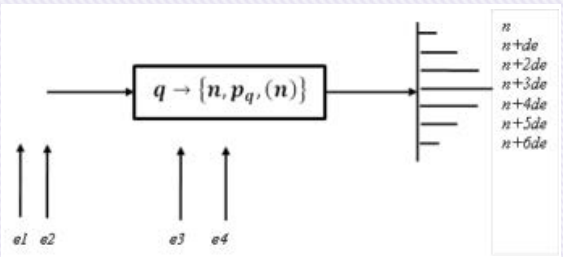

Figure 4: Measurement process as a mapping onto a distribution

In this figure the error sources that corrode the integrity of the input and corrupt the fidelity of the mapping mean that the assignment relation maps the input to the distribution of possible values, in this figure *n* to *n + 6de*. Where based on statistical concepts, one value, in this case *n + 3de*, is the maximum likelihood value and a confidence interval based on the shape of the distribution can be calculated at a given level of significance[11].
Note: *de* is the resolution of the system and thus the distribution as illustrated is discrete.

Summary

From the discussion above it is clear that it is possible to formally define what it is that constitutes a measurement process. How it is that the value of some specific extra-mathematical entity, which need not be a physical quantity, (e.g. IQ) can be transposed into a formal mathematical structure where a representative value can be assigned to an aspect of the entity under consideration. Additionally this formal process can be extended to mirror the actual limitations that would be inherent in a measurement process so that a practically achievable measurement process can be defined that will produce formal measurement results.

Having defined by intention what such a process is and how its output is structured, it may be well to pause and ask what is the purpose of formalising this measurement process. It is only in the formalisation of the output of the measurement process that the possibility of analysing this output can be achieved. Raw data inevitably has little meaning or context. It is only by the use for formal mathematical analytical techniques that the meaning and content, from which conclusions can be drawn and can be extracted from measurement data.

The nature of the structured formal output from any measurement process is inherently based on the nature of this measurement process itself and therefore the types of analysis that are appropriate for any measurement data set is fundamentally dependant on the formal structure of the measurement process itself so a thorough understanding of this process at a formal level is necessary to decide on the correct type of results analysis to adopt.

So far this examination of the measurement process has not delved into the concept of the 'level of measurement' and how this concept can be used to extend the theory of representational measurement to cover measurement processes that do not follow the conventional formal structure. In part two of this examination the nature of this concept of measurement level will be examined to show how it can be used to define other formal levels of measurement which produce output measurement results with a formal structure that allows the use of wider varieties of analysis than conventional numerical output.

Author

Dr John McCormick is a Fellow of the Institute of Science & Technology, as well as a Fellow of the Institution of Engineering Technology and a Fellow of the Institute of Physics. In a career that has ranged from assistant chemistry technician in a teaching laboratory to Lead Antenna Engineer in a major multi-national engineering manufacturer he has published extensively in peer reviewed journals and presented papers at a range of scientific and engineering conferences. Additionally he has co-authored a range of text books devoted to measurement techniques with an emphasis on free space electromagnetic metrology. Currently his research interests revolve around air and space borne remote sensor design, implementation and test.

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Fabrication and characterisation of cerium dioxide structures

Charles Osarinmwian

Researchers in Manchester have fabricated CeO_2 superstructures by a condensed-phase method and characterised porous CeO_2 pellets.

Introduction

Materials based on CeO_2 are used in the production and purification of hydrogen, and in various catalytic applications (e.g. automotive catalytic converters). The characterisation of oxygen vacancies on CeO_2 has improved understanding of the fundamental features of surface reactivity as well as the design of efficient supported catalysts[1]. Advances in surface reactivity could help understand the reduction of CeO_2 to $CeO_{1.940}$ in air plasma[2]. In nuclear fuel research, a corrosion test on fine CeO_2 powder in an alkali melt at 1050°C for 40h led to the statement that CeO_2 was inert in the melt[3]. This is important because the fabrication and characterization of CeO_2 and other surrogate oxide pellets plays a role in TRISO fuel development[4]. In this work, a condensed-phase method for fabricating CeO_2 superstructures by heating in LiCl-KCl eutectic melt and the physical characterisation of CeO_2 pellets are reported.

Experimental

CeO_2 superstructures were synthesized by a condensed-phase method that involved mixing CeO_2 powder with LiCl and KCl powders. A eutectic composition for LiCl and KCl was obtained by mixing 8.84g LiCl powder with 11.16g KCl powder[5]. The mixture was heated in air at 350°C for 4h and 500°C for 2h in an alumina crucible, and then rapidly quenched in air before grinding into powder. CeO_2 powder was mixed with the LiCl-KCl eutectic powder and then heated in air at 1050°C for 40h in an alumina crucible. At 40h the sample was quenched in air, immersed in de-ionized water and then filtered to recover the solid residue. The dried residue was characterised by a scanning electron microscope equipped with an energy-dispersive X-ray spectrometer, X-ray diffractometer, and Raman Spectrometer with a coherent 500mW laser.

Figure 1: PASCAL 140 Mercury porosimeter

The pore size distribution in CeO_2 pellets (pressed and sintered from CeO_2 powder) was determined from mercury porosimetry (Fig 1). The CD3P dilatometer system comprised two glass parts joined through a rectified conical joint: the dilatometer stem and 15cm^3 dilatometer bulb. The cone of the dilatometer stem was lubricated with silicone grease because of measurement below atmospheric pressure. Air around the ~ 3g CeO_2 sample was evacuated from the dilatometer bulb using a vacuum pump at 0.1kPa. Mercury passed down the 3mm capillary of the dilatometer stem to fill 450-500mm^3 of mercury in the dilatometer bulb. The mercury then intruded into pellet pores from 0.1 to 400kPa, which was lowered to 100kPa during mercury extrusion out of the pores. The pore size distribution was determined from the volume of mercury intruded at each pressure increment using the Washburn equation.

Results

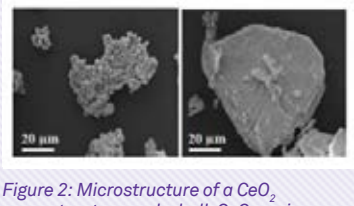

Figure 2: Microstructure of a CeO_2 superstructure and a bulk CeO_2 grain.

Removal of moisture from pendular liquid bridges between CeO_2 nanoparticles (Fig. 2) forms a superstructure consisting mainly of solid bridges after the LiCl-KCl eutectic melt (melting point: 352°C) was fully vaporized. In general, the bond strength due to the presence of a pendular bridge arose from the pressure drop over a particle

surface produced by the curvature of the liquid meniscus as well as the interfacial tension exerted by the liquid along the wetted perimeter[6]. Related work, using a NaCl-KCl eutectic melt, fabricated metal-nanoparticle superstructures by the self-assembly of liquid metal and nanoparticles by pendular bridges[7].

The underlying mechanism of this self-assembly was unraveled by analysis of the Gibbs free energy. These findings have application in solid state phase transitions[8,9].

The CeO_2 superstructures display the same crystal lattice planes as bulk CeO_2 grains. The Raman peak positioned at 465.7cm^{-1} (Fig. 3) corresponds to the triply degenerate F_{2g} mode for a cubic fluorite crystal consisting of three fcc sub lattices, one of Ce^{4+} ions and two of non-equivalent O^{2-} ions, where the O^{2-} ions vibrate symmetrically around the central Ce^{4+} ion. Bragg peaks with Miller indices (111), (200), (220), (311) and (222) in room temperature XRD spectra support observations of the CeO_2 lattice[10]. On the thermodynamically most stable (111) surface linear clusters of oxygen vacancies may form and strongly bind adsorbates[2] which contribute to pendular bridges during agglomeration in the melt (Fig. 1). However, more detailed work may be required to detect the change in stoichiometry between CeO_2 and $CeO_{1.940}$ as they share the same fluorite structure without significant alteration in lattice parameter[2].

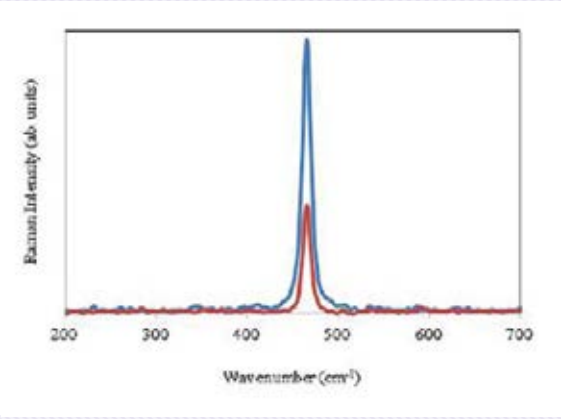

Figure 3: Raman spectra of cerium dioxide (Blue: Bulk CeO_2; Red: CeO_2 superstructure).

The peaks in Figure 4 show that significantly more mercury intruded into CeO_2(2) pores in the pore size range 1-10 µm because pore forming agents generated high porosities during the sintering process. More mercury intrudes into CeO_2(3) compared to CeO_2(1) because larger particles in CeO_2(3) form a higher porosity. Mercury intrusion within a relatively low pore size range (1-10 µm) indicates that the shape of internal pores were irregular.

