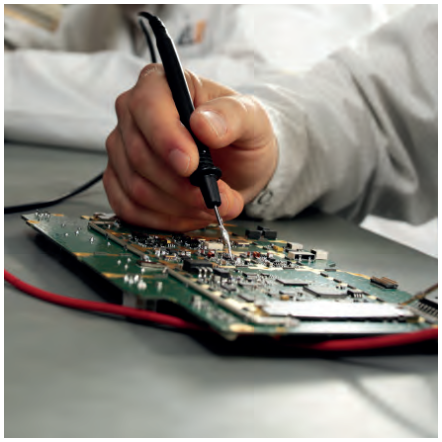
The Institute of Science & Technology

The Professional Body for Technical, Specialist, and Managerial Staff



The Journal

Spring/Summer 2020

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The Journal

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The Professional Body for Technical,
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Editor's welcome

Welcome and au revoir

Ian Moulson FIScT IST Vice President

Welcome to the Spring/ Summer 2020 edition of the IST's *The Journal*. We will also be publishing articles regularly online throughout the year via our website and e-Newsletter. Please see page 9 in this edition for article submission deadlines.

My thanks go to this edition's contributing authors for their excellent articles.

There is as a really interesting piece by Paul Le Pinnet about Joseph Priestley's part in the history of scientific glassblowing. Derek Sayers gives us sound advice on writing a thesis or scientific paper. Alan Gall tells us about Alfred Worswick and the pioneering days of heavier-than-air flight. Kevin Fletcher continues his series by looking at how far Humanist Theories can be applied to science & technology teaching and learning. Paul Marshall completes his two-part article on making old television technology make sense. Sumant Gadge tells us about why WiFi sensors for biomedical devices could be a boon to healthcare. The IST conference team review our IST One-Day Technical Conference 2019 which took place at the Birmingham Conference and Events Centre on 18th September, and remind us of this year's conference in York.

In our Members Comment piece Andy Kowalski gives his personal example of how university technicians can grow their roll.

And its au revoir from me. This is my last journal as editor. I took over the editorship in 2009 and can honestly say that I have thoroughly enjoyed the whole ten and a bit years in the role. My heartfelt thanks go to each and every one of the journal's contributors over that time. Together we have published well over 200 articles. I also want to extend my special thanks to Alan Gall, IST's Archivist, who has been an enormous help to me right from the very beginning.

The IST's Executive is now actively seeking out my replacement and will very much welcome enquiries from any member who may be interested in the role.

I would like to think that our journal has evolved into what is now a quality publication, with a style and content that reflects our unique standing as a professional body with an extremely diverse and vibrant technical membership. It gives an opportunity for our members and guests to freely present and publish articles, papers, and news items that would be of interest to our readership's varying expertise and extremely broad subject range. We have welcomed article submissions from all and any areas of technical interest, including areas such as IT, media, medicine, and the arts. We like to cover existing, historical, and new technological advances, and also unusual aspects of science or technology. And we particularly want to encourage technical people to publish for the first time, as part of their career development.

If you are interested in learning more about the editorship role then please do get in touch. Email us at office@istonline.org.uk in the first instance.

Take a minute to check out the new look of IST's regular e-Newsletter and get up to date news of what is happening in the technician community. Subscribe free at **istonline.org.uk** and follow the links to a series of periodic newsletters that we generate quarterly, and have a look at what we have been doing and the things we have planned for the near future.

We are always happy to include short articles and news items in the IST's e-Newsletter that you feel would be of interest to the technical community, or if you would like to promote a technician event, or advertise a job vacancy. Please do get in touch with any of the newsletter's editors **istonline.org.uk/resources/ist-newsletters/** or through our IST Office at **office@istonline.org.uk**

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

Au revoir, Ian

Chairman's view

Terry Croft, MBE, FIScT, CSci,
IST Chairman

Hello and welcome to our latest Journal.

Firstly, I hope I find you and your families well and staying safe. Our thoughts at this time go out to members and their families whose loved ones have become ill with Covid-19. We wish them a speedy recovery.

These are unprecedented times, and, in my lifetime, I have never experienced anything on this scale and magnitude that has the capacity to affect every member of the human race. We are having to adapt to a new way of life. This is difficult for many, but essential. Just by adhering to the rules and especially staying at home and social distancing, we are saving lives and taking the additional pressure off the NHS. It is fact that just by following these two rules we significantly reduce the number of infections which is absolutely necessary if we are to come out the other side with the minimum fatalities. So, thank you all for doing this. Further information is available at **www.gov.uk/covid19**

I know I can speak on behalf of the IST and all our members, in giving a big thank you to all our key workers (too many to name) from our NHS staff and social carers to the transport and supermarket staff who are delivering vital supplies and keeping the shelves stocked. At this critical time, we must forget politics and give credit where it is due to the Prime Minister and his team for leading the Nation and bringing to bear all government resources to fight Covid-19.

Although life as we know it has been put on hold, the IST team and our volunteers are working on a variety of ways to help and support our technical community. For example, we will be increasing our eNewsletter editions to not only to report on the latest impact of the virus on our places of employment but also to bring you good news stories on how technicians are helping the fight against Covid-19. We want to hear your good news stories whether regarding your work or your activities with the local community. Please send your news to **j.p.ashtone@istonline.org.uk** or contact the IST office at **office@istonline.org.uk** To keep up to date with developments please visit our website at **www.istonline.org.uk**

We currently find ourselves in a situation which changes day by day. As with many other professional bodies and institutions, we plan many months in advance to bring you regional events, local workshops, for example on professional registration and YOUR national conference. The Executive and I are therefore carefully monitoring the restrictions and advice currently in place. Everyone's health and wellbeing must be our priority and therefore we have now taken the decision that the 2020 AGM scheduled for 27th May will become a virtual meeting and details will be found online shortly. With a number of government spokespersons suggesting that the UK will not return to "normal" daily life for a least six months, the Executive has decided to continue to review the situation week by week regarding our Annual Conference scheduled to take place on the 16th September 2020 in York. At this moment in time we are still preparing for the event to take place. Please keep checking our website for regular updates.

Despite the virus, the team have been working hard, albeit from their homes, to try to continue to provide help and support to our members from career advice to helping them through the professional registration process. One key member of the team is Ian Moulson. Ian has been a member of the IST for more than twenty years. Ian became the Editor of the Journal in 2009 in addition to being a member of the Executive Committee. He has brought many changes to the Journal including design and expansion of content. The Journal's reputation as a well-respected publication has been enhanced through Ian's stewardship and recognised for its quality and content by many other organisations and professional bodies. This will however be Ian's last Journal. It is with great sadness that I have to announce that Ian has decided to step down from his editorial duties. On behalf of the IST and our members, I would therefore like to warmly thank Ian, for all the hard work and dedication that he has brought to this role. If you are interested in learning more about the editorship role then please do get in touch.

Finally, especially for those members who live alone or feel isolated during this crisis, we are here to support you. If you just need a chat then please feel free to contact me or a team member on **t.croft@istonline.org.uk** or **office@istonline.org.uk** Together we can get through this crisis.

With best wishes, Terry.

President's view

Helen Sharman, CMG, OBE, FRSC, FIScT
IST President

I hope that you are staying healthy and safe. We are all feeling the impact of the COVID-19 pandemic and my thoughts are with those who have become ill, or whose loved ones are ill. This message comes with heartfelt sympathy for everyone who has lost a loved one or a colleague recently.

If you are working in the NHS, other vital caring roles or you are part of the COVID-19 research and testing effort in another way, the IST adds its thanks to the appreciation I hope you feel from the country.

Technicians have been saying for some time that the world is changing faster than ever, but the extent and speed of COVID-19's impact on individuals, organisations and the global economy has been a shock to us all. People all over the world are finding themselves in situations they could not have planned for. Some of you may have jobs that require you to continue working under pressure in a lab; you might be working from home and juggling child care with a lap top on the kitchen table; perhaps you are in "furlough" not being able to work, or a freelancer who now has no work. You might have lost your job. The circumstances are unprecedented and while the Government is doing what it can as quickly as it can to ease the financial anxiety many people face, it is clear that for many of us, our lives are going to be quite different for some time.

The IST remains open with most staff working from home so please feel free to contact the IST as usual. We are keen to do what we can to help and support members.

Many media outlets have been asking me how I coped with isolation in space. The following are a few of my thoughts in case an idea might help. Do pass on to others!

Best wishes,
Helen

Thoughts from space on confinement and isolation

By Helen Sharman, first British Astronaut

Choosing to put myself in a small spacecraft with only a few other people, having planned and trained for this over many months is not completely analogous to the COVID-19 situation of uncertainty, self-isolation and social distancing. However, there are some similarities that the isolation we are in now does have with being confined to a spacecraft in a hazardous environment so I have pulled together a few thoughts here.

1. In space, we have the basics for life of food and shelter and crew mates for company. However, what astronauts miss most is friends and family, those personal relationships that we often take for granted on Earth. On long duration missions, astronauts also miss the huge variety of people who we would usually meet in daily life on Earth, people who we interact with even if we don't talk with them. I was in space before satellite phones were available to astronauts so I relied on the radio for contact with Earth and it was really good to be able to chat, albeit for only a few minutes (we were travelling over the Earth's surface at 17,500 miles per hour so we were soon out of radio "sight"). There are many ways we can maintain contact with people now: old fashioned phone, facetime, Skype, text, email, and so on; we can wave at neighbours, smile and say hello when we pass people 2 metres away in the street. One of the lovely outcomes of my notoriety was that my grandmother's long-lost cousin saw her on TV being interviewed about her feelings as an astronaut's grandmother. The cousin asked the TV channel to put him in touch and my grandmother remained delighted about that and their continued relationship until she died.

2. Living in a confined space with other people requires a bit more respect and tolerance than normal to maintain cordial relations. Astronauts do not select their own crew but the ability to cooperate and collaborate is a significant part of the selection process. As we don't usually choose the people we share our homes with on this basis, we have to work particularly hard at open communication and active interactions. We need to understand each other's frustrations, what annoys us and what helps us to relax. And it helps if the grotty jobs are shared (tasks like compacting the solid toilet waste and changing air

filters are done on rotation in space).

3. Working as a team, my launch crew docked onto the space station manually because our automatic system failed. At the time of my spaceflight, a manual docking was something in which everyone in the crew had an active part (my task was to operate a periscopic camera so the commander could see where he was going). If we missed the space station by a mile, we could have a second attempt at docking but if we missed the docking port by a few centimetres, we could damage our spacecraft and the station sufficiently that we would all die. We knew that we relied on each other for our lives. Having docked safely and opened the hatch into the station, I still remember that amazing feeling of togetherness as I hugged the cosmonauts who had been on board the station for the six months before my launch. Nearly 30 years later, my crew and I are still friends. Hard times shared can be a truly bonding experience.

4. Mission Control told me every day what I should be doing by the minute. I did not mind because I knew it was worth it for the amazing experience I was having. However, I did take pleasure in the small elements of my day over which I could exert some control, like what sort of fruit juice I drank and when I went to sleep. Now, we have been told how we have to live our lives in many respects and as a rule, we do not like being told what to do, let alone how to do it. But we can appreciate what we do control (no one is telling us which book to read or what time to get up, after all) and remind ourselves of the reason we are doing this: the purpose we all have, individually and together, to save lives.

5. I was not scared or anxious living with the risks of space travel because I had plans. I knew what to do in various emergency situations like loss of air pressure or a fire; I knew what to do in other non-standard situations like loss of radio contact or a manual docking. For us now, it could be as simple as having a set of contacts in easy reach, or a schedule for when you can access the home computer. Having seen how useful back up plans (like the ability to dock manually) can be in space, I still live my life with alternatives already thought through for anything important. I don't mind the extra effort that is often not put to use in the end because it makes me feel more relaxed.

6. When my space mission was in jeopardy part way through my training due to a lack of funding, I was asked if I would go into space just to become the first British astronaut, to do nothing other than float about and make a few broadcasts back to Earth. I said, "No!" because I wanted that spaceflight to be useful and I would rather let someone else be that astronaut in the future if that would be more worthwhile. And once in space, although it wasn't particularly nice to be scheduled so precisely by Mission Control, I was grateful to have a busy working day because it made me feel useful. Nowadays, usually, the work place is busier than ever before. If suddenly our working day becomes less busy, we can feel at a loss. But we can make our own daily schedules if they are not set for us, and if we are not working or volunteering, we can still have targets and make achievements every day. Perhaps there is a development goal relevant to our present or future career, or something not work-related like contacting an old friend or clearing a cupboard, that can make us still feel useful.

7. With time to spare, we can do what we have always wanted to do but were previously too busy for. Astronauts on long duration missions enjoy catching up with films and books, for instance. On Earth, even just at home, we have a whole load of activity to choose from. And we can plan something nice to look forward to (I am thinking about a mountain walk or two) because this will not last for ever.

8. One of the things my crew and I loved to do at the end of the working day in space was to look out of the window. As we orbited Earth, the planet rotated below so the view was constantly changing. I was entranced with how the sun reflected off lakes on Earth. Seeing lights in cities appear as we entered dusk was magical. Sunrise was spectacular, as the atmosphere brightened and the colours morphed from yellow to pale blue, going from pitch black to brilliant light in a few seconds. Snow, deserts, oceans and clouds were all beautiful. But I could not experience weather and fresh air in space. Now, we have the time to stop and stare a while. We can enjoy the things we might not otherwise have been able to do, like listening to birdsong, seeing how the sunlight moves across a building over the course of a day and how this can change depending on the time of year, appreciating the beauty in clouds and smelling the outside air as we open a window.