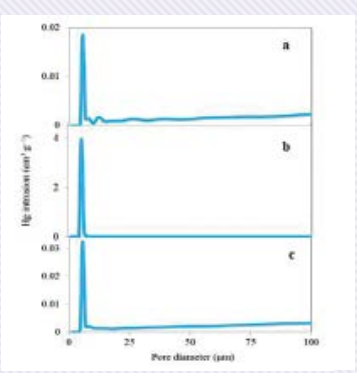

Figure 4: Pore size distribution of cerium dioxide pellets (a, CeO_2(1) Particle size = 45 mm and Porosity = 64.4 %; b, CeO_2(2) Pore forming agents and Porosity = 70.2 %; c, CeO_2(3) Particle size = 106 mm and Porosity = 65.0 %).

This observation is common in mercury porosimetry because of hysteresis between mercury intrusion and extrusion[11]. Hysteresis originates from a combination of contact angle hysteresis, pore connectivity, and ink bottle-shaped pores.

Conclusions

The formation of a CeO_2 superstructure by the condensed-phase method used here could provide a simple method for controlling the production of self-assembled nanoparticle superstructures. Also, the characterization of CeO_2 pellets revealed that pore forming agents maximize porosity and pore size.

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National Laboratory Service

James Trout

The National Laboratory Service is part of the Environment Agency and provides analytical data in a range of different environmental matrices. The Agency uses this data as evidence to make informed environmental decisions that benefit the environment and all those that use it.

The NLS consists of four laboratories with different analytical specialisms. The Starcross laboratory focuses on clean environmental waters, effluents and microbiology. The Nottingham laboratory focuses on dirtier, more complex environmental matrices and forensic waste analysis. Our Leeds laboratory deals with contaminated land, marine sediments and biota and our Caversham site are the experts in instrumentation and in situ monitoring.

The NLS is a very technical business and relies on the expertise of its people. The science underpinning our business needs to respond to the increasing challenge of new directives and emerging pollutants that require novel methodologies to reach lower levels of detection.

The NLS also sells its spare capacity to commercial customers and returns that money to the Environment Agency to allow them to do more for people and the environment.

To ensure our future success the NLS management teams are committed to improving our development framework and looking for new and interesting ways to motivate and develop our people.

To help us on this road I contacted the IST after reading a copy of the journal that a long standing IST member (Philip Hyde) had put on my desk. Phil had always talked very positively about the organization and believed it could be a real benefit for our organizations to work together in the future.

At the same time we started looking at the Science Council's new professional registrations for scientists. Becoming a member of a professional body and working towards becoming a registered professional has long been a core part of many professional development pathways and after looking into the benefits this looked like a great opportunity.

We have recently launched the partnership with the IST and the Science Council at Starcross and will be launching the partnership at the other sites over the next few months. Terry Croft has kindly agreed to attend the launches to talk to staff about the IST and how professional registration is becoming a prerequisite in the science sector. The Science Council also kindly sent along representatives to discuss the different levels of registration available.

(from left to right) Malcolm Lythgo, Deputy Director Monitoring Services; Amy Reed, Science Council; Terry Croft, IST; James Trout, Starcross Laboratory Manager; Jackie Tucker, Microbiology Team Leader; Simon Padley, NLS General Manager

We are looking forward to developing this partnership further and getting involved in the IST networks. I really hope to be able to use the amazing knowledge within the IST and its membership, to enable us to be more successful and to help our people develop. In return we are happy to work with others to share what we do in a high performing environmental laboratory.

James Trout MiST MCMI
Laboratory Manager
Environment Agency
National Laboratory Service

Why I am proud to be a Registered Scientist with the IST

Jackie Tucker

When I was asked to be the National Laboratory Service (NLS) lead for the registration of our analysts with the IST I was pleased, excited and a bit overwhelmed. When it was suggested that I should go through the registration process myself I thought, "Ok, put your money where your mouth is, set an example".

This was going to be easy, there is a structured application form and all I had to do was come up with appropriate examples for each criteria - simple. So I got the train to Nottingham NLS laboratory and joined in with James and Linda, the site leads for Nottingham and Leeds NLS laboratories, and went through the application form in a workshop. The hardest part was trying to think of examples to show what I did in my job. Because it's the day to day routine you don't think its worthy of scrutiny, and being reflective about your skills and knowledge is really hard.

It's not easy to remember how you got to know all the bits of information you use to make decisions, analyse samples and interpret results. Problems arise almost daily and you deal with them, on your own or as part of your team. Not only do I take for granted my own expertise but also that of my team. I know who to talk to if I think we have a quality issue, or want to know if we have enough resources to do the unexpected 20 or 30 samples that have just turned up.

Every year we go through our accreditation visit and we acknowledge that without this we would not have the confidence of our customers. Having gone through the IST registration process, I am aware that professional registration with a recognised professional body such as the IST will also be a bench mark for our customers. Our product is quality tested and so are our analytical teams.

This award is for the work I do now not the academic qualifications I have, which by the way, does not include a BSc. I returned to full time work twelve years ago having had time out for a busy family.

I went to university as a mature student and returned to laboratory work when the teaching career I thought I was heading for, just didn't take off. It's never too late to reflect on your skills and capabilities, and continuing with my professional development (CPD) will ensure that I stay motivated and up to date with the science we do in the laboratories and the issues that the wider Environment Agency community is involved in.

Jackie Tucker
Team Leader Microbiology
NLS Starcross Laboratory

Terry Croft, IST Chairman, presents Jackie with her RSci award at the National Laboratory Service

TechNet: Networking for technicians, by technicians

Natalie Kennerley & Melanie Hannah

Have you ever had a scenario as a technician where you have spent many hours researching a particular project, item of equipment, or protocol, only to discover 6 months down the line that one of your colleagues in a different department or faculty is an expert on the subject? Or even that there is in fact a whole division of another department that specialises in that particular field?

Frustrating isn't it!

We are two colleagues at the University of Sheffield who were similarly frustrated; but decided to get together and pro-actively do something about it. We are Natalie Kennerley and Melanie Hannah, both technical managers from the Faculty of Science (FoS) at the University of Sheffield and have created TechNet; a networking group which raises the profile of the technical community within the FoS and at the same time increases the visibility of the technician as a highly skilled individual.

It had been evident for some time that technicians are often seen as an invisible workforce; overshadowed by professional doctors, scientists and engineers. A university's primary aim is to succeed as a research and teaching institution, but the recognition for technical contribution is not always there. To quote, Martin Luther King Jnr, "the whole structure is inter-related and without one all others fail". Every technician is a vital cog in this wheel.

As such the 21st century technician has become a collaborator of cutting edge research, often resulting in co-author and first author publications in high impact scientific journals. More than 50% of UK technicians have a degree and a significant number have an MSc or PhD. They are experts in their own right, often presenting their research at national and international conferences. Long gone are the days of the stereotypical technician in a lab coat who does all the boring mundane jobs.

Our thoughts united at the FoS professional staff development day held in November 2013. We had been heavily involved in the design and planning of the event.

Some of the overriding issues to come out of the day reinforced their beliefs that due to lack of recognition, technicians were becoming isolated and sceptical. A significant proportion weren't aware of what their colleagues in other departments were doing. This is partly due to increasing workloads and responsibilities, not permitting the technician time to explore what is available University wide. In some cases technicians are tasked with concentrating on their academic's particular project only and therefore don't appreciate what's going on in other departments or faculties. Technicians can sometimes feel removed from the wider context of what a University is all about; fundamentally this is about creating a great student experience. Every single one of us has a role to play within this, right up to the VC. Unfortunately it's also a sad fact of today that some academics still view technicians as second class citizens. This prompted us to do something about it.

We wanted to change this and create a network which would be the technician's voice; their opportunity to be seen and heard; so we created TechNet.

So, why did we choose the medium of a network to fuel our idea?

It seems we're all part of a network nowadays, Facebook, Google+, Twitter, LinkedIn, Instagram – whether it be a means to broadcast to the world what you had for tea the night before, meet the future Mr or Mrs Right, or more seriously a tool for sharing data, exchanging information and developing professional or social contacts. From dyadic networks to complex adaptive systems, there's no getting away from it, communication technology has enabled networks to form into bigger global "events" with instant influence.

So, why use this form of communication medium? Simple, networking makes it possible to connect people who share interests and activities across many boundaries and more importantly geographical borders. Networking can be a powerful tool in which to build brand image, create brand awareness, to learn about new technologies and our competitors.

Networking increases organisational learning in ways that would not be possible within a self-contained hierarchical organisation. Networking allows scientific groups to expand their knowledge base and share ideas, and without utilising technology to allow faster networking, communicating theories can become stagnant, isolated and lost. Networks are a fantastic way to maintain and develop professional relationships, creating a strengthening of social ties and professional contacts. Networks also allow us to keep in touch with colleagues outside of our own locality and eavesdrop what their contacts are doing. Networks can be a means to keep updated on activities with colleagues in order to establish collaborations on common fields of interest and knowledge sharing. Important aspects of networks for professional purposes are their potential for dissemination of information and the ability to reach and multiply professional contacts exponentially. Networking groups enhance the possibility to join professional groups and pages, to share knowledge, publicise events, to discuss issues and create debates.

We wanted our network to be available to the unsung heroes of academia – the technicians. We therefore started the creation of TechNet. However, we had to be cautious.... there is such a thing as the reverse network effect. Some networks can actually begin to lose value as they grow because they get too big. There are two main ideas for why this might be, firstly connection theory. Connection theory is when new users join the network and lower the value for existing users, which is the total opposite of what a network is trying to achieve. The second idea is around content, each new user represents a new content poster, and this can be a double edged sword and can in fact turn against itself when it comes to keeping content from a large group of users under control. In appreciating these possible problems we worked hard to address such issues to maintain the success of the network.

How it all began in November 2013

Having researched what was going on at Sheffield we discovered there were already quite a few networks for some staff (Parents@TUoS, Women's Network, Administrators Forum), some more visible than others, but none that really encompassed the technical community as a whole.

We decided to put together a technical networking event badged under the name of "TechNet". The aim being to get technicians together and talking to each other, presenting their work to one another, sharing good practice and breaking down some of the invisible walls.

First things first - our mission statement

In order to be taken seriously by the University of Sheffield, Natalie and Melanie realised that they needed to have a vision; they set about writing a mission statement.

"TechNet provides an event for all technicians to meet and interact with the aim of sharing knowledge and best practice; to promote the professional status of technical staff and improve recognition for their contribution. TechNet is a non-political, not for profit, informal group. Membership is voluntary and is open to all higher education personnel at UoS. Events are held on a quarterly basis at varying locations and times on campus. TechNet seeks to encourage further collaborations, and stronger links between technical staff across disciplines. To allow networking and sharing of good practice outside scheduled meetings a website **(www.technicians-network.net)** has been made available for individuals to subscribe to".

The "event"

The format of the first event was adapted from existing successful groups, with the aim of providing the technicians at the University of Sheffield with a highly collaborative, participatory network that reflected their needs. Ultimately helping to professionalise and promote technical careers as the fantastic career pathway that we all know they are. This is further supported by the Institute of Science & Technology (IST) who work closely with the University of Sheffield (UoS) and the Higher Education Funding Council for England (HEFCE) Catalyst project which has been awarded to UoS to pioneer career pathways for technicians. **(http://www.sheffield.ac.uk/news/nr/technician-career-funding-1.370405)**

TechNet – "who are we?"

The first TechNet event was held in March 2014, funded by the IST and open to all within the University of Sheffield.

Making full use of the technology available in the meetings spaces, we gave an overview of what we were hoping to provide with the network, and used Turning Point Technology to poll the attendees about topics that they would like to see covered at future meetings. Turning Point Technology is a system which captures polling responses to pre-set questions, one of the reasons for using Turning Point was to demonstrate the versatility of this tool which some may not have come across before. The topics were informed by expression of interest forms that we had sent out to selected colleagues in advance, and they varied from specific training course information, to information about job shadowing and secondment opportunities. Participants could rate their level of interest from "I am an expert in this area" through "this would be useful to me now" to "this has no relevance to me". This initial event was evaluated by feedback questionnaire to seek participant views and ideas for future improvement by us.

This initial event was incredibly successful and generated interest from over 100 attendees from across faculties. The success of the event was measured by actions of those who participated. Following on from the event, we have been informed of exchange visits, work shadowing, equipment sharing, information sharing, support offered to others in the form of mentoring. This is the first time that a networking event has brought together technical staff from departments across all faculties into one place to share thoughts and ideas. This has never been achieved before in this aspect of professional staffing at UoS and something that we are extremely proud of.

The TechNet website was launched at this event, but due to spammers had to be fairly promptly disabled. Although this was a major setback for this fledgling network, using contacts they met through TechNet, we were able to call on experts in information technology to help address problems with the website.

Furthermore TechNet has opened up new avenues for website training and several persons, including Melanie, are currently working on reinstating the new site which will be operational again in early 2015. TechNet is supported by UoS which allows expertise within the network to promote the events. This enables the network to be self-fulfilling, which is a very good thing!

To diversify the network for future events we decided to form a dedicated steering group made up of 14 volunteers from the technical staff community, all of whom feel strongly about the positive contribution that technical staff make to the wider University community and are able to give advice and support. The steering group members have finalised the terms of reference for the network, providing a balanced view from all represented faculties. They contribute to the planning and resourcing of events, and gain some experience outside of their usual job roles as well. A Google Group and site are under development and we are working on how to develop this for the future.

This also gave us a group of individuals who could champion the network within each faculty. The steering group meet after each TechNet event to disseminate feedback and to also plan for the next event. A TechNet Executive group has also been formed to resolve any conflict or dispute the steering group may have in terms of planning for future events. As with any group conflict does occurs, but we would like to think that this is a positive action and means that all members are required to listen to the view and opinions of others, in fact a positive learning experience. The steering group need a majority vote to take ideas forward to the Executive group who make the final decision. The Executive group consists of 5 members from 3 faculties.

TechNet – "spotlight on career development"

Our 2nd event was held in July 2014 to coincide with the annual staff review and development process, this TechNet event aimed to provide signposts to career development resources from both within the University and beyond. Using the same format of invited speakers, and table discussions on themes, as well as novel team building exercises, like how to land on the moon! As none of the technicians had tried to land on the moon before it was a way to demonstrate how a technician has transferable skills, this exercise was well received and enjoyed by all! Michelle Jackson, IST Registrar introduced the IST's newly awarded licence status for professional registration, Chartered Scientist. We had talks from in house staff development, the UoS mentoring scheme and the Higher Education and Technicians Educational Development (HEaTED) regional coordinator.

Having a resource bank in the form of a dedicated UoS technicians web pages and the TechNet website to go back to after the event was very useful as there was a lot of content, and this was reflected in feedback. Again this event was well attended with over 80 participants present.

TechNet – "technician's showcase"

With over 60% of those polled at the original meeting feeling that networking with other universities was important, we invited Kelly Vere (Technical Manager at the University of Nottingham) to speak at our 3rd meeting. Kelly has written several articles highlighting the University Technician and the University of Nottingham won an S lab award in 2014 in the "Making a Difference" category for the creation of a technician's network, so we were very pleased when she accepted. We also invited technicians from a wide range of backgrounds to talk about their roles, as a showcase of expertise. It was again a very well attended event, with little time for questions or comment, which led to Kelly kindly returning on two separate occasions for follow up Q & A sessions with those interested. The discussions at these events ranged from personal development opportunities, the accreditation of technical teaching and international technicians.

TechNet – "who do you think we are?"

Our next event will take place in February 2015 and will be another informal and interactive networking event. We hope to encourage the technical staff at Sheffield to interact with each other, and to make as many new contacts as possible. As previously discussed there is strong evidence to support the fact that this is a worthwhile pursuit.

The ultimate aim of this session will be to arrange an exchange visit with a previously unknown colleague. This is important as it allows greater understanding of how we all work together as an organisation and how we are all working to achieve the same goal, i.e. high quality research output as well as a great student experience.

Very often individuals can find that contacts with other technicians outside of the department, faculty or organisation can spark new ideas of interest or different ways of thinking. As a result of TechNet we have been able to use expertise from other areas for the benefit of the steering group in terms of website design, administration, and IT support. These individuals had previously not known each other or indeed didn't know each other existed. Allowing these individuals to come together has increased transparency across the organisation, and improved communication streams. It has highlighted gaps in relevant training, which, as a group we can highlight to senior management and work to bring about change.

Forging links with others and the future of TechNet

One of the key challenges for a networking group is keeping the participants engaged and is something that we focus hard on. Event promotion is carefully worded to entice participants in and keep momentum going. We also feel that it's crucial to really listen to what those coming to the events want to get out of the network, after all this is a network for technicians, by technicians. If we fail to take people's ideas and suggestions on board we will quickly lose their interest and engagement. Another way in which we try to keep a high level of engagement is to hold the events over the lunchtime period when some individuals feel more comfortable taking time out to attend. Of course food is also important, who wouldn't be tempted by a coffee, a sandwich and some cake!

The application for registration for each TechNet event is distributed through the university e-mail system and goes to all staff. This has really raised the profile of the network and of technicians, and has led to some interesting and productive outcomes. Some examples of these have been to highlight the need for more finance training for technicians, training on Google sites, and increased understanding of the annual staff appraisal process and promotion opportunities.

Research by the Technician Council found the UK must educate another 450,000 technicians across all sectors by 2020 to address a massive skills shortage. This is leading to more students becoming interested in technical careers. This is due to the changing attitude of higher education institutions and industry and increased recognition for the technician, which is promoted through TechNet and such organisations as the Science Council and the IST. Graduates are now beginning to see that a technical career is both rewarding and has the potential to be a well-paid job with opportunities to get into management.

TechNet has been invited to attend several careers fairs for STEM undergraduates from across the region of South Yorkshire. We were asked to present a session for the Faculty of Engineering (FoE) staff away day, and also invited to the HEaTED regional event in June 2014. The engineering event captured gaps in training that this group of individuals felt they needed. As a result we were able to go back to the FoE and inform them of this so that they could target their staff training programmes.

We aim be a conduit for sharing information about local training opportunities, conferences and other relevant events. Together with other members of the TechNet steering and Executive group we are also actively involved in the promotion of professional registration via the Science Council and IST.
This has had a positive effect in recruiting interest from other Universities, these being the University of Leeds, the University of Nottingham, and the University of Newcastle.