9. In space, I did not once think about possessions, the objects that we often strive to own, perhaps to show off our wealth and identity. Back on Earth and confronted by materialism, I reset the relative value of "stuff""in my life. Once we have the basics to survive, it is human relationships – our family and friends, neighbours and colleagues – that are the most meaningful. Being less of a consumer society will benefit the environment and reserve resources for what we really need, but I think we will feel it in a society that will be more communal, more cohesive and generally nicer. When we start to pick up our lives again, we will have a better world to live in.

New members

New members April 2019-March 2020

Membership No.	Name	Grade
T16217	Mr M A Hedley	MIScT
T16218	Mr J Sutton	MIScT
T16219	Miss S Pidoux	MIScT
T16220	Dr H B Nayaka	MIScT
T16221	Miss S Barke	MIScT
T16222	Mrs A Woolsey	MIScT
T16223	Mr J D Woolsey	MIScT
T16224	Miss R Brookes	MIScT
T16225	Mrs J M Todman	MIScT
T16226	Mr S O Coulson	MIScT
T16227	Mr A L Baker	MIScT
T16228	Mr I J McKay	MIScT
T16229	Mr I S Igyuse	MIScT
T16230	Ms Oldfield	MIScT
T16231	Mrs C Sunley Miller	MIScT
T16232	Mr A Farthing	MIScT
T16233	Mr A C Hipwell	MIScT
T16234	Mr W C Leung	MIScT
T16235	Mr A J Hogan-Hughes	MIScT
T16236	Miss S Poole	AssocIScT
T16237	Mr A J Davison	MIScT
T16238	Ms R A Freestone	MIScT
T16239	Mr J Ihula	AssocIScT
T16240	Miss T Sivagnanam	MIScT
T16241	Mr I D Kankia	MIScT
T16242	Miss J Downes	MIScT
T16243	Mrs D L Fox	MIScT
T16244	Mr M Leedham	MIScT
T16245	Mrs K Owen	MIScT
T16246	Mr M Randell	MIScT
T16247	Mr A Wainwright	MIScT
T16248	Mr D Fower	MIScT
T16249	Mr R Bostock	MIScT
T16250	Mrs S J Northey	MIScT
T16251	Mr Kagiopoulos	MIScT
T16252	Mr J E Sloan	MIScT
T16253	Mr P W Cropper	MIScT
T16254	Mrs J Marshall	MIScT
T16255	Miss J K Fountain	MIScT
T16256	Mr O Conghaile	MIScT
T16257	Mr U B Katagum	AssocIScT
T16258	Dr S J Bacon	MIScT
T16259	Dr R G Segumpan	MIScT
T16260	Dr F S Gagg	MIScT
T16261	Mr S L Goff	MIScT
T16262	Mr E C Heeley	MIScT
T16263	Dr S Abdulla	MIScT
T16264	Mr A Adamu	AssocIScT
T16265	Mr E M Togunde	AssocIScT
T16266	Miss E M Stewart	MIScT
T16267	Dr M Bolutiwi	MIScT
T16268	Mrs J Holmes	MIScT
T16269	Miss T Cowley	MIScT
T16270	Mr C L Guggiari-Peel	MIScT
T16271	Mr Y Dong	MIScT
T16272	Mr K Owen	MIScT
T16273	Ms D Margariti	MIScT
T16274	Mr G Jones	MIScT
T16275	Mr J Warren	MIScT
T16276	Mrs A E A Jordan	MIScT
T16277	Mrs O O Imolehin	MIScT
T16278	Miss Hutchinson	MIScT
T16279	Dr K A Tree	MIScT
T16280	Dr D N Potier	MIScT
T16281	Dr J C Wills	MIScT
T16282	Mrs J M Selby	MIScT
T16283	Miss S Honey	MIScT
T16284	Dr G Hyde	MIScT
T16285	Miss J Green	MIScT
T16286	Mrs T Davey	MIScT
T16287	Miss L Bates	MIScT
T16288	Mr S G Evvetts	MIScT
T16289	Mr J A Cooper	AssocIScT
T16290	Dr A Burns	MIScT
T16291	Mr C A Wilkinson	AssocIScT
T16292	Mr A J Smith	AssocIScT
T16293	Mx S Weir	AssocIScT
T16294	Mr C S Green	AssocIScT
T16295	Mr W J Allan	AssocIScT
T16296	Mr S J Mortimer	MIScT
T16297	Miss B Wallis	MIScT
T16298	Ms Barabas	MIScT
T16299	Miss K Green	MIScT
T16300	Dr M A Baxter	MIScT
T16301	Mrs P K Smith	MIScT
T16302	Mr D C Allen-Ross	MIScT
T16303	Mr J Magee	MIScT
T16304	Mr I D Read	MIScT
T16305	Mr Y R Gautam	MIScT
T16306	Mrs A Pugh	MIScT
T16307	Ms R Parkin	MIScT
T16308	Dr S Stubbs	MIScT
T16309	Mr M Bradshaw	MIScT
T16310	Mr D James	MIScT
T16311	Miss C Griffin	MIScT
T16312	Miss K Morrice	MIScT

Membership No.	Name	Grade
T16313	Mrs L MacGillivray	MIScT
T16314	Mrs K Hafezi	MIScT
T16315	Mr L Murphy	MIScT
T16316	Mr J M Jones	AssocIScT
T16317	Ms K M McLaughlin	MIScT
T16318	Mr H O T Blackie	MIScT
T16319	Mr A N Kabiru	MIScT
T16320	Mrs L Binnington	MIScT
T16321	Dr D Sun	MIScT
T16322	Ms D Margariti	MIScT
T16323	Miss A Young	MIScT
T16324	Dr D E Belcher	MIScT
T16325	Dr M E Ballentine	MIScT
T16326	Mr N B White	MIScT
T16327	Miss A Fawkes	MIScT
T16328	Dr P E Lithgow	MIScT
T16329	Miss S A McCormack	MIScT
T16330	Miss S J McCafferty	MIScT
T16331	Dr I Artamendi	MIScT
T16332	Mr F H Shayor	MIScT
T16333	Mr W Cook	AssocIScT
T16334	Mr A Y Abdu	MIScT
T16335	Miss J R Phillips	MIScT
T16336	Mr J Holt	MIScT
T16337	Mr W P Hawkins	MIScT
T16338	Miss J D Medcalf	AssocIScT
T16339	Dr N Owen	MIScT
T16340	Miss E A Wild	AssocIScT
T16341	Mrs T Marshall	MIScT
T16342	Miss E Ford	AssocIScT
T16343	Ms F Chen	MIScT
T16344	Mrs N J Keitch	MIScT
T16345	Mr B Dworzański	MIScT
T16346	Miss J A Furmston	MIScT
T16347	Mrs K S Coffey	MIScT
T16348	Mrs D Gale	MIScT
T16349	Mr D Canning	MIScT
T16350	Ms R M Prawer	MIScT
T16351	Miss K A L Rosewell	MIScT
T16352	Mr R L L Hart	MIScT
T16353	Mr C Fraser	MIScT
T16354	Mr A U Idris	AssocIScT
T16355	Dr L De Cecco	MIScT
T16356	Miss T R Howe	MIScT
T16357	Mr J Rich	MIScT
T16358	Mr D J Nicholl	MIScT
T16359	Mr G Lefman	MIScT
T16360	Mr O S Agboola	MIScT
T16361	Miss K Smith	MIScT
T16362	Mrs J A Freeman	MIScT
T16363	Mrs A Nefedova	MIScT
T16364	Miss J M Rennie	MIScT
T16365	Miss H R Szladicsek	MIScT
T16366	Mr S C Gilbert	MIScT
T16367	Mr D MacGregor	MIScT
T16368	Dr I Cruz-Gallardo	MIScT
T16369	Mr N Hemming	MIScT
T16370	Mr N S Cardoso	MIScT
T16371	Dr L S J Hughes	MIScT
T16372	Mrs A A Mahmud	MIScT
T16373	Mr J Grinham	MIScT
T16374	Eur Ing A Carter	MIScT
T16375	Mr A P Reaney	MIScT
T16376	Dr M F LO	MIScT
T16377	Mr W Knight	MIScT
T16378	Mrs H Goodes	MIScT
T16379	Mr M Charij	MIScT
T16380	Mr I M Cairns	MIScT
T16381	Mr A H G Abiri	MIScT
T16382	Mr G M Platt	MIScT
T16383	Mr D Palmer	MIScT
T16384	Eur Ing L Campbelli	MIScT
T16385	Mrs N A Oko	AssocIScT
T16386	Mr J O Huntington	AssocIScT
T16387	Ms R C Mendoza	MIScT
T16388	Mr B J Omoikhoje	MIScT
T16389	Mrs Abu Barikisu	MIScT
T16390	Mrs H Lawan	MIScT
T16391	Ms T S Monaghan	AssocIScT
T16392	Mr L Latif	MIScT
T16393	Mr R Wilson	MIScT
T16394	Mr A Heikal	MIScT
T16395	Mr S J Reid	MIScT
T16394	Mr A Heikal	MIScT
T16395	Mr S J Reid	MIScT

Total – 179

New registrations

Science Council Registrations & Transfers

Membership No.	Name	Grade
T15986	Mr W Woodside	CSci
T16230	Ms Oldfield	CSci
T16259	Dr R G Segumpan	CSci
T16260	Dr F S Gagg	CSci
T16261	Mr S L Goff	CSci
T16263	Dr S Abdulla	CSci
T16284	Dr G Hyde	CSci
T16286	Mrs T Davey	CSci
T16308	Dr S Stubbs	CSci
T16315	Mr L Murphy	CSci
T16321	Dr D Sun	CSci
T16328	Dr P E Lithgow	CSci
T16329	Miss S A McCormack	CSci
T16350	Ms R M Prawer	CSci
T15679	Mr J M Robertson	RSci
T15732	Dr K Knight	RSci
T15772	Dr P Waines	RSci
T15804	Miss G E Bradshaw	RSci
T15850	Mr L Weymouth	RSci
T15852	Mr J C Kirkwood	RSci
T15924	Miss I van Zwieten	RSci
T15932	Miss B J Grooby	RSci
T16079	Mrs S Gaunt	RSci
T16216	Dr N Phisarnchananan	RSci
T16238	Ms R A Freestone	RSci
T16248	Mr D Fower	RSci
T16262	Mr E C Heeley	RSci
T16266	Miss E M Stewart	RSci
T16270	Mr C L Guggiari-Peel	RSci
T16275	Mr J Warren	RSci
T16282	Mrs J M Selby	RSci
T16283	Miss S Honey	RSci
T16297	Miss B Wallis	RSci
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T16303	Mr J Magee	RSci
T16304	Mr I D Read	RSci
T16307	Ms R Parkin	RSci
T16313	Mrs L MacGillivray	RSci

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T16349	Mr D Canning	RSci
T16366	Mr S C Gilbert	RSci
T16368	Dr I Cruz-Gallardo	RSci
T16378	Mrs H Goodes	RSci
T16395	Mr S J Reid	RSci
T15846	Mr N Gillott	RSciTech
T15847	Mr R Abbott	RSciTech
T15848	Mr A Thornton	RSciTech
T15858	Mr M Kirkland	RSciTech
T16039	Mr D M Yeadon	RSciTech
T16128	Miss A Edwards	RSciTech
T16236	Miss S Poole	RSciTech
T16242	Miss J Downes	RSciTech
T16255	Miss J K Fountain	RSciTech
T16256	Mr O Conghaile	RSciTech
T16285	Miss J Green	RSciTech
T16299	Miss K Green	RSciTech
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T16306	Mrs A Pugh	RSciTech
T16309	Mr M Bradshaw	RSciTech
T16310	Mr D James	RSciTech
T16311	Miss C Griffin	RSciTech
T16312	Miss K Morrice	RSciTech
T16314	Mrs K Hafezi	RSciTech
T16316	Mr J M Jones	RSciTech
T16337	Mr W P Hawkins	RSciTech
T16342	Miss E Ford	RSciTech
T16343	Ms F Chen	RSciTech
T16358	Mr D J Nicholl	RSciTech
T16364	Miss J M Rennie	RSciTech
T16365	Miss H R Szladicsek	RSciTech
T16367	Mr D MacGregor	RSciTech
T16369	Mr N Hemming	RSciTech
T16377	Mr W Knight	RSciTech
T16379	Mr M Charij	RSciTech

Total – 82

IST Journal Publication

Back copies of our journal publication are viewable online.

Article submissions for the IST Journal

The IST Journal is a quality publication. Its style and content strongly reflect the IST's unique standing as a professional body that has an extremely diverse and vibrant technical membership.

The Journal's informal style offers an opportunity for our members and guests to freely present and publish articles, papers, and news items that would be of interest to our readership's varying expertise and extremely broad subject range. We do try to encourage articles to be written with our diverse technical membership in mind.

We positively welcome article submissions from all and any areas of technical interest, including areas such as IT, media, medicine, and the arts. We like to cover existing, historical, and new technological advances, and also unusual aspects of science or technology.

We particularly want to encourage technical people to publish for the first time, as part of their career development, and we can offer help and assistance in putting a first article together.

Contact

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The guidelines for article submissions to the IST Journal and e-Journal are:

1. Article submission deadline for our annual hard copy edition is 31st March. Deadlines for 2020 e-Journal articles are:

No.	Release	Deadline for Articles
16	2nd March	17th February
17	1st June	11th May
18	3rd August	20th July
19	28th September	14th September
20	7th December	23rd November

2. Your article should be submitted electronically in Microsoft Word format; with its images supplied separately as JPEG files (it is important that all your article images have a minimum resolution of 300dpi. Images embedded in a Microsoft Word document are not usually reproducible to the necessary print resolution).

3. Short articles: these can be any length up to roughly 2,000 words.

4. Major articles: these are normally no longer than roughly 6,000 words. We can only publish one or two major articles per edition. Larger articles may need to be accommodated across two or more editions.

5. All articles should be written in UK English. This is important as, depending on the content size and quality of English, they can take up a lot of editing time. Some can require extensive re-writing. We may have to decline very poorly translated articles.

6. Editing – we will edit all articles into the IST Journal's house-style, and may have to correct for spelling and grammar. Text layout and images may need to be changed, altered, or omitted. Pease see "IST Journal house-style" description on our web site. It will help enormously if your article follows this style as much as possible.

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 separate images sent with it as email file attachments.

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The main role of the President is to lead and guide the Institute in its strategic and operational development. Helen is ideally suited to this role having become the first British astronaut when she launched into space on board a Soyuz space craft on 18 May 1991. Helen graduated with a degree in chemistry from the University of Sheffield before working in industry. Following which she trained at the Yuri Gagarin Cosmonaut Training Centre in Star City near Moscow. Helen became a science communicator after her space flight, and more recently she has started a new career in management, working at the National Physical Laboratory and at Kingston University London, before moving to Imperial College in the summer of 2015.

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Chairman: Terry Croft MBE FIScT CSci

Terry is the Chairman of the IST. He is passionate about, and is committed to, the technical community. His work involves promoting the professionalisation of the technical workforce. He brings a wealth of experience to the board through his involvement with the wider sector and as the Founding Director of the National Technician Development Centre for Higher Education.

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Natalie is the IST Secretary, and has responsibility for ensuring that we comply with legislative requirements and that we maintain suitable official records. Natalie is also Public Relations Advisor, and in that role she represents the IST at events, conferences, exhibitions, and open days. In addition, she is a Senior Assessor, assessing applications for Registered Science Technician, Registered Scientist, and Chartered Scientist. Natalie is the Director of the National Technician Development Centre for Higher Education.

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

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Acting Education Officer: Philippa Nobbs FIScT

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

E: education@istonline.org.uk

Membership Development Officer: Kevin Oxley FIScT CSci

As Membership Development Officer, Kevin develops strategies for membership engagement with the IST. Working alongside the Marketing Officer and PR Advisor, Kevin develops the implementation of recruitment and retention campaigns. He also promotes the benefits of membership to Higher Education institutions and industry. Kevin is also the Institute's Diversity Champion and works to ensure that the IST operates in line with the principles of diversity, equality, and inclusion, and to measure progress in that regard.

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Registrar & Marketing Officer: Michelle Jackson FIScT CSci

As Registrar, Michelle oversees the registration schemes run through the IST and contributes to the development of associated strategic and operational procedures. She liaises with the Science Council with respect to continuing development of the registration process and monitors all aspects of the IST registration and assessment processes. As Marketing Officer, Michelle looks at new and existing ways in which the IST markets itself to its members, prospective members, and the science and technology community. Michelle is the Deputy for the Faculty of Engineering's Director of Operations at the University of Sheffield with regard to technical resources, H&S and Infrastructure. She manages all aspects of these areas within the FoE alongside the Departmental Technical Managers and Departmental Safety Officers.
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John-Paul is an IST Executive Support Officer and also the IST's social media/engagement advisor. He works closely with the Executive to enhance engagement with the wider technical community helping the IST to develop its profile/presence across various marketing platforms including Twitter, Facebook, and LinkedIn. He is co-editor of the IST e-Newsletter and IST website. John-Paul has been part of the technical staff at the University of Sheffield since 2012. He has also worked in the healthcare industry for 12 years and is currently Operations and Recruitment Manager, responsible for company operations and over 50 staff whilst also regulating finance, writing quotes and medical plans for large scale events.
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Fellowship & Overseas Advisor: Derek Sayers FIScT FInstLM FRMS

As Fellowship & Overseas Advisor, Derek coordinates the review of Fellowship applications, setting in place panels of other Fellows for peer review, and advises the Executive on the outcome of the reviews. He also maintains the documentation of those applications. Derek is our point of contact for overseas inquiries from members and for organisations wishing to work with the IST; he liaises with such organisations and reports back to the Executive. Derek is a Vice President of the IST.
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Partnerships/Champions Coordinator: John Dwyer FIScT

John is co-ordinator for Partnerships/Champions. His role involves actively promoting professional registration for the IST throughout the UK: attending meetings, workshops, and conferences, and seeking champions for this cause at institutions nationally.
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James is the Laboratory Manager for the National Laboratory Site at Starcross in Devon. The NLS is a national service of the Environment Agency and provides analytical data for a range of sample types. James is a Chartered Manager and a Governor of Newton Abbot University Technical College. He will be helping the IST develop industrial links and promoting frameworks for professionalising science/technical staff working in that sector.
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IST Archivist: Alan Gall BSc MSc MMath MInstP MRSC FIET FIScT CSci
Alan has been IST Archivist since 2004. Originally a laboratory assistant, he has worked in industries concerned with edible oils, food additives, polymer stabilisers, electroplating and explosives. He is currently a company director involved with magnetic materials, electrical engineering and general mechanical engineering. Contributions to *The Journal* began in 2003 with an article on the Manchester University technician William Alexander Kay. He has provided regular articles since then.
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IST Journal Editor: Ian Moulson FIScT
Ian has been editor of the IST's biannual publication *The Journal* since 2009. Before his retirement he was Departmental Manager of the Department of Electronic & Electrical Engineering at the University of Sheffield (UoS). His career at UoS spanned some 40 years, beginning there as an electronics technician following a number of years in the electronics industry and an electrical engineering apprenticeship in the steel industry. Ian developed technical knowledge across a diverse and wide range of engineering disciplines including electronic, electrical, control, computing, civil, mechanical, process, and materials engineering. Ian is a Vice President of the IST.
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IST Journal & e-Newsletter Assistant Editor: Kirsty Parkin
Kirsty is Assistant Editor to the IST's journal and e-Newsletter. She also works as a Research Support Officer for the National Technician Development Centre for Higher Education and studies business management with the Open University. Kirsty is also heavily involved with a local theatre company, doing production and stage management.
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Geoff is a member of the IST Education Board and one of the assessors for professional registration. His background is in the planning and management of technical training programmes. He is Chairman of the Technical Managers in Universities organisation (TMU).
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How far can Humanist Theories be applied to science & technology teaching and learning?

Kevin Fletcher

Introduction

I have already given a brief consideration in a previous article (Fletcher 2018) to the extent to which a model of Gestaltist psychology can be applied to science and technology teaching. This was then followed by a similar consideration of Cognitivist Theories of Learning (Fletcher 2019).

In this brief discussion I hope to consider Humanist Theories of Learning and map the extent to which they can be applied to, and used in, Science & Technology teaching.

The Humanists

Since about 1960, beginning with the publication of A. S Neill's *Summerhill*, a new movement aimed at criticising and improving education in fundamental ways gathered momentum. The movement has been particularly attractive with post-16 education whose students have been unhappy with their own schooling. It seemed to respond to their own resentment with the regimentation, pressure, competition, and so on. The movement has had several names: "new romanticism", "open schooling" and "alternative education", but is now generally termed "humanistic education".

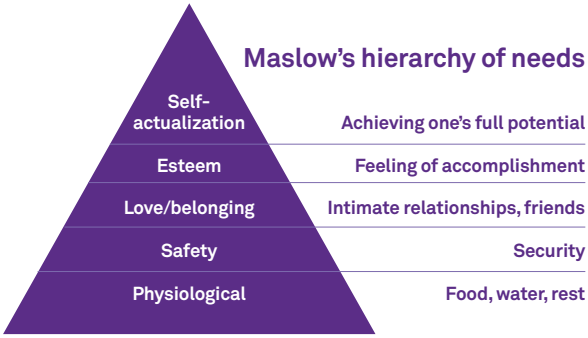
The Humanist school of psychology was developed as a reaction against behaviourism because its proponents saw behaviourism as reducing the concept of the human being. The person was seen as being worthy of dignity and teachers needed to develop qualities of worth and self-esteem. This involved helping every person to make the most of themselves that they could.

Abraham Maslow, is best remembered for his work on motivation. His hierarchy of human needs is well known and is a feature of many management books.

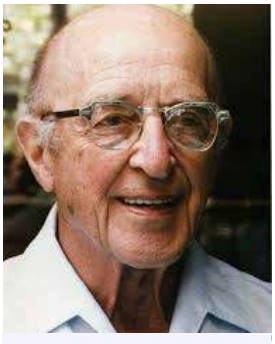
Essentially, Maslow states that needs must be satisfied before effective learning can take place. If a science & technology student is tired, cold and hungry, then the quality of learning will be reduced. The student who feels threatened in the learning situation is unlikely to learn effectively.

Abraham Maslow

Our task as teachers is to create a science & technology environment where students feel part of a group and feel that their contribution has worth.



Carl Rogers' thinking is similar to Maslow's. He felt the need to place the student at the centre of the learning process through active self-discovery rather than having to respond to stimuli. He stated that humans are essentially "good" and that they have a desire to develop and grow. The job of the teacher, in his view, is to generate the conditions and environment for students to develop their own self-concept as part of science & technology.



Carl Rogers

The key to effective, long term learning is based upon **experiential learning** that has the following features: personal involvement, stimulation of feelings and thinking, self-initiation and self-evaluation. The behaviourists see the need to structure and control the learning whereas the humanists see it as essential to trust the learners to follow their own learning programme at their own pace and direction. **Active learning by doing is seen as the key**, but some form of reflection through evaluation is essential.

The humanist approach is quite different to what was (and, perhaps, is) the perceived way in which adults learn. Schools have always stated that they want to educate the whole person rather than train them for an occupation. Colleges tended to keep to subject matter and link their courses to specific occupational areas – in fact the recent legislation ensures that employers have considerable influence over colleges via their corporation.

The humanist learning theories are not so coherent as the behaviourist or cognitivist theories. Like cognitivism, they stress the active nature of the learner. Indeed, the student's actions largely create the learning situation. Humanists emphasise:

1. The urges and drives of the personality;
2. Movements towards increased autonomy and competence;
3. The compulsion towards development and growth of the individual;
4. The active search for meaning;
5. The goals that individuals set for themselves;
6. The social setting in which students operate.

The theories state that learning and setting goals for oneself are natural processes calling into play the persona; learning abilities that students already have and seek to enhance. Learning is largely by imitation and identification with others. Motivation for learning comes from within.

These views also stress the autonomy whereas other views stress learning in terms of "control": the learner is controlled by the stimuli, by the teacher or by the subject matter of science & technology. The materials, humanists argue, on which students exercise their learning skills are less important than the goals that they have set themselves. This means that the role of the teacher is to increase the range of experiences so that the students choose how to achieve their own learning changes.

So, how do we, as teachers of science & technology, apply the humanist perspective? Perhaps we can:

1. Be aware of the extent to which we control the learning and, where possible, allow students to make choices and to manage their own learning;
2. Establish a warm, positive class atmosphere so that every student believes that they can learn and that you want them to learn;
3. Act as a facilitator to learning and encourage, help and assist the learning process;
4. Consider participating as an individual in group settings
5. Do our best to help students to develop positive feelings about themselves;
6. Use role play and simulation exercise when they are appropriate;
7. Provide learning activities that will lead to the development of the habits and attitudes that we want to foster.

Conclusion

As with all the schools of psychology, there is evidence that to some degree Humanist theories can be mapped onto science and technology teaching and learning situations.

There is also evidence to suggest that such learning theories can be applied to teaching science and technology in order to improve its outcomes through student fulfillment and success.

Summary

In this article, I have outlined some of the basic concepts of Humanism and then attempted to show how they can be applied in science and technology. I have gone on to try to distill these ideas into a "checklist" which might be used in lesson planning and the delivery of science and technology in the classroom.

In a future article, I intend to discuss Inductive and Deductive Teaching and Learning and how these might operate in science and technology.

References

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WEB Sources

I acknowledge the use of certain images (in the public domain) and information taken from various web sources such as Wikipedia which were found using search terms entered into search engines such as Google.

Acknowledgement

Much of the material for this article was taken from worksheets and hand-outs developed and used by the Teacher Training Team at Hull and Goole Colleges over many years. I freely acknowledge these documents, images and my colleagues as the source material for this article.

Author

Kevin Fletcher, BA, BSc (Hons), AdvDipEd, MA, MEd, MEd, Cert. IT & Comp, FSET, CBiol, MRSB, MIScT, QTLS, is the retired Head of an East Yorkshire Further Education College. Having spent the first ten years of his career as a Laboratory Technician & Manager in various secondary schools, Kevin's first degree took him into secondary school teaching for a further ten years, ending up as a Head of Science and Deputy Headteacher. Finally, he moved into Further and Adult Education for a further ten years as Head of School in Hull before becoming Head of Goole College. Throughout his career, Kevin maintained a teaching commitment in his areas of interest which are Science, Education/Psychology and Management. He still keeps abreast of developments in these areas despite having retired.