Natalie & Melanie

Again, our involvement highlighted the role of the 21st century technician and the key role that technicians play is a vital element in the student experience. More and more grant awarding bodies are beginning to require that named technical staff have professional registration. More HE jobs are beginning to also list this as essential or desirable criteria. Locally the staff development unit and HR have been in touch to offer support in a two way process. We can advise on areas of developmental need as identified by technical staff, and also we can contribute to future technical training offered by the staff development unit.

The future of TechNet is based on the participation of the technicians. As has been stated previously, all the organisers, executive and steering group members are volunteers and technicians (or have been technicians), who recognise the value of working across boundaries and who are passionate about being technicians. The future plans of the network will revolve around the input from them and the participants and what they perceive to be important and relevant issues.

Future plans include stronger links with the undergraduates, with the possibility of work experience programs, and working with the careers service to further promote professional technical careers as a career choice at graduation. We are interested in growing specialist user groups, or special interest groups that would link across faculties.

We would also like to develop more networking opportunities with other universities and organisations and are currently working hard to achieve this. If you would like to become involved please contact us.

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Overall we would like to build on the success of TechNet and continue to provide the world class teaching and research by being a world class technical team across the whole University.

Technically the future is bright!

Heliciculture: purpose and economic perspectives in the European community

Raffaele Conte

Abstract

Heliciculture is an agricultural activity currently experiencing a renewed interest as a profitable practice in the European area. This work aims to briefly describe the characteristics, the uses and the breeding of the principal edible snails with a focus on the economic perspectives related with the "snail farming."

Introduction

Heliciculture, or snail farming is the process of raising land slugs for human consumption and for the extraction of slime to produce cosmetics, drugs or biomaterials.

Snails have been farmed since prehistory. The Greeks, Phoenicians, and other pre-roman Mediterranean cultures ate land snails, a practice conserved until today in the Mediterranean cuisine (Duhart, 2009). Snail preserves were established in Rome in 50 B.C. as shown by the abundance of shells that were found in many archeological sites (Lubell, 2004) and, during the expansion of the Roman Empire, the uses of snails were extended to its boundaries as evidenced by the case of the "Wall Fish" eaten in Britain.

Snail consumption was reported also during the Middle Ages, for example in convents their meat was allowed during the fast (Duhart, 2009). From the 19th Century, snails were introduced in America, Africa and some Asian countries.

Main species of snails

Snails are members of the phylum Mollusca which contains at least 80,000 species and is the second largest phylum in the animal kingdom. Members of this group are found throughout the world. They are predominantly aquatic, but some are terrestrial. All farmed snails are members of the class Gastropoda and are land snails. Of the snail species that live in the wild in Europe, about a dozen are edible and only four to five are commercialised. Of those, *Helix aspersa* covers 40% of the market, *Helix pomatia (L.)* 28%, *Helix lucorum (L.)* 22%, *Eobania vermiculata* (Miiller) 8.5% and the rest 1.5%. From the above species, heliciculture is possible and economically profitable only with *H. aspersa* (Elmslie, 1989). Physical features of these species are expressed by variations in size, colour, and banding of the shell.

Helix aspersa

Helix aspersa, also known as *Cornu aspersum,* is native to the Mediterranean area. This gastropod is considered a pest in gardens and in agriculture, especially in regions where it has been introduced accidentally. Phenotypically, adult exemplars have a hard shell of 25–40 mm in diameter and 25–35 mm high, with four or five whorls. The shell is brownish. (Heller J.,2001).

Helix Pomatia

Helix pomatia is also known as escargot. This specie is highly prized as a food but, despite this, it is rarely farmed commercially due to the difficult cultivation. For another, *Helix pomatia* is threatened by continuous habitat destructions and it is registered in the "IUCN Red List" and in the "European Red List of Non-marine Molluscs as Least Concern" (Cuttelod A. et al., 2011) Visually, the shell is white-brownish and has five to six whorls. The width of the shell is 30–50 mm and the height is 30–45 mm (Heller J,2001).

Helix lucorum

This mollusk is also known as Turkish Snail.
The phenotype presents a white shell but almost entirely covered with broad brown bands. There are 4-5 slightly convex and rapidly increasing whorls (Heller J,2001).

Eobania vermiculata

Eobania vermiculata or *Helix vermiculata* belongs to the genus *Eobania*. It is also known as the "chocolate-band snail". This is because its shell presents a whitish background colour with darker coloured bands or spots. The shell has 4-4.5 whorls. It is 22–32 mm width and 14–24 mm height. (Heller J,2001).

Helix aspersa

Helix Pomatia

Helix lucorum

Eobania vermiculata

Fig.1 Snail species

Snail uses

Today, in Europe, the annual consumption of snails exceeds 100,000 tones and their demand is satisfied only for 60-70%. These molluscs are consumed in many countries of the old continent but mainly in France (~40000 tonnes/year) and Italy (~6000 tonnes/year) (Elmslie, 1989). Snail meat is very low in fat (0.5 to 0.8%) and relatively low in calories (60-80 cal/100 g), but has a biological high value of protein (12-16%) minerals (1.5%) and nitrogen (2.5%) (Virgiliu Morei,2012).

French cooked snails

These Gastropoda were valued over time not only for their taste and nutritional properties but also for numerous therapeutic or biological properties (Bonnemain, 2005).
In antiquity Pliny thought that snails increased the speed of delivery of active substances and recommended their use to treat pain related to burns and abscesses. Today, various slime based preparations are used for different purposes such as dermatological disorders and symptoms associated with tuberculosis and nephritis. Further, helicidine, a bronchorelaxant drug (Pons et al, 1999) and HPA lectine, a marker in several types of cancer (Thies et al, 2001), were obtained from the mucus and from the meat of the snails. For another, snail slime is currently used in human cosmetics, by companies such as "Biocutis", "Misshaus" and "Alternative Secrets" due to the fact that this secretion is rich in proteins of high and low molecular weight, hyaluronic acid and antioxidants.

The qualitative-quantitative chemical analysis revealed the presence in this mucus of allantoin (0.3 - 0.5%), collagen (0.1 - 0.3%), glycolic acid (0,05 - 0.1%), lactic acid (0,05 - 0.1%), anti-protease (1.3 - 1.8%), vitamins, trace minerals and a high content of glycine, hydroxyproline, proline and glutamic acid. (Giulia Penazzi, 2010). Thanks to these substances, snail slime has a double function when applied to human skin. Firstly, it stimulates the formation of collagen, elastin and dermal components that repair the signs of photoaging and, secondly, it minimizes the damage generated by free radicals that are responsible for premature skin aging. Further uses of snail slime are related with its physical characteristics; in fact this substance acts as both glue and a lubricant allowing the slugs to strongly adhere to the surfaces of walls and ceilings. Many researchers are working to improve the methodologies of extraction of this material and also aim to create synthetic slimes based on clay and polymers (Randy H. Ewoldt et al., 2007).

Snail farming and economic perspectives

The elevated consumption of snails caused an overexploitation that, added to the degradation of suitable habitats due to land use and pesticides, determined a decline of the natural populations in some countries from Western Europe. Then, the development of heliciculture is a real possibility of investment, mainly in countries of Eastern Europe. The farming of edible snails has evolved in the last decade when many agricultural producers were attracted by the idea of getting almost immediate benefit with little investment and not much technical effort. Generally, four methods of snail farming were developed: plastic tunnels, intensive breeding, extensive breeding, and mixed system. "Plastic Tunnels" are a simple system of protection of farmed snails from the environment and from predators.

This methodology of breeding is cheap, but many disadvantages are related with the fact that it is difficult to control the temperature in the tunnel. In the "intensive systems" the snails are housed in an insulated controlled environment. Lighting is regulated to prevent hibernation. The soil is treated in order to be moist, 10cm deep to facilitate egg laying and neutral to alkaline to provide the calcium carbonate required for the shells. "Extensive systems" are neutral or alkaline soils which are self-draining. The breeding site has a protection from the wind, a sprinkler system to keep the substrate moist and troughs made from wood or building blocks covered with plastic netting to hinder predators. The "mixed system" incorporates indoor breeding during the rest season (November to March) and outdoor fattening during the feeding season (April through October) (Roger Bryant, 1994).

The establishment of a snail farm does not represent a major investment and an amount of 10,000 Euro (7,900 GBP) is generally considered suitable for a 2,000 square metres farm. Snail farming can generate more income sources. The main earning potential is in the marketing of live snails. However, additional profit can be obtained from the sale of shells, snail eggs and slime. With the correct management of the business. The entrepreneur can achieve a valuable profit through assessing the different qualities of the snail species and the production differences to optimise the breeding technology for a Mediterranean climate, to avoid difficulties relating to harvesting in other continental areas.

Conclusion

At the present, heliciculture can experience a true development and a sustainable economic growth in the European context. On the other hand, the research on the new pharmacological and technological uses of the slime derivatives can act as an incentive to the diffusion of this farming on a large scale, choosing the appropriate technology in order to overcome the climatic limitations.