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FIScT

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A brief history of Chinese railways

Daxue Sun

I grew up in a small town in the Northeast of China. In my childhood, on the edge of acres of maize field, I was always curious to watch on as passenger and freight trains flew by like giant caterpillars. I very much enjoyed being engulfed by the thunderous crispy sounds and the gusty, smothering whirlwinds. "Too dangerous," my father used to shout at me, but it was utterly impressive in those days with no other entertainments available to youngsters and I never forget it. Twenty years ago, I came to the UK after a PhD research project, to continue my engineering ambition. In the last decade, the technology development of the Chinese high-speed rail has been extraordinary. My fifteen-year old couldn't keep his eyes off the Chinese bullet trains every time we visited China, and he quite often wondered about the history of the Chinese Railway.

Figure 1. The Woosung Road Railway in 1876. (Credit en.wikipedia.org)

The pioneering work of the Chinese Railway, known as the Woosung Road Railway, was built in Shanghai in 1876 by Jardine Matheson & Co, a British trading firm in the Far East. Unfortunately, the first Chinese commercial railway was short-lived and later shipped to Taiwan by the British investors because the construction work was carried out without approval from the central government of the Qing Dynasty.

Figure 2. The Tangshan-Xuegezhuang Railway in 1862. (Credit zh.wikipedia.org)

In 1881, designed by a British engineer, a 6.2 mile railway line was laid between Tangshan and Xuegezhuang to transport coal from the Kaiping mines. The Chief Engineer of the mines named the locomotive Rocket of China after George Stephenson's Rocket. For almost a year it was animals that pulled the coal trucks, so the local people called the trains the Horse-Mule Railway. That was because the government claimed that the noises from the locomotive engines could disturb the tranquillity and spirit of the royal burial site. This railway line was extended to Tianjin in 1884 and then to Shanhaiguan in 1888, known as the Guanneiwai Railway.

Figure 3. The South Manchuria Railway in 1906. (Credit en.wikipedia.org)

The Revolution of 1911 in China became a turning point for the Chinese Railway at the dawn of the 20th century. The newly formed republic government forced Puyi, the last imperial emperor in Chinese history, to abdicate as a result of mishandling of the Railway Protection Movement by his government.

The patriotic movement was incentivised in Sichuan province against the Qing government's plan to nationalise local railway development projects and to protect foreign investment banks. Mobilisation of the imperial troops from Hebei province to suppress the movement created an opportunity for revolutionaries of the Wuchang Uprising. In the end the revolution toppled the Qing dynasty and established the Republic of China. It was estimated that in the early 1990s around 3750 miles of modern railway had been built nationally, and there were still more to be planned in collaboration with foreign powers. The Czarist Russia built the China Eastern Railway in 1901. After defeat in the Russo-Japanese War, Russia deceived the Chinese government and sold the South Manchuria Railway to Japan in 1905. The Americans built the Canton-Sam Shui Railway in 1904. The British built the Shanghai-Nanjing Railway in 1908 and the Kowloon-Canton Railway in 1911. The French built the Sino-Vietnamese Railway in 1910. The Germans built the Jiaoji Railway in 1904.

Figure 4. The Chengdu-Chongqing Railway in 1952. (Credit zh.wikipedia.org)

The Chinese Communist Party defeated the Nationalists and established the People's Republic of China in 1949. Approximately 13,750 miles of practically unusable rail networks sabotaged in the wars were reconstructed. Most of the reconstruction work was undertaken in the Northeast of China. It took the government 7 years to build its first railway line (314 miles) - the Chengdu-Chongqing Railway in 1952. By 1957, additional 3790 miles of national railway were laid. Passenger trains reached an average speed of 22 mph and freight trains averaged 16 mph. However, the launch of the Great Leap Forward in 1958 and the Cultural Revolution in 1966 had wreaked havoc on the country's fragile economy and political system. The Red Guards of Chairman Mao could travel from around the country to Beijing to see the supreme leader on any train for free. Despite the poor economy and political turmoil in its home rail construction, the Chinese Railway Ministry still managed to build the TAZARA Railway (1160 miles) across Tanzania and Zambia as a foreign aid project. The Culture Revolution officially altered in August 1977 after the death of Chairman Mao. It was not until late 1980s and early 1990s that the government could supply a meaningful budget and commissioned new railway building projects after a lengthy, economic rejuvenation. Diesel and electric trains gradually replaced steam locomotives. Construction of the first section of the Qinghai-Tibet Railway between Xining and Golmud (506 miles) was complete in 1984. The extension of the Qinghai-Tibet Railway (1215 miles) was eventually finished in 2006, in despite of the high-altitude challenge (5000 m) to the railway construction workers.

Figure 5 the China Star Train SS8 001 in 1998. Credit baike.daidu.com

"A journey of a thousand miles begins with a single step," the ancient Chinese philosopher Lao Tzu once said. In May 1998 the Guang-Shen Railway was renovated for travelling at speed after a feasibility study of high-speed rail in the Southwest of China. In June 1998, SS8 001, based on the design of Swedish tilting train X2000, a Chinese prototype of electric train made a speed record of 150 mph in a trial run and made Chinese railway history. The Qin-Shen Railway (90 miles) was built in 1999 and became the landmark of high-speed rail transition in China. In 2002, DJJ2 China Star, the first high-speed train designed by Chinese engineers, achieved a speed record of 200 mph. By April 2007 the high-speed rail lines in China had reached 3800 miles, and for the first time in history the China Railway High-speed (CRH) series were introduced to the public services.

China's early high-speed trains were either imported or built under the technology transfer agreements

with foreign train manufacturers including Alstom, Siemens, Bombardier and Kawasaki Heavy Industries. Following this initial technological support, Chinese engineers re-designed the train internal components and manufactured indigenous trains through its state-owned companies. In August 2008, the Beijing-Tianjin High-Speed Railway was the first commercial rail line to be put into operation in China. A new generation of CRH380A trains broke the speed record of 220 mph on the Shanghai-Hangzhou High-Speed Railway. By the end of 2018, all the planned high-speed railway lines were built. Operating in 33 of 34 provinces they exceeded a distance of 18,000 miles. China has two thirds of the world's high-speed rail lines in commercial services. A decade of perseverance and with substantial funding from the Chinese government, especially the economic stimulus programme during the Great Recession, has seen the rapid development of high-speed railway travel. The High-Speed Railway will continue to be expanded to reach 24,000 miles in 2025 according to the Chinese Railway Ministry.

The success of the Chinese Railway came at a price. On July 23 of 2011, two high-speed trains collided on the Ningbo-Wenzhou Railway in Lucheng District. One train travelling near Wenzhou was initially struck by lightning. It then lost power and finally stalled. Malfunctioning signals caused another train to crash into the rear end of the stalled train. A few carriages derailed in this accident resulting in the death of 40 people and 172 injured according to the government news agency. The safety and management of the Chinese High-Speed Railway system had raised massive public concerns. This accident also affected the business plans to export the cheaper high-speed train technology to other development countries.

Figure 6 CRH380A High-speed Train. Credit baike.baidu.com

"Tragedy should be utilised as a source of strength," Dalia Lama XIV used to say. The 21st century has brought China a huge opportunity to play catch-up and make railway history. It is an incredible achievement that the advent of high-speed railway in China has greatly reduced travelling time and hence has transformed Chinese society, and has boosted the country's economic power. The high-speed rail allows those who cannot afford to live in the most expensive cities like Beijing, Shanghai, Shenzhen, Guangzhou, Macau and Hong Kong to easily commute from cheaper housing in smaller suburban cities. It is just one of the many factors accelerating Chinese development. The real reason for that is the political will that was shown by the communist government for high-speed trains, something that almost every other country seems to lack.

Author

Dr Daxue Sun (Chartered Engineer and Fellow of the Institute of Mechanical Engineers, Chartered Scientist and Member of Institute of Science and Technology) is the Design & Analysis CoE Lead of Engineering Design Capability of Sellafield Ltd. His role in Engineering Capability is to provide technical leadership, strategic management and tangible engineering solutions in design, analysis, assessment and structural integrity to the nuclear decommissioning process. In his spare time, Daxue is a contract columnist of a writing APP – Zine, and collectively has been writing and publishing in English and Mandarin over 150 articles in the last 3 years. He is a visiting foreign professor of Liaoning Science and Technology University, and a visiting foreign lecturer of Northeastern University in China.

Joseph Priestley a man of the "Enlightenment"

Paul Le Pinnet

In 2011 I was asked to give a talk on the history of scientific glassblowing as one of a series of lectures held throughout the day in the Science Museum, London. But where do you start a history? I have always thought that the transition from alchemy to chemistry was during the enlightenment of the late 18th century with experiments being conducted more and more in glass vessels. Since that time scientific glassblowing has developed alongside chemistry.

I have lived most of my life in Warrington and have been aware of the name of Joseph Priestley as he taught at the Warrington Academy (fig1) during the 1760s. This non-conformist Academy was described as the "Athens of the North".

Figure 1. Warrington Academy

The Academy attracted free thinkers from around Britain, Europe and America. While there Priestley met such people as Benjamin Franklin, Matthew Boulton and Josiah Wedgwood. Priestley taught English grammar and during his spare time conducted chemistry experiments. There are just three items of his in the Warrington Museum: a glass retort, a vacuum pump and a burning glass used to direct the sun's rays onto various chemicals. Whilst in London I visited the Science Museum expecting to see more of his glassware. I was somewhat disappointed as the only piece belonging to Priestley was his Electricity Generating Machine.

Apparently, in 1764 Benjamin Franklin encouraged Priestley to study electricity rather than chemistry. Two years later Priestley published a seven-hundred-page book entitled *The History and present state of Electricity*. It outlined the conductivity of metals and explained the difference between conductive and non-conductive materials. His text became the standard for the next one hundred years. Michael Faraday used it for his work on electromagnetism, and William Hershel on infrared radiation. Henry Cavendish and James Clark Maxwell both relied on Priestley's work. As a result, Priestley was made a Fellow of the Royal Society.

Priestley continued with his chemistry experiments, and was fascinated with what he described as "common air". He knew that the air we breathe was a gas. The question was is it a single gas or a mixture and how would he be able to prove it either way? He developed a pneumatic bath in which he could conduct a series of experiments. The bath consisted of a series of inverted domes within a bowl of water to make a gas tight seal. (fig2)

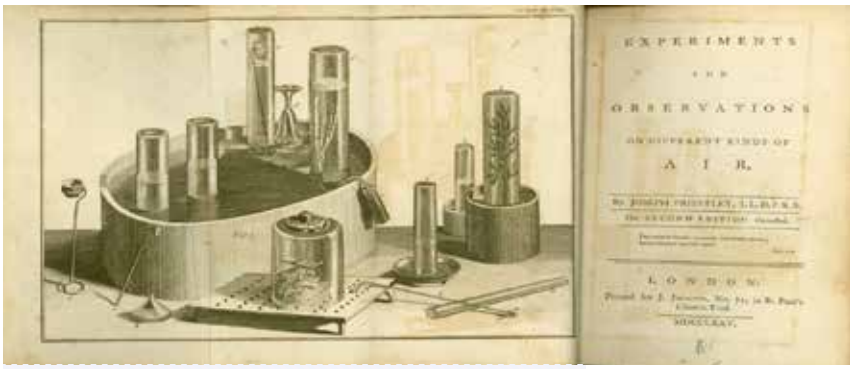

Figure 2. Experiments and Observations on different kinds of air

A lit candle will give off both light and heat. A dome of known volume was placed over the candle which continued to burn. As the candle died the water rose taking up 21% of the volume no matter what the shape or size of dome. Thus, proving to Priestley that air is indeed a mixture of gases. Priestley repeated his experiment with a small caged animal suspended above the water in the dome, when this died the water rose to exactly the same level. He called the gas that supported both combustion and life dephlogisticated air, the , the remainder he called nitrous air. We now know that air

consists of 78% nitrogen, 21% oxygen and 1% argon and traces.

Priestley heated mercury oxide and noted that when a candle was placed nearby it burned with "remarkable vigorousness".

Within his pneumatic bath he also conducted photosynthesis experiments proving that vegetation produces oxygen!

In 1767 Priestly moved to Leeds to be a church minister. He lived next to a brewery so he had a good supply of carbon dioxide, and continued his chemistry as a hobby. In 1773 Lord Shelburne offered him a post as tutor to his two children and Priestley moved to Bowood house, Calne near Chippenham. He was given time and money to equip a laboratory and whilst at Bowood he published a number of books, copies of which are in the Warrington reference library.

Thomas Payne who had written *The rights of Man* was a good friend of Priestley. They both supported the Americans in their war of independence against Britain 1775-1783, and they also both gave their support to the "French Revolution" 1789-1794. This brought Priestley into direct conflict with the British Government. Lord Shelburne, on the insistence of his wife, told Priestley to leave but gave him a pension and enough money to buy a house.

Priestley moved to Sparkbrook in Birmingham with his family and his equipment where he set up a laboratory and library. Sadly, the local people did not like Priestley's radical views. In June of 1791 three men tried to enter his house whilst shooting pistols through his windows, just missing a maid servant. One night in July he was warned that a mob was on its way to "do him harm".

Figure 3. The attack on Priestley's home, Fairhill, Sparkbrook, Birmingham. Credit: Wikipedia

Priestley and his wife escaped and hid for three days, eventually finding refuge in London. The mob ransacked his house (fig3), laboratory and Library. On the 19th July 1791 he wrote a letter to the people of the town of Birmingham:

You have destroyed the most truly valuable and useful apparatus.

You have destroyed the Library corresponding to that apparatus which no money can re-purchase.

You have destroyed manuscripts which have been the result of laborious study of many years and which I shall never be able to re-compose.

Yours faithfully

J. Priestley

Two years later Priestley left for America. He settled in Northumberland County, Pennsylvania. Sadly, his son died soon after arriving in America, and his wife died one year later. Priestley continued experimenting up to his death in 1804.

Figure 4. Portrait of Monsieur de Lavoisier and his Wife, chemist Marie-Anne Pierrette Paulze. Credit Wikipedia

A contemporary of Priestley was the French chemist Antoine Lavoisier together with his wife Marie Anne Pirette Paulz "Madam Lavoisier" (fig 4). She was well educated, speaking French, English and German with a good understanding of Latin also. She worked alongside her husband writing up the experiments. Madam Lavoisier translated the works of Priestley, Cavendish and the Swedish chemist Carl Schiel for her husband to read and made observations in the margins. Antoine then repeated the experiments.

This led Antoine to understand that nothing is created or destroyed. It changes phases but the mass remains the same. He defined elements for the periodic table and renamed dephlogisticated air as Oxygen. He defined compounds and used quantitative analysis.

His greatest failure was that he built on the work of others without crediting their work. It was the Royal Society who rectified the situation on behalf of Priestley.

December 1793 Antoine Lavoisier was arrested, imprisoned, put on trial and condemned. He asked for time to complete an experiment but was told that the revolution had no need of chemists or scientists. On the 8th May 1794 he was taken with twenty-six others and guillotined.

Before his trial Madam Lavoisier had realised that if convicted his property and goods would be forfeit. So, she gave all his notes, drawings and published works to their friends for safe keeping. Soon after Antoine's execution Madam Lavoisier was also arrested because she had been married to a convicted traitor and was imprisoned to await trial and probable execution. But the revolution ended abruptly with the fall of Maximillian Robespierre, and Madam Lavoisier was released. Discovering that that her house had been emptied her friends rallied round and gave her a table, chairs and a bed to lie on. Around one and a half years after the execution of Antoine all of his laboratory glassware and equipment was returned to her with a small note saying: to the widow Lavoisier returned the property of Antoine Lavoisier Chemist. "Executed in error".

This was the only apology she ever received. She exhibited the glassware to raise money to live on, and as she grew older she had to sell off some items. She died in 1836.

The man who accused Antoine Lavoisier and thus brought about his death was Paul Marat. Born in Switzerland and trained as a doctor in Paris, London and Edinburgh, he was given his doctorate by St. Andrews University. Paul Marat spent time at the Warrington Academy and worked with Priestley on his early experiments.

Marat returned to Paris and became a ferocious leader of the revolution leading the call for the death of the King, his family, aristocrats and land owners. Lavoisier was on his death list because he had derided Marat's skills both as a doctor and scientist.

However, the Committee of Public Safety refused to condemn Lavoisier as he was in charge of the production of gunpowder for both the Army and Navy. But agreed they would keep his name on file! Paul Marat was assassinated 13th July 1793 by Charlotte Corday who thought that without Marat the terror of the revolution would end. But it grew worse.

I am delighted to say that all of Madam Lavoisier's engravings, notes and published works, plus most of the glassware, are safe and well at Cornell University U.S.A. What better place for it to reside as France rejected Lavoisier and Britain rejected Priestley.

Eventually, the Royal Society acknowledged that Priestley worked for the good of science and gave him the Copley Medal. Other recipients are: Benjamin Franklin, Humphrey Davy, Michael Faraday, and Justus Von Liebig, Robert Bunsen, Ernest Rutherford, Albert Einstein and in 2006 Steven Hawkins.

Joseph Priestley is in good company.

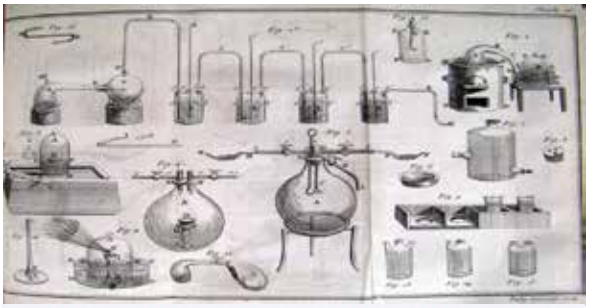

Figure 5

Finally, if we look at the engraving by Madam Lavoisier (fig 5), without whom her husband's and Priestley's work would have disappeared, and imagine the cylindrical vessels to be spherical with interchangeable joints we can think of a gas transfer manifold complete with manometers and associated paraphernalia which looks, to me, very much like modern Scientific Glassblowing.

Author
Paul Le Pinnet MBE

Paul has recently retired at the age of seventy, after more than fifty years as a scientific glassblower. His services to the profession have been acknowledged by the award of an MBE, announced on 10 June 2016 in the Queen's Birthday Honours List. The following year he was elected as a Fellow of the British Society of Scientific Glassblowers in recognition of these achievements and his long-standing, active membership. Later in 2017 the Society conferred on him the title of Honorary Member. Paul is author of *Laboratory Scientific Glassblowing: A Practical Training Method*, published by World Scientific Publishing Europe. The book is rapidly becoming a standard text on the subject.

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Making old television technology make sense

A new approach to technological television history and conservation – part two

Paul Marshall

I will now turn towards the stirrings of colour television which was a very hot topic in Europe in the mid-1960s.

First generation British colour television cameras

Most major companies and broadcasters had experimented with colour television in the 1950s and the USA began a service in 1954. In Europe, colour television cameras had become a small but viable commercial proposition with markets serving military, industrial, medical and aeronautical applications, but the broadcast market was limited to orders for experimental equipment and trials. The principal domestic television set manufacturers were also adapting and developing the American colour set technology and producing prototypes. In the early 1960s, EMI began developing colour TV cameras using three 1" vidicon tubes and a plate dichroic colour splitter to produce filtered red, green and blue (RGB) primary colour images. One model went into production, the EMI 204, but sales were poor and performance limited. At the same time, the Marconi Company was also producing similar 3-tube industrial colour vidicon cameras alongside its range of image orthicon "coffin" cameras based on RCA models. The American colour television boom had begun in earnest with sales of colour televisions growing rapidly spurring the need for more colour programming. Essentially, there were three basic classes of colour camera in production in the early 1960s, vidicon and Image Orthicon and hybrids of the two. None were satisfactory, but the recorded history does not tell the full story. Use of residual hardware has already had a part to play in analysing the issues.

Figure 2 recalls a time when the UK Science Museum Group was still active in the history of the technology of television. Today, what was done for the International Broadcasting (IBC) Exhibition in Amsterdam in 1999 could not be repeated – at least not by the museum. The then Senior Curator of Television at the National Museum of Photography and Television, John Trenouth, contacted me with a view to taking a pair of first-generation colour cameras to the next IBC. We had previously collaborated over an earlier display of operational 1950s Image Orthicon cameras at an earlier IBC, but this was a much more demanding project. Following discussions, we decided that I would tackle the restoration of the mighty Marconi "coffin" camera and another engineer, the late Rob Robson, would tackle the EMI 204. These were both major restoration projects but both cameras were ready on time and duly shipped to Amsterdam and put on operational display. The reception was tremendous with television engineers and other professionals making a beeline to come and see our display. The then head of Sony cameras was astounded by what we had achieved.

Hidden behind this was a very important learning exercise perpetuating for at least one more generation the problems (and strengths) of these incredible cameras. The Marconi gave by far the best pictures with excellent colourimetry, stability and reliability (it did not go wrong at all over the whole 4 days of the exhibition).

The EMI camera was much smaller and lighter in weight, but the colourimetry was as contemporary documentation describes – dreadful. Technically, it would still be entirely possible to do this again, but there will never be the same opportunity offered by the UK Science Museum Group.

Second-generation British made broadcast colour cameras

We have reached the mid-1960s in this backing narrative and I will now continue with camera technology to examine the period when Europe finally adopted colour television and the manufacturers of all manner of television hardware went through a boom period. Television cameras were iconic items in the 1960s and the British public still recognises them, even if they do not know their origins. Sadly, the BBC was

stamping its authority on the camera manufacturing industry with very damaging long-term results. Furthermore, political battles dressed as engineering ones were being fought out over which colour coding system to use. The American NTSC was pitched against the German PAL and French SECAM. What has rattled down the years and is still a hot topic amongst older broadcast engineers and historians is the question of which type and model of colour camera was the most appropriate and successful. It is an arcane topic, but one which still spurs much discussion. Residual hardware has its part to play, but only if it is restored properly and to high engineering standards. I will first examine the historical background to the cameras and then describe how I present this to visitors to my period Outside Broadcast units.

Figure 2 First generation colour TV cameras on show. Left to right: Marconi B3200 3x3" Image Orthicon "coffin" colour camera, camera control units and picture monitors, EMI 204 3x1" vidicon colour camera. Note that the red "Dalek" is correctly reproduced by the "coffin" camera but not the EMI 204. This was the stand of the then National Museum of Film, Photography and Television and I had restored the "coffin" to operational status specifically for the 1999 International Broadcasting Convention in Amsterdam. Picture: author.

The stage was set for colour television in the UK. The country was finally moving to 625-lines on UHF (a major task in itself) with a view to adding colour as soon as possible. Just as American colour television began to properly take-off and at a time when European state broadcasters (and I include the USSR in this definition), were about to draw swords over which country would be "first with colour TV in Europe". The Philips company produced a new camera tube technology, the Plumbicon.[1] Philips began manufacture of 3-tube colour cameras using the new tube (the PC60 and later derivatives) but they were not of indigenous origin, and the BBC could not adopt them if there was a UK sourced alternative. In any case, the design did not meet the BBC specification of 4-tubes (RGB + Luminance) with integral lens.

Marconi recognised the Plumbicon tube for what it was – a game changer – and set about designing a new 4-tube camera. The new camera, christened the MkVII (and formally as the B3205), was designed in late 1965 and early 1966 in the incredibly short time-frame of 9 months to catch the burgeoning US market. Besides the key US market, the design also had to address the likely needs of the BBC/ITV for a quality broadcast colour camera, although this was believed to be a few years away. Unfortunately, the needs of the world market were very different to those of the BBC (and to large extent, of ITV). The BBC wanted 4-tubes, it wanted vidicons for their resolution capabilities (or so it believed, in 1966), and it wanted integral optics (built in zoom lens) for a short front to back physical size (BBC cameramen's demands – not world market ones). The world market wanted a choice of lenses and integral optics made that very difficult. This was a key design decision. The relay optics of the MkVII made the optical design much easier for the lens makers and yielded benefits in terms of access for servicing, but would the BBC buy it?[2] Full of innovations and yielding high picture quality, the BBC steadfastly refused to order any because of the front to back length of the camera head which was not in adherence to their specification.

Over at EMI – firmly wedded to BBC demands – the company created an integral lens design with a short front-to-back dimension using the BBC preferred vidicons. This undoubtedly suited EMI as they also made the tubes whereas Plumbicons would have to be sourced from rival Philips. The complex and compact dichroic colour splitter prism tightly coupled to the zoom lens, necessitated a demanding specification resulting in the tubes being off-axis to each other. All the rival designs had tubes in the same geometrical plane (typically, as a fan-tail arrangement) as it yields optimum registration stability (the overlay of red, green and blue images) in the face of changing temperature and especially orientation within the earth's magnetic field. The demand for an integral lens was not something that was easy to satisfy and required close co-operation with the lens designer and only Angenieux agreed to co-operate. The new design – launched but not shown in 1966 – was to be known as the EMI 2001. EMI was creating a camera for the BBC but failing to address world-market demands. Despite the announcement in 1966, it was not ready for manufacture and still in development, whereas the Marconi MkVII was already being sold and installed. The Marconi Company had created a new colour camera which had tried to square the circle – satisfying world demands whilst trying to keep the BBC on board for any future requirements. An almost impossible task. Was selling to your national state broadcaster the way to commercial success, or was it to properly address the world market demands?

Figure 3 Second generation colour television cameras in the UK. Only the PC60 and Marconi MkVII were in use during the first year of colour television, with the EMI 2001 joining late in 1968 Left to right: EMI 2001, Philips PC-60, Marconi MkVII

To meet the target date for the full service, the BBC desperately needed colour cameras for their studios at Television Centre in London. Mid-way through 1967, the EMI 2001 was still in development and would not be ready until sometime in 1968. This left the BBC with a dilemma – use the foreign manufactured Philips PC60 derivatives or order Marconi MkVIIs? The decision was taken to order MkVIIs just 3 months before the opening date. The Marconi Company agreed to the very tight timescale to manufacture, test and install 17 complete cameras. The delivery and installation dates were fulfilled, and the BBC was able to stick to its schedule. The BBC had effectively forced both UK manufacturers to commit to the 4-tube principle which was expensive to make, expensive to run, required higher lighting levels and were not where the world market had moved to. In media histories and BBC internalist reminiscences describing this period, the EMI 2001 is presented as a classic camera, a world beater and the mainstay of UK colour television for studio use throughout the 1970s and beyond. Up to a point, it is true. Cameramen liked the short front-to-back dimension and it did give good pictures once given huge amounts of light and it was used to produce many famous programmes over a long period of time. However, the reality was that the BBC had lumbered itself with an extremely expensive design which was costly to run and already seriously out of date by the time it came into full operation in the early 1970s. At least one senior engineer at the BBC, C. B. B. Wood, had seen this issue coming, but little was done about it.