Author

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Images courtesy Wikipedia.com

Removing obstacles: Promoting effective learning

Kevin Fletcher

Introduction

In a previous article (Fletcher, 2014) I discussed the concept of ensuring we serve the needs of learners by first finding out about them. I then went on to consider learning processes in a nutshell (attention, information, processing and comparing to prior experience, conclusions and understanding, application and testing) before finally considering how the mental state of learners' "feelings" can affect the learning process.

This led me to think about discussing this aspect of the learning process further; and considering other "obstacles" to learning. This is the basis of the discussion which follows: a list of factors that might have a negative impact on how well our learners can learn followed by a short discussion about lessening, as far as practically possible, the impact of such obstacles.

Obstacles to learning

For me, possible "obstacles to learning" seem to exist in five main areas:

1. The Learning Environment.
2. Learner Background
3. Other Learners
4. The Teacher
5. Organisational Context

So it seems sensible to take each in turn and consider possible obstacles to learning within each.

1. The Learning Environment

In my previous article (Fletcher, 2014) I considered how learner feelings such as:

- Anger
- Anxiety
- Depression
- Embarrassment
- Fear
- Frustration
- Resentment

can affect the learning environment and that these need to be borne in mind when teaching.

What I neglected to consider in much detail was the physical environment of the "classroom" itself. Factors such as:

- Noise
- Classroom size, layout, temperature and light levels
- Distractions
- Class size and furniture
- Room suitability for purpose
- Adequate resources

All of which can act against effective learning taking place. As well as learner state of mind, these too need to be considered by the teacher as part of lesson planning in advance of delivery.

Some of these factors can be remedied quite simply with good planning and simple action such as moving furniture or altering room layout. Others may require a little more liaison to relocate to other classrooms or ensure they are allocated appropriately, or set out in readiness for the intended subject or lesson.

2. Learner background

As well as the state of mind of our learners (their "feelings") at the time of the lesson, their backgrounds, histories and experiences all play a part in affecting learning. Some may be present obstacles to it:

- Fear of failure
- Time (weeks/months/years) since last involvement with learning
- Social background/culture/language
- Disability/Learning Difficulty
- Attitudes/Motivation/ Beliefs
- Academic ability (literacy/numeracy/ICT skills)
- Prior knowledge
- Learning preferences

It can be difficult, if not impossible to reduce obstacles such as these as there isn't much one can do to change a person's history or experience. A teacher has to take a learner from where they are to where they need to be. The negative effects of obstacles such as these mentioned can be lessened to some degree, however, by initial assessment. That is, finding out about learners and their preferences/knowledge/background and hopes/fears by asking them and understanding them. This can be achieved by finding out about them through activities such as ice-breakers or an open class discussion (or individual essay/questionnaire) about hopes and fears or thoughts. Teachers can create instruments such as questionnaires with these goals in mind, or use can be made of existing questionnaires or it could be the ideal role for pastoral/tutorial sessions that have a welfare focus. The key point is that we know about our learners by gathering information about them, so that we can lessen the effects of any obstacles by tailoring our teaching with this knowledge in mind.

3. Other learners

Very often, obstacles to learning come not from within individuals but from those who surround them:

- Personality conflicts
- Different learning styles
- Ability range/age range in a group
- Distractions/poor behaviour
- Cliques within groups/loners/outsiders

All of these can affect the learning environment and become barriers to individuals achieving their potential.

Good classroom management, clear lesson planning, room layout, organising/mixing groups for specific activities, directing questions at particular individuals and using a variety of learning aids and resources might lessen the detrimental effects that other learners may have on the learning process. The key is to ensure that we are aware of these possible barriers and take some action to lessen their effects.

4. The teacher

One of the most difficult aspects to consider is that it is the teacher who is the barrier to learning. If this is the case, then the following factors may be in play (and all of them can be an obstacle to learning):

- Teaching at the wrong ability level
- Poor teaching/classroom management skills
- Inadequate subject knowledge
- Poor communication/listening/speaking skills
- Inadequate use (or knowledge of use of) resources
- Teaching style/mannerisms
- Being "boring", no variety of pace/style
- Low credibility/unapproachable
- Having favourites

These possible obstacles can be no easier to overcome than a learner's prior knowledge and life experience. Just as it is difficult, if not impossible to change a learners' history and experience, it is equally so when considering the teacher; with his or her own history/experience/style,, for those things make them who they are.

They are a part of identity. Yet, again their impact can be lessened by reflective practice (something else I discussed previously, Fletcher 2007 & 2008) and by peer review/ student feedback (Fletcher 1998) or by Staff monitoring, assessment and development processes. One of the simplest and most effective ways of monitoring oneself is to be video-taped while teaching and use that as a vehicle for self improvement. It can lessen many obstacles to student learning that we ourselves create by being who we are.

5. Organisational context

The last possible obstacle to learning that I will consider here is the organisation in which the learning takes place. If it is an unwelcoming building with inadequate resources, a dated heating system and with a poor record of student success or staff development, then obstacles are there before one even steps inside!

Again these can be difficult obstacles to overcome but they can be lessened if teaching takes place out of the main hub, perhaps in the community, or during more pleasant times/ months. Perhaps outreach centres can be established to lessen the impact of an organisation or at least a classroom that is a beacon and safe-haven for learning.

Conclusion

Having considered some of the more general obstacles to learning, it is clear that as with all things, some simple solutions present themselves. Equally the more difficult obstacles cannot be surmounted overnight and may take years to overcome (if this means changing an organisation's culture, for instance). Some obstacles, such as past experience and history can only be lessened as far as practically possible and will never be fully overcome.

In summary, obstacles to learning will always present themselves, and as teachers being **AWARE** of their existence is the first step to lessening their impact on our learners.

Once we recognise sources of possible obstacles, we can begin to address them.

The purpose of my article has been to raise awareness of some of these sources with a view to reducing their impact on learners everywhere.

Acknowledgement

The sources for this article are mainly teaching materials I put together, in conjunction with colleagues from the Teacher Training Team, while at Goole College. They have been collected, adapted and collated from various sources and individuals over a long period and they continue to evolve.

Photographs/ illustrations come from my collection of photographs taken while teaching or were taken from the following web based sources:

www.teachingmonster.com
www.triskills.com.au
www.gettyimages.co.uk
www.metophea.blogpsot.co.uk
www.heritageopenday.org.uk
www.galleryhip.com

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Digital technology beginning to bolster arts and culture budgets

Arts and cultural organisations are increasingly turning to digital activities to grow revenue.

A turn to crowdfunding and online donations is the top trend for 2015.

A new survey of arts and cultural organisations reveals that more are turning to digital technology to help bolster their finances. In the second of a three-year study, the Digital R&D Fund for the Arts partners - Nesta, Arts Council England and the Arts and Humanities Research Council (AHRC) - surveyed 947 arts and cultural organisations about how they use online and mobile technology and how they plan to do so over the next 12 months.

The findings, published in Digital Culture 2014, show that an increasing number are reaping the rewards of their digital activities with nearly three quarters (73%) saying it had a major positive impact on their work this year, compared with 60% last year. In line with last year, organisations said digital technology was most important to marketing (92%) preserving and archiving (81%) and operations (78%). However, more than half (51%) also now consider it to be important to their business model, up from a third last year (34%).

The growing use of digital technology by arts organisations looks set to continue; 75% said they plan to increase their digital activity over the next 12 months. The top three activities expected to grow in 2015 are related to raising money and include using crowdfunding platforms to generate income for new projects, accepting online donations and selling products or merchandise online.

The report also reveals that arts and cultural organisations are expanding the ways in which they use digital technologies, with the proportion with websites optimised for mobile growing from one third (33%) last year to more than half (55%) in 2014. Many groups are now using data-driven techniques to engage audiences and for fundraising with more now using data to better understand their audience through analysis, segmentation and/or profiling compared to last year.

However, the barriers to adopting digital technology remain unchanged with more than two thirds (70%) reporting that a lack of funding and shortage of staff time are preventing them from fully achieving their aspirations.

"Digital technologies like social media and mobile-optimised websites are fast becoming part of arts and cultural organisations' core activity, with many using them not only to engage audiences but to create new work and support their business model. Crucially, they are having a considerable positive impact and growing numbers appear to be reaping financial returns. "Digital projects are often resource intensive and need to be carefully matched to organisational goals, but this year's findings suggest that as a sector we are becoming more effective in our digital work. Through activities like crowdfunding and online donations we can expect to see increasing numbers raising income through digital means next year." - (Tandi Williams, Digital R&D Fund for the Arts research manager.)

New funding for animal diseases that could spread to humans

The Department for International Development (DFID) and the Defence Science and Technology Laboratory (Dstl) partner with four UK Research Councils to fund the Zoonoses and Emerging Livestock Systems (ZELS) programme.

A £20.5 million programme of research and training to tackle diseases that could pass from animals to humans has been funded by six UK partners.

Over the next five years the Zoonoses and Emerging Livestock Systems (ZELS) programme will fund 11 projects in developing countries in Africa, South Asia and South East Asia, bringing together expertise from the human and animal health sectors. In addition, £1.5 million of funding will give 15 students from the UK and developing countries doctoral training in ZELS-related research.

Zoonoses are diseases capable of passing from animals to humans and are estimated to have cost more than $20 billion in direct costs globally between the years 2000-2010, with a further $200 billion in indirect costs. As well as threatening human and animal health, zoonoses affect livestock production, causing economic and social harm to communities in developed and developing countries.