Presenting artefacts to the public

In private hands in the UK, in the specific case of the cameras described above, there are two or three EMI 2001s that can produce pictures, but they remain some way from the broadcast standards of the day. I personally have three (almost four) Marconi MkVIIs, in good, close to broadcast quality condition installed in the oldest fully operational colour outside broadcast truck in the world, Southern ITV's rebuilt "Big Bertha". There are no known PC60 or derivative models operational to a high standard in the UK and no data about any elsewhere, despite the model selling more than 1,800 units worldwide – three times the sales of Marconi and EMI cameras of the period added together. Residual operational camera hardware provides a window into the past not just for media historians and engineers but for the public, but it does have to be done with a high attention to detail and best practice electronic and mechanical engineering.

Figure 4 "Southern Television" Outside Broadcast unit "Big Bertha" inside and out

There are three classes of events attended by "Big Bertha". The first is in relation to operations relating to "Golden Age Television" and thus strictly corporate. The second is to specialist shows and events usually involving engineers (past and present), media professionals and journalists. Shows involving the public tend to be the most rewarding (and the hardest

work), but ultimately all three are valuable and spur operations to maintain and improve the vehicle and its on-board technology. Going to public displays and events with operational Marconi MkVIIs always creates a stir. The vehicle – based on a coach chassis familiar to the public – is not as forbidding as some Outside Broadcast units and presents a semi-familiar "friendly face" with a Plaxton Panorama coach front end. As a spacious longitudinal layout vehicle with a complete and easy walk-through along its whole length, it is also easy to process people through, explaining to the always interested public. Curiously, being an ex-ITV vehicle, it also seems to be a more inviting experience for the public rather than the perception of a "pompous" BBC. What is truly gratifying is the level of interest from teenagers of both sexes and the tactile controls (which we allow them touch) are a forever popular novelty compared to computer keyboards and touch screens. I am always indebted to members of the volunteer team as it is certainly not something that can be taken on as an individual. Much of the above applies to the other large vehicle (as described in the "TV-70" segment), but as a transverse layout unit it is less visitor-friendly. The same will ultimately apply to the "new" *Project Vivat* unit as it is also transverse and not so amenable to visitors. The stories surrounding the British made cameras – and the colour ones in particular – are always well received and I would hope that they may be something of an inspiration towards British manufacture and to innovation.

Video tape recorders and telecine

Through the decade 1960-1970, the use of video tape recording in the UK passed from being relatively rare to commonplace. The technology remained 2" Quadruplex and other than adding colour and valves replaced by transistors, nothing much changed. However, another thing that did not change is the deeply impressive nature of the huge machines costing as much as a four-bedroom detached house with a single tape the price of a small car. Within my own collection I have 7 machines and one dating to 1970, an RCA TR70B, is fully operational and used for occasional transfers, but commercial transfers really need to be on later machines. There is still a limited demand in the UK for this work, but further afield in countries such as Russia and Saudi Arabia there are literally hundreds of thousands of 2" Quadruplex recordings yet to be transferred. With all the known machines in the world, this will take many decades and alternative methods of recovery of the information on the magnetic tracks has been investigated. The reality is that most 2" tape is now disintegrating beyond the point of recovery, but a 'contact-less' method may well be possible. In the meantime, venerable machines around the world in archive centres are still performing sterling service but the pool of knowledgeable engineers is shrinking. Such machines never were a simple task to operate and now with seriously degraded tapes an intimate understanding of the technology, its limitations and possible methods of recovery are key. This is another case where deep technical skill must be passed on as the problems will only become worse until desperation produces a "contact-less" technology probably based on the MOKE (Magneto-Optic Kerr Effect) principle.

There are no known telecine machines from the decade surviving in operational condition in the UK. One of the oldest known to be still operational is my Marconi B3404 from 1974 but I do have earlier machines including a Rank Cintel MkII from 1965 (colourised 1969) which could be made operational. There is little commercial demand for any of these machines for transfers as they can be done more easily and better with modern machines still commercially available. The Sandford Mill Museum does operate a Marconi B3410 Line Array machine for public display but that is from the 1980s.

Conclusions

The narrative above describing a decade of development of some television technologies in the UK covers a wide spectrum of factors which ultimately decided the direction of products and technology. The use of operational residual hardware in terms of keeping historical narrative accurate is important, but so too is how the general public's perception and knowledge can be increased by engagement.

Some of this work with the hardware feeds into written histories and these really do need to improve, but how? History written from the narrow media-centric perspective has its place but does not create traction with other disciplines or the public. Taking the alternative, purely internalist technology-based narrative does not solve the problem either – it is just as unsatisfactory with too much attention focused on narrow technological issues. There must be a balance, and to enhance this balance must be added the shaping forces of politics, commerce and social trends. To do this there has to be new thinking and an acceptance that technology and wider forces are very significant factors.

One of the primary issues is how the technological hardware itself is to be conserved for future generations to be able to study and assess the strengths and weaknesses of the equipment and technologies involved. To do this, equipment must be restored and conserved to high standards and this requires high-grade engineers to carry out the work. The technical operators and technicians of the day were used to dealing with faults on a manageable scale on equipment which was nearly new and with

readily available specialist spare parts and full technical back-up. The conservationist today has no base-workshop or factory support and must deal with equipment literally having hundreds of faults and very often degraded vital parts. It is down to attention to detail and skimping on that in the case of cameras results in poor quality, unrepresentative pictures. In the case of a camera, telecine or VTR it can take many hundreds of hours of specialist work to deliver a picture approximating to broadcast quality. To do this in the future, younger graduate and post-graduate engineers will have to be trained to enter a new field of electronic conservation and restoration. In my own work in restoration and conservation I am frequently told that I must take on an apprentice before these skills are lost. This is not about so-called "maintainers", it is about a new generation of highly skilled, knowledgeable and versatile engineers not only able to carry out the work of restoration, preservation and conservation to a high standard, but also to write about it and document it. Only in this way will the full picture of broadcast technology history be properly studied and preserved.

Author
Paul Marshall PhD, BSc. (Hons.), CEng., MIET

Paul began the early part his 40-year electronic engineering career as a student apprentice with The Marconi Company. He has since worked for a number of companies on many prestigious engineering projects in the UK and world-wide. In addition to his "main" career, Paul has run "Golden Age Television" (see: www.golden-agtv.co.uk) with Dicky Howett since 1992, which has helped to support Paul's ever-growing collection of broadcast television equipment. He has collected and restored to operational condition a vast quantity of broadcast TV equipment, including two 12 ton outside broadcast units. Paul completed a part-time PhD (Manchester University, History of Technology) researching the early history of TV.

References

[1] L M Biberman & S Nudelman, eds, *Photoelectronic Imaging Devices: The Plumbicon*, E H Stupp and R S Levitt, Plenum Press, N.Y., 1971, pp. 275-300
[2] Norman N Parker Smith, "Colour Television Cameras – the Designer's Choice", *Sound and Vision Broadcasting*, Vol 7 Spring 1966, 1-7

Guidelines for writing a thesis or scientific paper

Derek Sayers

Introduction

These notes, originally for MSc students, were produced to give some guidelines on how to present a thesis. It has been updated and revised here as part of advice given to applicants seeking election to Fellowship of the Institute of Science & Technology (IST) or authors submitting a scientific paper for publication. It is not intended to be comprehensive but merely to give some advice on presentation.

Further general information on the writing of theses may be gained from consulting members of staff where you work who have already done a PhD or any other postgraduate degree, which necessitated the writing of a thesis.

If you require further help on content presentation, Hawkins (1985) has written some notes on writing a Doctor of Medicine thesis, which are generally applicable here. O'Connor and Woodford (1976) have written a very good book on writing scientific papers, which in general applies to theses. Two other publications, Calan and Barabas (1977) and Lock (1977) might also help. Online, Angel Berra PhD (2014) gives advice similar to what is written here.

Anatomy of the thesis

A Thesis presented for support of an application to Fellowship of the IST should usually be 75 to 100 pages long and typed on A4 paper with **double** spacing. Illustrations, references and title pages amounting to about 25% of this total. A scientific paper for publication is usually much shorter as editors cannot afford the space for long articles. The maximum amount of words will be advised by the editor.

The following plan should be used for the text: -

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The title should be short yet specific, abbreviations must not be used.

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Index the various parts of your thesis and allow for page numbers. The page numbers should start immediately following the Index. Do not try to add the page number here until the whole work has been typed and finished.

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State here in one paragraph the aims and objectives of the work, the methods used, and the results you have achieved.

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Although not strictly necessary, a list of key words immediately following the Preface is helpful for computer filing of the thesis. The key words should be a list of words summarising the subject, methods and perhaps materials used. Also, some definitions can be useful.

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This should describe in about two hundred words the contents of the thesis (less for a paper). Hawkins (1985) stresses that this should be given careful attention because the examiner turns to the Abstract first. If he cannot understand it, it weakens his enthusiasm for reading the remainder of the thesis. If you wish, the Preface and Summary can be combined. An indication of what is required can be obtained by reading an abstract and the accompanying paper from any Journal in a scientific library.

Review of Literature
This is the first chapter of the thesis and is sometimes titled "Introduction". It should be a study in depth of previous authors' work. Here a critical approach should be taken of past work and differences of opinion should be reported when relevant to your thesis. When quoting from other sources use quotation marks at the beginning and end. All acronyms and initialisms should be written out in full at the first time of use with the letter forming the acronym in parenthesis; the acronym can then be used afterwards.

Materials and Methods
The hardest part of writing any thesis is separating "Material Methods" from "Results" and "Results" from "Discussion". It is so easy to write in "Material & Methods" "– so and so materials were used are such and, in such method, and the results were very good so therefore I believe..." In a good thesis or scientific paper, the way you do the work, the results obtained, and what the result's mean, should be distinct, and in different chapters.

For the Institute of Science & Technology, a great deal of importance is attached to technical details, therefore arguably this is the most important chapter. The use of tables, figures and photographs are useful, but make sure you describe these in your text. When indexing illustrations many writers find it easier to separate the tables from the figures and photographs; i.e. Figure 1... and Table 1... The inclusion of photographs or drawings of apparatus and techniques can be very important. Tables present lists of numbers or text in columns, each column having a title or label. It is best to avoid using a table when you wish to show a trend or pattern of relationship between sets of values. These are better in a "Figure" as a visual representation of the data. All Tables and Figures must be referred to in the text.

When you are writing "Material and Methods" remember to include any materials and methods that did **NOT** work well as those that did work. If possible, do not comment at this stage on why the method did not work – it should appear in the "Results" chapter. When you are using specialised materials or apparatus do not forget to reference who or where they come from. For instance, if you used "Analar" sodium chloride mention the company and if possible the catalogue number.

When collecting and assessing computer data, perhaps collecting data on patients in hospital or members of the public, the Data Protection Act must be strictly adhered to. Briefly remember the following:

1. NEVER use subjects' or volunteers' names
2. State when, where and for how long the survey was carried out
3. State criteria used to decide if a subject was suitable or not
4. Methods of assessment should be explained fully
5. The reliability of the methods of assessment must be discussed
6. State the type of statistical analysis used if any

Above all, you must make clear here how much work was done by you and how much by others.

Results
The reporting of results is separate from the Discussion and the Conclusions reached. Here you should report the results of the procedures in detail. Unsuccessful experiments or procedures and "wrong turnings" can be reported briefly. Remember to report negative results. It is tempting to carry on and comment on the meaning of the results, but this must be left for the discussion.

Discussion
Here the results are interpreted, commented upon and deductions drawn. The object is to consider your methods and results in relationship to previous work results, and to suggest what new knowledge has been produced by your work and how this will influence future methods or further investigations. Do not repeat here what you have put in the preceding chapters. It is unlikely that you would want to add more illustrations here but you may wish to refer to those in the Results section.

Conclusion
This should be a brief statement of the results of the work and it is often best presented as numbered sentences.
1. .....

2. .....
3. ..... etc

Acknowledgements
Simply acknowledge and thank all those who have helped you in any significant way in preparing your work. It is useful to include a brief address and qualifications of the person and the place where they work.

References
There is a fairly standard way of setting your reference :

References must be in alphabetical order. Do not number your references; as you may wish to add one at the last moment, it makes unnecessary work altering all the numbers.

Do not write forenames in full, just in initials; if you are not sure which is the forename and which is the surname, then check elsewhere, do not guess.

The references should appear as follows:

Baker J.R. (1995)
English style in scientific papers.
Nature (Lond) 176, 851-852

Berja A (2014)
Steps, to structuring a science paper editor will take seriously
Elsevier .com/connect

Calnan J. & Barabas A. (1977)
Writing medical papers – A practical guide.
Williams Heileman – Medical Books Limited 2nd ed.

Hawkins C.F. (1985)
Write the MD thesis. How to do it.
(2nd ed), BMA London

Lock S. (1977)
Thorne's Better medical writing.
Tonbridge Wells: Pitman Medical 2nd ed.

O'Connor M. & Woodford F.P. (1976)
Writing Scientific Papers in English. Elsevier.
Excerpta Medica. North Holland

Appendix
This can be useful for tables, case reports; perhaps a series of illustrations such as x-rays where inclusion earlier in the thesis would break the continuity of the text.

In the case of a scientific paper **DO NOT** insert these into the text. The editor will decide where they should appear.

N.B. Please note, that, when using other Author's diagrams, sketches, tables etc. YOU MUST give a complete reference of the Author, under the figure or table and the complete reference, i.e. Author's name, page number, book title, date published etc in the Reference section.

Presentation

Typing Thesis
When using a computer for typing your thesis then the program used is entirely your choice – Microsoft Word being the, most common. Ideally a thesis should be typed on one side of A.4 size paper using double line spacing with a 4cm margin on the left. All pages (after the Index) should be numbered on the typed side only. The type used can vary but cannot be mixed; "Times Roman" is the most common. It is possible to justify both left and right margins but justification of the right margin makes indentation in some cases difficult (this paragraph is justified left and right).

Scientific paper
Check the "Submission Guidelines" of the Journal you are submitting to; in some cases they might conflict with that written here (such as Reference styles). Usually a PDF format is advisable otherwise some tabulation and fonts might change.

Headings
Assuming the typist is using a word processor a number of headings and sub-headings might be available

1. **BOLD CAPITALS UNDERLINED**
2. **BOLD CAPITALS**
3. NORMAL CAPITALS UNDERLINED
4. NORMAL CAPITALS
5. **Bold underlined lower case**
6. **Bold lower case**
7. Lower case underlined

Sub-headings can be indented once or twice and perhaps numbered or lettered: -

8. First indentation
9. Second indentation

Photographs and Diagrams
Normally now photographs can be scanned into a thesis although for good quality they should be on a separate page and photographic quality paper used.

Sometimes it might be ideal not to number these pages as it confuses the automatic page numbering by the computer. In the text you might add "facing page 56".

For scientific papers the photographs should be sent separately. Some editors will accept them on a storage device i.e. memory stick (Check the submission guidelines of the journal.)

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Tables
Large tables are difficult and time-consuming to type; they are also often difficult for the examiner to comprehend. If it is necessary to display a great deal of information in one table then highlight the important portion of your table using **bold** lettering or underline.

Figures and Tables are numbered independently in sequence you refer to them in the text i.e. Figure 1 and Table 1. To avoid confusion, you might consider "Table 1" and "Figure A". Conventionally, legends for Tables are written above the Table and the legend for Figures written below the Figure.

Thesis

Copies
For the IST you are required to submit three copies to the examiners; make sure you have one extra copy for yourself.

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Author
Mr D.C.J Sayers FIScT, FInstLM, FRMS

Acknowledgements
I am indebted to Mr Tim Sandle MIScT for his valuable advice and minor additions to the script.

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:
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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.

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John-Paul Ashton MIScT, RSci IST Social Media Engagement Advisor

WiFi sensors for biomedical devices: A healthcare boon

Sumant Gadge

What are Biomedical sensors?

Human bodies works in a mysteriously rhythmic way. Everything we do has a cycle. The way we walk, talk, breathe, think, the way our heart beats and even the way we sleep, everything works in a regular repetitive pattern. These patterns can tell us a lot about our health. They are vital for the normal working of our body. If any of these patterns is lost or interrupted, we have a problem! Scientists and clinicians look for any abnormalities in these patterns to diagnose any disorders or prescribe course of action to make us better again.

These physiological patterns produce very tiny, low strength electric signals that can be detected non-invasively, but detecting these patterns accurately from the surface of the skin is not an easy job. Accuracy is the key here, as the signals measured are not only low strength but also multi-dimensional. Medical devices use task specific, highly accurately calibrated sensors to do this job. Sensors are devices used to detect or analyses a physical or chemical property. The sensor is often an electrical or mechanical device.

Sensors that measure force, pressure, or changes of extra low voltage are commonly used in a healthcare industry for physiological measurement. There are nowadays apps available on your smart phones which can give you a general indication of your heart rate, ECG and sleeping cycles for example. But the biomedical sensors are tightly focused, more sensitive, robust and much more accurate than the ones on a mobile phone.

What information do they sense?

These sensors help us detect the walking pattern (Gait cycle), heart beats (ECG or Electrocardiogram), brain waves (EEG or Electroencephalogram), respiration cycle (PPG or Plethysmogram), sleep pattern (PSG or Polysomnogram or Sleep study), skeletal muscular activity (EMG or Electromyogram) to name a few. Some sensors can give us an accurate view of a body organ, while some can only can give us an indication of the activity due to complexity of detecting the signal.

A biomedical sensor is usually covered in a protective plastic coating with an adhesive material to attach it on a patient's skin. This sensor pack is then connected to a medical device via an electrical cable to carry the sensed voltage/information back to a device for processing and displaying on the screen. How the row information sensed from a patient is changed into a meaningful data is altogether a different chapter. We will just focus on the sensors at the moment.

Current challenges and difficulties with the wired sensors in various clinical areas from Neonatal Intensive Care to Palliative (End of Life) Care set-ups

As much as these sensors are useful in detecting any abnormality/deviation/arrhythmia the physical design of these sensors can sometimes pose difficulties when they are attached to a patient. They can often limit a patient's mobility, and at times impede efficient patient care. For example, in Neonatal Intensive Care Units (NICU) especially, the high number of hard-wired sensors needed while caring for a tiny premature baby can be very difficult to work around. Usually in NICU, a critically ill baby is connected to numerous devices to measure ECG, SpO2 (Saturated partial Oxygen percentage in blood), NIBP (Non-invasive blood pressure measurement), IBP (Invasive Blood Pressure measurement), TCM (Trans cutaneous Monitoring of blood gases), Temperature, EEG etc. Some measurements may require more than one sensor e.g. an ECG may be 5 lead or 12 lead and EEG may be up to 256 channels to have a complete overview of the functionality. On top of these there is also the ventilator tubing delivering the most required respiratory support, the nitric delivery system to support ventilation, the thermoregulatory systems, and the infusion lines feeding intra venous medicinal drugs to this tiny baby. These cables/wires/leads create a mesh around a patient and sometimes make it impossible to touch a baby for treatment or care. The picture below tries to summarise the story for you!

This similar situation can also arise in surgical theatres where a surgeon is completely relying on the accuracy of the several monitors connected with long cables to a patient (under anaesthesia) that can then create a wire mesh and possibly a trip hazard. A situation like this can be a hazard to the care giver as well as the patient.

Figure 1. A premature baby inside an incubator in the neonatal intensive care unit. The sticker attached to the chest is one of three ECG probes. A pulse oximeter cuff is secured to the foot, and a temperature probe is attached to the baby's back. The nasal tubing provides non-invasive ventilation.
Credit. BMJ under Creative Commons license

Some sensors are attached to a patient for a considerable amount of time for continuous health monitoring. For example, in the Neonatal Unit, the baby to mum skin contact (Kangaroo care therapy) is utmost important for their growth and bonding. But this can become difficult due the many wires impeding that contact and an important part of that care is lost.

These cables are usually made up of a metal wire which is not always safe during imaging or scanning a patient. So if a patient needs an urgent scan like an X-ray, the cables create artefacts in the image and distort the clarity thereby delaying the treatment. One more aspect in this regard is safety during defibrillation. When delivering a shock, if the ECG sensors or sensor cables come in contact with the charged defibrillator pads, it may burn patient's skin and can cause adverse effects such as electrical shock or damaging medical equipment.

The elderly or critically ill adult patients face similar difficulty in terms of patient care and imaging. The care givers can trip over a cable, disconnect a sensor and may also damage patient skin. Almost in all situations like these, patients will not be able to respond, as they may be critically ill or under anaesthesia or other such medication. There have been incidents reported where the in-situ catheter lines/ventilator circuit got accidentally disconnected due to tripping over by nursing staff, giving rise to the danger of the patient's condition rapidly deteriorating if it was failed to correct the issue within time.

Another most common issue with these cables is the internal breakage. Sometimes due to excessive use/misuse, the fine wires (carrying a vital electrical signal) covered by a protective sheath break and fail to transfer the information. This situation can be a potential risk as the nursing staff will not be able to differentiate between a technical fault (caused due to internal damage) and a genuine clinical condition.

WiFi sensors: a breakthrough?

As you can now see, most of these issues can be due to the sensor cables hanging from a patient. Can we overcome this issue? Can we get rid of these long hanging cables so that the patient area will not be cluttered and will be free of any trip hazards? Thanks to advances in wireless technology, most of these sensors can be made wireless, so no or very little cable mess around a patient. WiFi sensors can possibly change the face of the healthcare industry and can make a stay at a hospital a little bit more pleasant by offering much needed freedom and mobility!

Major benefits

Apart from the obvious ones mentioned above, WiFi sensors can bring in a number of benefits to patient care:

1. Better patient experience. Obviously, nobody wishes for a hospital visit unless there is a real need. Patients will often be suffering pain and under stress, and the last thing they will want is to be confined to bed hardwired by numerous sensor cables to medical monitors. The freedom and mobility which WiFi sensors can offer will definitely contribute toward an improved patient experience.

2. Reduced human factor errors. With the introduction of the sensor output digitised at source the information will be more easily presented.

3. Reduced waste. Eliminating very long and bulky electrical cables, that are often sheathed in a thick heavy-duty plastic covering material, will contribute to a better natural environment.

Design Requirements

The concept is outstanding but not straightforward. A lot of consideration needs to be put in to come up with safe and secure WiFi sensors that will be accepted by this highly critical industry. A few points to consider are:

1. Discrete: In acute care settings where continuous monitoring is vital the sensors have to be attached to a patient's fragile skin for days. This poses a risk of deteriorating the patients skin condition due to the weight and size of cables attaching sensors to the medical device/monitor. The design of WiFi sensors will need to be light weight and compact. With the advancements in microelectronics, it should be possible to fit all the necessary circuits, including on-board batteries, on a paper-thin size skin like material. As these sensors will sometimes be used on tiny premature babies, the overall surface area coverage will also be of importance.

2. Secure and robust on data integrity: As several sensors will be used on a patient and several such patients will be placed in a ward bay, and a number of bays on a ward, it would be quite crucial that the sensors talk to their dedicated monitors and that the data transfer and storage is encrypted at an appropriate level in line with information governance.

3. Reliable with low signal loss and better connectivity: One of the most important consideration would be reliability. As the patient gets moved from one place to another or even a patient changes their posture/position, the sensor to device connectivity must be strong enough to cater to these fluctuations.

4. Universal nature: One of the major benefits this technology can bring is the possibility to configure the sensors to read specific parameters e.g. a sensor can be made to read ECG and simultaneously or at some other times, it should be able to read patient temperature. Going ahead in the future, these sensors can be designed to be interchangeable between different devices (models as well as manufacturers).

Concept and prototype of a wireless sensor

Current work: Currently, wearable and implantable sensors are attached to a patient. These sensors wirelessly transmit the acquired physiological information to a control device such as an access point. This access point receives such information from other control devices. The collective data set is then conveyed to remote places via a body area network (BAN) for diagnosis and consultation for therapy. This type of wireless transmission is collectively called Wireless Sensor Network (WSN) or Wireless Body Area Network (WBAN). The figure below describes various stages of information flow in WBAN.

As shown in the figure 2, during stage/level 1 (Intra-BAN communication), the information is transferred from sensors to a personal control device. At level 2 (Inter-BAN communication) all such control devices transmit the information to an Access point. The access point then communicates with long distant recipients like ambulances or hospital telemedicine servers over the secured internet channels. This is level 3 (Beyond-BAN communication) of the WBAN architecture. Please refer to article no.2 and no.6 for a detailed understanding of the WBAN architecture and set up.

Smart Contact Lenses[3], MY Heart project[4], NASAs work in wearable devices[5] are just a few classic examples using WBAN architecture. Google1 started

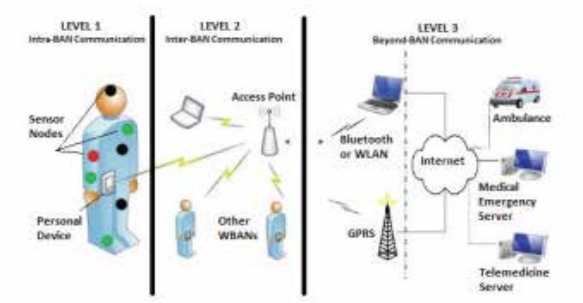

Figure 2. WBAN Architecture. Credit: Journal of Physics [2]

an innovative project of developing Smart lenses that could use tears to assess the insulin level and warn patients and/or clinicians of any potential risk. Unfortunately, the project was discontinued due to unavailability of enough evidence that assessing the sugar level in such a way is effective.

Meanwhile, at Ann & Robert H. Lurie Children's Hospital in Chicago, something really innovative is happening. A group of clinicians, scientists and biomedical engineers have come together to develop a prototype of skin like wireless sensors for neonatal use[7]. The sensors are being tested and seek regulatory approval before being commercialised.

The photos below showcases the ease and freedom these sensors bring to patients. As these are very thin and lightweight, even the tiniest patient in a hospital should not feel the burden of carrying these.

Possible drawbacks

Every coin has two sides! With every innovation comes the good and the bad parts. We have seen the obvious benefits of these sensors but there can be disadvantages too. Mentioned below are a few stumbling blocks to this innovation becoming a reality.

Crosstalk: As these sensors are not physically attached to the control device through cables, there is a high possibility of cross talk between the control device and the other sensors in the vicinity (but not attached to the same patient). Other possible causes of cross talk can be radios, TVs and networking instruments. To prevent this, the quality and strength of the WiFi signal should be high enough. Also, appropriate tuning, secure coupling as well as frequency modulation will help reduce the cross talk.