The programme is funded by the Biotechnology and Biological Sciences Research Council (BBSRC), the Defence Science and Technology Laboratory (Dstl), the Department for International Development (DFID), the Economic and Social Sciences Research Council (ESRC), the Medical Research Council (MRC) and the Natural Environment Research Council (NERC).

By bringing together world-class scientists from various disciplines and from around the globe, the programme aims to improve the health and wellbeing of animals, humans and the environment and, ultimately, enhance the lives of millions of people.

"Zoonoses not only threaten animal and human health, but have huge economic and social repercussions around the world.

"The ZELS programme will fund world-class research projects, using expertise from the UK and international partners, to address some of the critical challenges posed by zoonotic diseases. In addition, training doctoral students from the UK and developing countries will help create the skills needed for researchers to continue to tackle these damaging diseases." – (Dr Melanie Welham, BBSRC's Science Director)

"Smallholder farmers in the developing world who depend on their livestock to earn a living are hit twice by these diseases. Not only do they lose their income when animals become infected, they and their families are then at risk of becoming sick themselves.

"This new funding is an important step towards controlling the spread and reducing the impact of some of the most prevalent of these diseases. It will protect the livelihoods and the health of millions of families in the developing world and boost economic growth in eleven of the world's poorest countries." – (Baroness Northover, Parliamentary Under-Secretary of State for International Development)

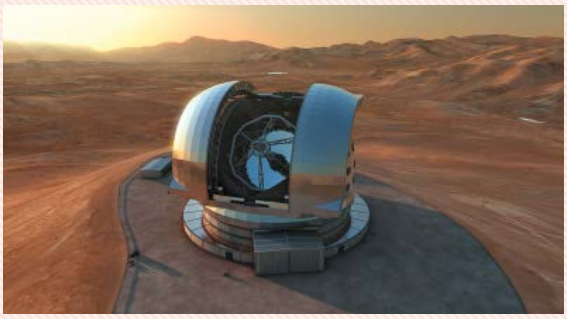
The funded ZELS projects are:

- Looking at factors affecting transmission of zoonotic pathogens from livestock to people. Professor Sarah Cleaveland, University of Glasgow.
- Zoonoses in Livestock in Kenya (ZooLINK). Professor Eric Fèvre, University of Liverpool.
- Establishing a strategy to control brucellosis in dairy herds of West and Central Africa. Professor Javier Guitian, Royal Veterinary College.
- Developing the evidence base to control brucellosis in sub-Saharan Africa. Professor Daniel Haydon, University of Glasgow.
- Combating bird flu by developing new diagnostic tools and vaccines. Dr Munir Iqbal, The Pirbright Institute.
- An integrated approach for surveillance and control of zoonoses in emerging livestock systems. Professor Duncan Maskell, University of Cambridge.
- Controlling and monitoring emerging zoonoses in the poultry farming and trading system in Bangladesh. Professor Dirk Pfeiffer, Royal Veterinary College.
- Tackling Human African Trypanosomiasis on the edge of wilderness areas. Professor Stephen Torr, Liverpool School of Tropical Medicine.
- Epidemiology and evolution of zoonotic schistosomiasis in a changing world. Professor Joanne Webster, Royal Veterinary College London.
- Controlling Bovine Tuberculosis in Ethiopia. Professor James Wood, University of Cambridge.
- Food safety hazards in emerging livestock meat pathways (HAZEL). Professor Ruth Zadoks, University of Glasgow.

At least 61 per cent of all human pathogens are zoonotic, and have represented 75 per cent of all emerging pathogens during the past decade (ref: World Health Organisation).

The four Research Councils in the ZELS programme receive funding from the Government's Science Budget. The Science Budget is administered through the Department for Business, Innovation and Skills (BIS).

It's a green light for the world's biggest telescope as construction is approved



Artist's impression of the E-ELT (Credit: ESO)

The green light has been given for construction of the world's biggest optical and infrared telescope, the European Extremely Large Telescope (E-ELT), which will provide huge opportunities for the UK astronomy community and UK Industry.

Preparation of the site for the European Southern Observatory (ESO) E-ELT began in Chile in 2014 with contracts for the construction of the telescope itself to be agreed in 2015. This will offer significant industrial opportunities for UK companies to participate in this exciting project. UK companies have already secured more than £9million in contracts and this figure could rise at least ten-fold before construction is completed.

"The UK E-ELT Project Office is very happy that the E-ELT project will now move into full construction phase. This means that the contracting process can now begin for the big-ticket items like the Dome and Telescope Main Structure and Primary Mirror Segments. Building the world's biggest optical and infrared telescope provides huge opportunities for both the UK astronomy community and UK Industry. The telescope will enable discoveries at all scales of the Universe, from measurements of life-marker gases in the atmospheres of exoplanets to understanding the birth and evolution of stars and galaxies in the early Universe."
– (STFC's Professor Colin Cunningham, UK E-ELT Programme Director)

The first phase of construction, at an approximate spend of one billion Euros, will deliver a fully working telescope with a suite of powerful instruments and first light targeted in ten years time. The largest ESO contract ever, for the telescope dome and main structure, will be placed within the next year.

The E-ELT's 39-metre diameter optical mirror, consisting of over 600 hexagonal segments, will help unlock the mysteries of our universe, capturing 15 times more light than any other optical telescope currently in existence and creating images 16 times sharper than those produced by the Hubble Space Telescope.

The Science and Technology Facilities Council (STFC) supported by significant UK government investment, is one of the 15 ESO members involved in the E-ELT. As a result, UK scientists and engineers are already successfully securing a pivotal role in construction and eventual operation of the E-ELT project, as well as in the development of the cutting edge instrumentation.

"We are delighted that construction of the world's largest telescope has commenced. The UK is leading the consortium that will build the first light spectrograph for the E-ELT. Spectroscopy allows us to understand the physics of a wide range of astrophysical objects - from planets around other stars to the very first galaxies in the Universe. UK astronomers are delighted that this flagship project is now underway. By allowing studies of the faintest objects in exquisite detail, it will dramatically improve our understanding of the cosmos." – (The University of Oxford's Professor Niranjan Thatte, who leads the design and development of HARMONI, a first light instrument for the E-ELT)

"At the end of the decade long construction period, the E-ELT will turn years of dedicated research and design in Universities and institutes in the UK and other ESO member states into a world-leading astronomical facility with unprecedented capabilities." – (Professor Patrick Roche, also of the University of Oxford and a member of ESO Council)

Pipe dreams

With buried water pipes costing millions to replace being able to maintain them is vital. An EPSRC-sponsored research team at the University of Sheffield have been working with water companies to find ways to maximise performance of the UK water system that includes pipes over 100 years old.

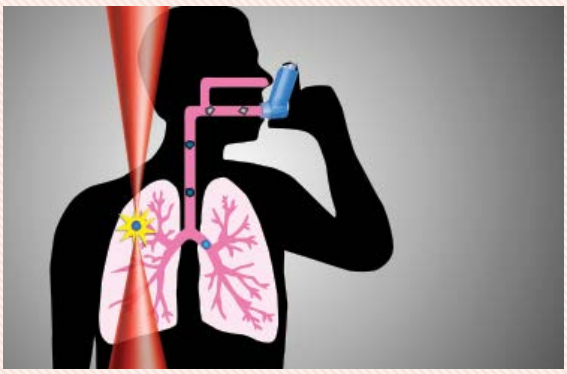
Led by Professor Joby Boxall the team built on and interacted with an industry sponsored research theme called PODDS also carried out at Sheffield. Using a purpose built laboratory based temperature control experimental pipe facility - 80 millimetres in diameter and over 600 metres in length - microscopic images and DNA based techniques the team examined the critical pipe water interface exploring and proving the importance of controlling factors.

They found that by manipulating the system and rerouting flows the risk of a build-up of material could be reduced and therefore managed, resulting in a higher quality of drinking water without the need for renewing pipes or expensive and disruptive invasive cleaning. Collaborating water companies are fundamentally changing their approaches and are already reporting improvements in levels of service and millions of pounds savings.

“With drinking water discoloration being the single biggest cause of customer contacts, it is vitally important that potential problems are prevented to safeguard water quality delivered to the public.” - (Professor Boxall)

Laser scientists' new research could improve the treatment of the 5 million asthma sufferers in the UK

UK scientists have used a laser beam trap to examine how drug particles from asthma inhalers behave as they are projected through the air. Their findings could improve the effectiveness of inhalers for the over 5 million people in the UK suffering from asthma. Over 73 million inhalers are used every year in the UK. By studying how the expelled drug particles might behave as they enter the human respiratory tract and travel into the lungs, this new research could lead to an improvement in the formulation of these drug delivery systems, increasing their effectiveness whilst reducing negative side effects.



Graphic: Study of drug particles generated from asthma inhalers, in a model lung using laser beams to both levitate and interrogate the structure of the particles (Credit: STFC)

Using the Octopus laser imaging facility at the Science and Technology Facilities Council (STFC) Central Laser Facility, the scientists trapped individual solid particles of the drug salbutamol sulphate. They suspended them in air to test how they behave in conditions modelled to simulate those in the human respiratory system. This is the first time that tests on these microscopic particles have been carried out in an environment that mimics their journey from inhaler to lung. Their research is published in the Royal Society of Chemistry journal, *Chemical Communications.*

Dr Francis Pope (foreground) and Dr Andy Ward working with the STFC Octopus laser imaging facility. (Credit: STFC)

"We captured each particle by trapping it between two focused laser beams, and then tested its behaviour in different temperatures and levels of humidity. Our tests show how water is adsorbed by following changes in chemical bond vibrations. Usually such tests are done on a glass slide so this is the first time the particles have been tested while airborne, as they would be when travelling through the respiratory tract"
– (Dr Andy Ward from the STFC Central Laser Facility)

"The human respiratory tract is anatomically evolved to prevent particles being inhaled. To overcome the natural defence mechanisms of the body, complex delivery devices and extremely small drug particles are required. These particles are typically 2-5 micron in diameter, making them approximately a tenth of the width of a human hair. Any moisture that clings to the particles as they travel from inhaler to lung is likely to increase the particles' size, and this may affect the site of particle deposition within the lung. It can result in the drug being deposited in a non-ideal site, giving rise to less effective treatment and potentially an increase in side effects."
– (Dr Peter Seville from the University of Birmingham's School of Clinical and Experimental Medicine, one of the researchers on the project)

Four of the research team in the STFC Octopus laser imaging facility (L-R: Dr Peter Seville , University of Birmingham; Dr Andy Ward, STFC Central Laser Facility; Dr Francis Pope, University of Birmingham; Clare Fitzgerald, University of Cambridge.) (Credit: STFC)

Using Raman spectroscopy techniques to measure the vibration and wavelength of light from molecules, the research team was able to provide a new method of studying the salbutamol sulphate as it exited from a commercially-available inhaler.

They discharged the inhaler into the optical laser trap, without changing the drug's physical and chemical properties, captured a microscopic particle in air and recorded its size, shape and chemical signature to show evidence of any water adsorption. This all happened within a matter of seconds, closely replicating the time, relative humidity and trajectory of the particle in the lung.

These pressurised inhalers, which deliver a measured dose of drugs with each use, account for around 70% of inhaler sales in the UK, and are the most frequently used devices for asthma and chronic obstructive pulmonary disease.

The research team comprised scientists from the Universities of Birmingham and Cambridge, Imperial College London and the STFC Central Laser Facility, based at the Research Complex at Harwell, Oxfordshire.

The research was funded by STFC, NERC and the European Research Council.

"This research could lead to more efficient inhalers to deliver drugs for respiratory problems. Our results will also inform pharmaceutical companies who may be looking to improve the chemical structure of the drug, increasing effectiveness whilst reducing negative side effects. We would not have been able to do this work without the unique capability of these lasers to capture and levitate particles, providing a new way to test the performance of the inhalers." – (Lead investigator, Dr Francis Pope from the University of Birmingham)

Dirt provides new insight into Roman burials

The first scientific evidence of frankincense being used in Roman burial rites in Britain has been uncovered by a team of archaeological scientists led by the University of Bradford. The findings – published in the Journal of Archaeological Science – prove that, even while the Roman Empire was in decline, these precious substances were being transported to its furthest northern outpost.

The discovery was made by carrying out molecular analysis of materials previously thought to be of little interest – debris inside burial containers and residues on skeletal remains and plaster body casings. Until now, evidence for the use of resins in ancient funerary rites has rarely come to light outside of Egypt.

The samples came from burial sites across Britain, in Dorset, Wiltshire, London and York, dating from the third to the fourth century AD. Of the forty-nine burials analysed, four showed traces of frankincense – originating from southern Arabia or eastern Africa – and ten others contained evidence of resins imported from the Mediterranean region and northern Europe.

Classical texts mention these aromatic, antimicrobial substances as being used as a practical measure to mask the smell of decay or slow decomposition during the often lengthy funeral rites of the Roman elite. But it was their ritual importance which justified their transportation from one end of the empire to the other. Seen both as gifts from the gods and to the gods, these resins were thought to purify the dead and help them negotiate the final rite of passage to the afterlife.

Rhea Brettell from the University of Bradford, whose research is funded by the Arts and Humanities Research Council, was the first to realise that these grave deposits were an untapped reservoir of information which could provide the missing evidence.

"Archaeologists have relied on finding visible resin fragments to substantiate the descriptions of burial rites in classical texts, but these rarely survive. Our alternative approach of analysing grave deposits to find the molecular signatures of the resins – which fortunately are very distinctive – has enabled us to carry out the first systematic study across a whole province."

These resins were only recovered from burials of higher status individuals, identified from the type of container used, the clothing they were wearing and items buried with them. This is consistent with the known value of frankincense in antiquity and the fact it had to be brought to Britain via what, at the time, was a vast and complex trade route.

"It is remarkable that the first evidence for the use of frankincense in Britain should come from such seemingly unpromising samples yet our analysis demonstrates that traces of these exotic resins can survive for over 1700 years in what others would reject as dirt." - (University of Bradford Professor of Archaeological Sciences, Carl Heron, who led the research)

The project was collaboration between the University of Bradford and specialists at the Anglo-Saxon Laboratory in York, the Museum of London and the Universities of Bamburg and Bordeaux.

"This eye opening study has provided us with new and amazing insights into the funerary rituals of late Roman Britain. The University of Bradford's significant research has also rewarded us with further understanding of a rich young Roman lady, used in the study, whose 4th century skeleton and sarcophagus was discovered near Spitalfields Market in the City of London in 1999, making her burial even more unique in Britain."
– (Dr Rebecca Redfern, research osteologist in the Centre for Human Bioarchaeology at the Museum of London)

Image of Spitalfields woman: Museum of London (c)

This study published in Journal of Archaeological Science covers inhumation burials. The University of Bradford researchers have subsequently also identified resins in a cremation burial from the Mersea Island barrow, where the resins were added to the ashes in the urn prior to burial. These findings are due to be published in 2015.

World's first artificial enzymes created using synthetic biology

Scientists have created the world's first enzymes made from artificial genetic material. Their synthetic enzymes, which are made from molecules that do not occur anywhere in nature, are capable of triggering chemical reactions in the lab. The research, published in Nature, gives new insights into the origins of life and could provide a starting point for an entirely new generation of drugs and diagnostics.

The findings build on previous work by the team at the MRC Laboratory of Molecular Biology, which saw them create synthetic molecules called 'XNAs' that can store and pass on genetic information, in a similar way to DNA. Using their lab-made XNAs as building blocks, the team has now created 'XNAzymes', which power simple reactions, such as cutting up or stitching together small chunks of RNA, just like naturally occurring enzymes.

"All life on earth depends on a series of chemical reactions, from digesting food to making DNA in our cells. Many of these reactions are too sluggish to happen at ambient temperatures and pressures, and require enzymes to kick-start or 'catalyse' the process. Until recently, it was thought that DNA and RNA were the only molecules that could store genetic information and, together with proteins, the only biomolecules able to form enzymes. Our work suggests that, in principle, there are a number of possible alternatives to nature's molecules that will support the catalytic processes required for life. Life's 'choice' of RNA and DNA may just be an accident of prehistoric chemistry." – (Dr Philipp Holliger, who led the research at the MRC Laboratory of Molecular Biology.)

Every one of our cells contains thousands of different enzymes, many of which are proteins. But some of the key fundamental reactions necessary for life are performed by RNA, a close chemical cousin of DNA. Life itself is thought to have begun with the evolution of a self-copying RNA enzyme.

"The creation of synthetic DNA, and now enzymes, from building blocks that don't exist in nature also raises the possibility that, if there is life on other planets, it may have sprung up from an entirely different set of molecules, and it widens the possible number of planets that might be able to host life." – (Dr Alex Taylor, the study's first author in Phil Holliger's lab at the MRC Laboratory of Molecular Biology, and a Post-doctoral Research Associate at St John's College, Cambridge.)

DNA and RNA are the building blocks of life, storing all of our genetic information and passing it on to future generations. In 2012, Dr Holliger's group showed that six alternative molecules, called XNAs, could also store genetic information and evolve through natural selection. They have now expanded on this principle to discover, for the first time, four different types of synthetic catalyst formed from these entirely unnatural building blocks. The XNAzymes are capable of catalysing simple reactions like cutting and joining RNA strands in a test tube. One of the XNAzymes can even join XNA strands together, which represents one of the first steps to creating a living system.

Because their XNAzymes are much more stable than naturally occurring enzymes, the scientists believe they could be particularly useful in developing new therapies for a range of diseases, including cancers and viral infections, which exploit the body's natural processes to take hold in the body.

"Our XNAs are chemically extremely robust and, because they do not occur in nature, they are not recognised by the body's natural degrading enzymes. This might make them an attractive candidate for long-lasting treatments that can disrupt disease-related RNAs." – (Dr Holliger)

"Synthetic biology is delivering some truly amazing advances that promise to change the way we understand and treat disease. The UK excels in this field, and this latest advance offers the tantalising prospect of using designer biological parts as a starting point for an entirely new class of therapies and diagnostic tools that are more effective and have a longer shelf-life." – (Professor Patrick Maxwell, Chair of the MRC's Molecular and Cellular Medicine Board.)

Funders of this work included the MRC, European Science Foundation and the Biotechnology and Biological Sciences Research Council.

IST appoints first ambassador in China

Robert Cooke

The Institute of Science and Technology (IST) has appointed its first ever ambassador in China. Cheng Hong (right), who is based at Tongji University, Shanghai, will help to advance the Chinese technical community by spreading the word about the support offered by the IST.

For the first time, technicians in China will have a point of contact in their own country who can help them get involved in the IST's work to raise the status of technicians. Cheng Hong will be able to advise Chinese technicians on matters such as continuing professional development, access to training, events and networks, and joining a professional register.

Application forms and guidance for anyone wishing to become a Member or Fellow of the IST will be available in Chinese online soon. We are also looking at how we can best support our Chinese colleagues who wish to become Chartered Scientists (CSci), Registered Scientists (RSci) and Registered Science Technicians (RSciTech).

Terry Croft, Chairman of the IST, said: **"As the science and technology industries continue to thrive in China, there is a growing demand for skilled, experienced and professionally registered technicians. Building on what we have achieved in the UK and elsewhere, we are committed to supporting the Chinese technical workforce and helping to drive innovation.**

"With that in mind, we are absolutely thrilled to have Cheng Hong join our team. As well as being a highly experienced and capable engineer, he has a firm grasp on the issues facing technicians in his country, and will be an important asset to his colleagues around the world."

Cheng Hong is a mechanical engineer at Tongji University, with expertise in electromechanical integration equipment, mechanical processing technology and manufacturing processes. He is also an experienced trainer, working on projects based around welding, turning, casting, 3D printing and laser cutting.

Technicians in China who would like to find out more about the IST can contact Cheng Hong in the following ways:

Email: chenghong@tongji.edu.cn
Telephone: 86-21-65986970
Post: The Engineering Practice Center of Tongji University, No. 100 Zhangwu Road, Yangpu District, Shanghai City, 20092, P.R. China

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 the 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

The Institute of Science & Technology

Leading Your Technical Team

The Leading Your Technical Team Programme Set
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 Glasgow Caledonian University, University of Leeds, University of Oxford, Canterbury College, University of Bristol, University College Cork, and Norwich University College of Arts 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.'

'The course was run in a relaxed and informal manner, at the same time being really informative which led to an interesting and useful experience.'

'This course is well structured and presented. It thought 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.'

The Leading Your Technical Team Programme Set

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

2014/15 Pogramme Dates and Cost:

Building on Your Leadership Skills

Date: To be confirmed for 2015, please contact Wendy **(T: 0114 276 3197 e: office@istonline.org.uk)**
Times: Start 09.30 close at 16.00 Day Two
Venue: York Marriott Hotel
http://www.marriott.com/hotels/travel/qqyyk-york-marriott-hotel/

Leading Your Technical Team

Date: To be confirmed for 2015, please contact Wendy **(T: 0114 276 3197 e: office@istonline.org.uk)**
Times: Start 09.30 close at 16.00 Day Two
Venue: York Marriott Hotel
http://www.marriott.com/hotels/travel/qqyyk-york-marriott-hotel/

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 departmental manager of the Department of Infection & Immunity within the Medical School at the University of Sheffield. He began his career at Sheffield as a trainee Medical Laboratory Scientific Officer over 30 year 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

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 2015/2016 are;
   - **Autumn edition is 31st July.**
   - **Spring edition is 31st January.**

2. 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.

3. Short articles: these can be submitted in any length up to roughly 2000 words.

4. Major articles: these are normally no longer than roughly 6000 words per edition, but please contact the Editor for longer submissions as they can usually be accommodated across two or more editions.

5. 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.

6. All articles must be written in UK English. (If English is not your first language, you should ask an English-speaking colleague to proofread your article.) Poorly translated articles may be declined by the editors.

7. 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 2015 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.

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 practices in their chosen field.

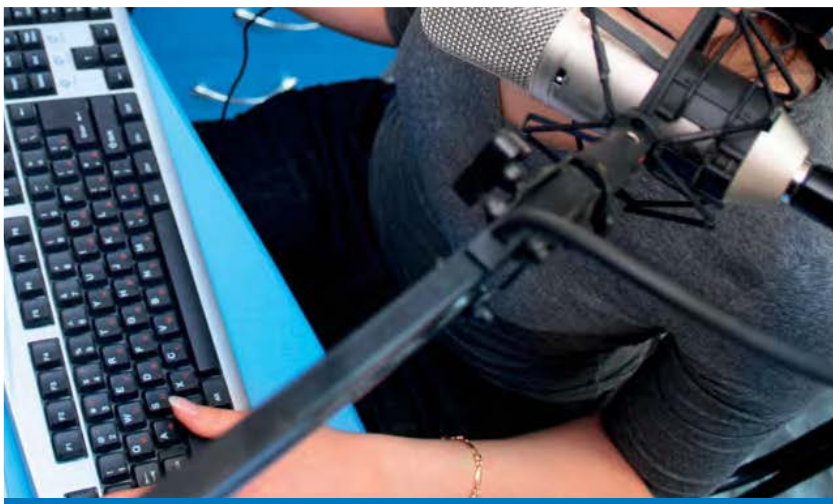
Criteria for Registration include:

- 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 fulfill 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.



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Visit http://istonline.org.uk/
Follow us on Twitter @istonline

The Institute of Science & Technology

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

Since 1987, the Institute of Science & Technology has operated a Register of competent and qualified technical practitioners

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 66 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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F: 0114 272 6354 W: www.istonline.org.uk

IST Organisation

The Executive Committee

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To be announced
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Secretary:
Chris Smith MIScT, RSci
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Joan Ward FIScT
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Philippa Nobbs FIScT
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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
- ellow: £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

The Institute of Science & Technology

The Institute of Science & Technology one day Technical Conference 2015

Date: Thursday 10 September 2015
Venue: The Met Hotel, Leeds

We are delighted to bring to your attention the IST's one day Technical Conference to be held in Leeds on Thursday 10th September 2015.

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.

This one day conference and its workshops will focus on updating technical knowledge, skills, and career development. It will also provide delegates with valuable networking opportunities to engage and learn from other technical staff and other technical supervisors/managers.

Target participants

The conference has been specifically organised for IST members, technicians, technologists, technical supervisors, laboratory/service managers, and technical managers.

Speakers/presenters

The full programme which includes speakers and workshops from a variety of industries, institutions, and professional bodies will be available on the IST web pages (http://istonline.org.uk/news-events).

We want to offer you the opportunity to contribute to this conference through delivering one of the following:

- **Workshops:** should be lively, participative sessions of up to an hour. Can you engage participants in discussion or 'testing' of projects and initiatives? Do you have practical experience to share or want to move an initiative forward through consultation with participants? Then this format is for you. Sessions also present an opportunity to experience other development approaches, or demonstrations/ hands-on use of technology. The format should involve some element of presentation or facilitation on the part of the contributors, plus considerable discussion and/or practical activities involving participants. Please allow some time for questions and answers at the end.

- **Posters:** offer you the chance to share experiences with others in an informal way, to tell a story in pictures and/or words. If you have not previously contributed to a conference, why not try a poster? Your poster can be one large text/graphic, or e.g. 3-5 PowerPoint slides printed out to create a 'story'. Depending on space constraints, poster displays may be on show throughout the whole conference - Flip chart size.

- **Case study:** to share with delegates your experiences and knowledge. The format should involve some element of presentation or facilitation on the part of the contributor(s), plus considerable discussion and/or practical activities involving participants. Please allow some time for questions and answers at the end.

If you are interested in contributing please contact Wendy Mason by no later than 2 May 2015

Please spread the word amongst your colleagues who may wish to attend. The conference will be supported by a significant exhibition of suppliers.

Price: Per delegate
£90 IST Members, £145 (Non IST members),
£80 per person for Group Booking of 10 delegates
(from either members/ non- members)
Overnight accommodation £89
(B/B accommodation on the evening before the event)

Please contact **Wendy Mason office@istonline.org.uk** to book your place on the conference
T:0114 276 3197
F:0114 272 6354

Promote your business with the IST

Advertising in the journal offers a cost-effective method of reaching the specialist technical community.

The Institute of Science & Technology's bi-annual Journal is a practically focused high quality publication, aimed at all levels of the technical and specialist community, who work in a wide and diverse number of areas. These areas range through industry, business, and education disciplines, from science labs and engineering facilities to recording studios and IT departments. Its main focus is the opportunity to keep our members, and also the very many other colleagues in the wider community of professional technicians who read it, informed.

The IST is an international organisation with members from across the UK and Europe, South America, Africa, Malaysia, and Australia.

We strive to help industry, business and education to maintain and grow the quality of their technical staff, and help them to keep up with constant advances in science and technology.

The Journal offers an ideal opportunity for suppliers of services to industry, business, and education disciplines to promote their products, develop new contacts, and reinforce existing relationships. Suppliers and manufacturers are much more likely to reach the people who are directly using their services and products through the IST and its Journal.

Advertisement opportunities 2015/16

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1/4 page
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Trim: 148.5 x 105
Bleed: 154.5 x 111

Double page spread
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Bleed: 303 x 426

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