Loss of signal: This can pose a big risk on patient care especially in situations where continuous monitoring is of utmost standing. If the WiFi connectivity is poor, this situation can often occur. This will reduce the credibility of these sensor and users may not have the confidence

Figure 3. Neonates with various WiFi sensors
Credit: Anne & Robert H. Lurie Children's Hospital Chicago

to use them on critically ill patients. Setting up a robust network connectivity should be a priority when designing these sensors.

Increase in costs: Due to the amount of research and time invested in designing these sensors, they may cost considerably more compared to the traditional sensors. This may deter the investors and researchers in investing their money and time in this development. A balance must be achieved and confidence must be gained for the end users to outweigh the advantages against the initial costs.

System reliability: Sometimes it's not just the sensors but the complete medical system becomes unreliable due to fragility factor introduced by connectivity, material quality and patient skin condition. This is not something which can be corrected overnight, this will take time and effort. But this can make or break the future of WiFi sensors in the healthcare sector.

Possible breach of privacy and security: With the advent of crosstalk, comes a possibility of making the patient confidential data available to outside world (often to unwanted recipients). The system must be continuously monitored

Future developments

Imaging Compatibility: As these sensors will be widely used on patients who require continuous monitoring, it will be highly beneficial if these can still be worn when they are undergoing procedures like MRI (Magnetic Resonance Imaging) scan, CT (Computed Tomography) scan or even an X-ray. As most metallic elements cause artefacts during these imaging methods, choosing appropriate parts to manufacture these sensors will be vital. Of course, this will require careful planning and vigorous testing.

Universal use: As mentioned before, if we can design and manufacture such sensors that can be used on different makes and models of medical devices for measuring same or different parameters, it will make things easy for clinical staff. All they should have to do is program or configure a sensor to be able to measure specific vital signs. This may seem far from reality at the moment but looking at the fast pacing advancements in technology, it certainly is not impossible!!

Re-usability: Due to the investment and effort being put in to making such robust, safe yet sleek WiFi sensors, the cost of these items will be very high as compared to the traditional sensors. The increased purchase price can be an impediment for future buyers.

Author

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Sumant is a Clinical Scientist at East Kent Hospitals NHS University Foundation Trust. After completing his MSc in Medical Physics in 2006, he has been working within various sections in MPACE (Medical Physics and Clinical Engineering) group. Sumant also teaches at the University of Kent (Visiting lecturer) and supervises final year projects for B.Eng. students. He is an active member of Policy and Guidance group at Department of Neonatology and assists the simulation team conduct study days and signs off the device competencies for clinical staff including newly qualified doctors. Sumant is a qualified ISO QMS auditor and had been conducting the internal audits within the MPACE group. His main areas of interest are Medical Device design and regulations, MRI, teaching and training and Policy and Guidance.

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Alfred Worswick and the pioneering days of heavier-than-air flight

Alan Gall

Introduction

In 1896 Lord Kelvin (alias William Thomson, 1824-1907) received an invitation to join the recently formed Aeronautical Society. At the age of 72 the elder statesman of science seems to have lacked the vision of his earlier days, on this occasion at least. He replied on the 8th of December:

I was greatly interested in your work with kites; but I have not the smallest molecule of faith in aerial navigation other than ballooning or of expectation of good results from any of the trials we hear of. So, you will understand that I would not care to be a member of the aëronautical society.[1]

Perhaps he had not followed the exploits of John Stringfellow who, as early as 1848, flew a large model plane powered by a steam engine.[2] A very limited flight, admittedly, but a good indication that developments in engines and aerodynamics would lead to eventual success.

The person hopeful of recruiting Kelvin to the ranks of the Aeronautical Society, one Baden Fletcher Smyth Baden-Powell, younger brother of Robert Baden-Powell,[3] went on to establish the British magazine *Aeronautics*[4] – which took an interest in the aircraft designs of one Alfred Worswick.

The Worswicks of Wigan

On the12 July 1879, Mary Ann Worswick (née Wood) gave birth at home to a boy called Alfred. There he joined siblings Henry James, John (junior), Frederick, Walter and Annie. The Worswicks were an enterprising family, involved with vehicle hire, selling furniture, bill posting and entertaining Wigan folk at various theatres.

Intimately connected with the Worswicks were members of the Gee family (see later) – headed by John Gee, by all accounts something of a human dynamo. He served as an alderman in Wigan and at various times had connections with: Timberlake & Co, Kew Gardens[5], Wigan & District Tramways Company, a brickmakers, and an ironfounders.[6] In addition he ran a grocery business at Scholes and notably operated in partnership with John Worswick (senior) as Worswick & Gee, owners of the Royal Court Theatre, King Street, Wigan, built at a reported cost of £18,000 in 1886 (figure 1).

Shortly before 1890, an emporium called the Theatre Royal came into the hands of Alfred's brother Henry James. The building dated back to about 1850 and badly needed a face-lift. It received this under Henry, who replaced virtually the entire interior. The theatre had previously been taken on a lease (from 1884) by W. Revill & Son. Under Mr Fred Revill, the management had its own version of the phrase "don't call us, we'll call you" when engaging new acts: "One week's silence a most polite negative."

Figure 1. John Worswick's Royal Court Theatre. Courtesy of Ron Hunt, Wigan World website

The partnership of Worswick & Gee was dissolved in January 1894, but the Worswick connection with entertainment continued. The Theatre Royal, despite its extensive refurbishment in 1890, lasted only a further fourteen years, but demolition in 1904 coincided with the opening of their Grand Hippodrome built on an adjacent site. The Worswicks formed the Wigan Entertainments Company Ltd in 1910 which nearly saw a hundred years of operation before being dissolved in 2003.

It would be natural for Alfred to be involved with activities at the theatres and in the 1901 census he is described as a theatre electrician, although an obituary says that he adopted automobile engineering as a profession. Whatever skills he possessed, these were put to use in his increasing fascination with powered aircraft.

Those magnificent men

The first controlled flight of a manned, heavier-than-air machine, under its own power, is credited to Orville Wright, achieved on 17 December 1903 at Kitty Hawk, North Carolina. It lasted twelve seconds. The Americans and French were seen as leaders in the development of aircraft, with British efforts lagging behind. Aeronautics (the British publication) commented:

... experimenters in this country have acquired the unfortunate attitude of of drawing an impenetrable veil of mystery over all their labours and trials. It is difficult to see what object they hope to achieve by their secrecy, which stands in glaring contrast to the frankness and openness that accompany experiments in France.[8]

Unlike Lord Kelvin, French-American civil engineer Octave Chanute had faith in successful "aerial navigation" well before the efforts of the Wright brothers. His 1894 book *Progress in Flying Machines* brought together much of the available knowledge that was needed to kick-start serious attempts at aviation.

Despite the reticence of some would-be aviators, an American magazine, also called *Aeronautics*, regularly reported on English flying accomplishments, with the names of A.V. Roe and Moore-Brabazon being particularly prominent in the 1910s. The January 1910 issue of Aeronautics remarks on a story that Moore-Brabazon carried a pig on one of his flights (figure 2). John Theodore Cuthbert Moore-Brabazon, later Lord Brabazon of Tara, had the distinction of holding the first pilot's certificate issued by The Royal Aero Club of Great Britain, dated 8 March 1910.

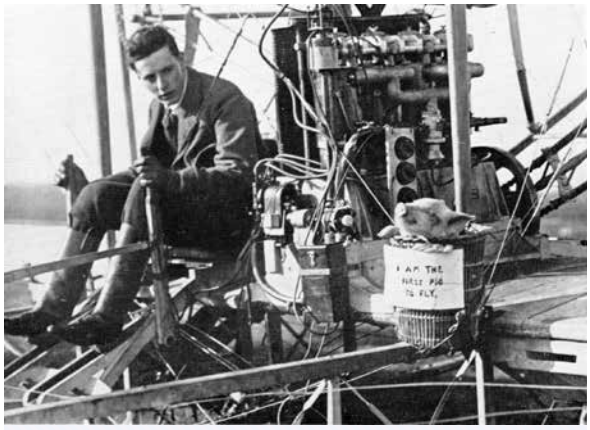

Figure 2."Pigs Might Fly". J. T. C. Moore-Brabazon on board a biplane made by Short Brothers, Isle of Sheppey (The Brabazon Story, 1956)

Another pioneer on the British scene, American by birth, Samuel Franklin Cody, flew man-lifting kites in 1905 (Cody box kites are still well-known). With the ambition of being the first man to fly in Great Britain he moved on to construct aeroplanes and has been credited with this achievement.[9] Moore-Brabazon gained fame for flying a circular mile, a first in this country on a British machine flown by a British subject.

Elsewhere, Alberto Santos-Dumont made the first certified public flight in mainland Europe on 22 August 1906 and Louise Blériot won the £1000 *Daily Mail* prize for flying over the English Channel from Calais to Dover on 25 July 1909 (figure 3).[10] The *Daily Mail* continued its sponsorship of aviation awards, paying the princely sum of £10,000 to Louis Paulham for his150-mile flight from London to Manchester.[11]

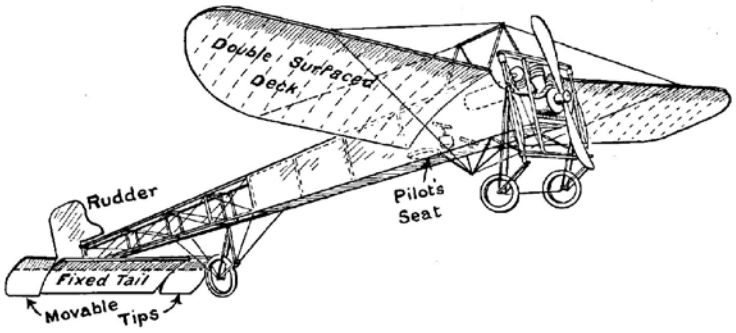

Figure 3. Diagram of the Blériot monoplane used to cross the English Channel in 1909 (How it Works, c.1911)

The early period, around the 1910s, saw the emergence of many names to be associated later with major aircraft production in Britain: Geoffrey de Havilland, Frederick Handley Page, "Tommy" Sopwith, Richard Fairey, and Alliott Verdon Roe. Moore-Brabazon went on to become Minister of Aircraft Production in World War Two, and chair the Brabazon Committee that devised the specification for the Bristol Brabazon airliner.

Alfred Worswick studied technical information as it became available and in 1908 lodged his specification for "An Improvement in Propellers and Wings for Aeroplanes and the like". This gave him patent number 8591, accepted 15 April 1909. By 1908 he had moved into a new house called "The Woodlands" on Gathurst Lane, near the village of Shevington, a suburb of Wigan. A nearby field would prove useful.

Motorplanes Ltd

Figure 4. Advertisement from Aero 12 July 1910

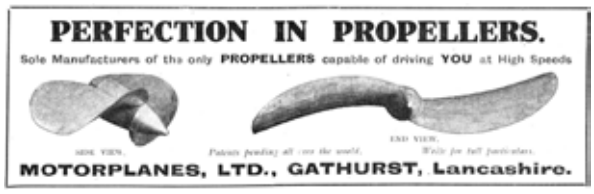

Figure 5. Advertisement from Aero 31 May 1910

Figure 6 Advertisement from Aero 3 May 1910

Alfred initially called his new venture The Motorplane Manufacturing Company and with expectation of success for newly registered patents, converted this into Motorplanes Ltd, incorporated 21 February 1910. Throughout the process, he received help from a member of the Gee clan, Randolf Hatton Gee, at that time a solicitor in his mid-twenties. Alfred assumed the role of Chairman of Directors, although the board consisted of only one other individual, Randolf Gee. A partner in the Wigan accountancy firm of Lathom & Taylor filled the post of company secretary, another youthful member of the Gees, Reginald Gee Taylor.

The Worswick patent, number 8591, detailed the design of a propeller rigidly held at the front, but with a flexible rear that would automatically change shape with varying flying and wind speeds (figure 7).

... thereby always obtaining a forward thrust under any conditions, either in a strong breeze and the propellers driven slowly, or when the machine attains a high speed. This may be compared to a gull or other bird in flight against a strong breeze or travelling at a great speed in the calm air.

Alfred could hardly have missed the local news about a minor disaster that befell A.V. Roe when two of his aeroplanes were damaged by fire while passing Wigan on a train. The triplanes reportedly caught fire after sparks from the locomotive's engine landed on some packing. The materials used in the construction of early planes made them particularly vulnerable to such accidents.

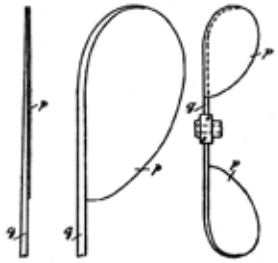

Figure 7. Propeller design as shown in patent 8591 of 1908. Material q is rigid and p is of spring steel

The rider of a bicycle is concerned only with balancing himself right and left. The aeroplanist may be compared to the music-hall artiste who rides a single wheel on which he has to balance himself in all directions.[12]

Alfred considered the problems of control surfaces and his application for a patent on "Improvements in Balancing and Steering Aeroplanes and the Like" carries the date 23 January 1909, accepted in November of that year. The specification covers a three-plane system – a vertical steering plane and two horizontal elevators, with details of the wire control system. Two months later he returned to propeller design, this time with a patent for fully-rigid blades.[13]

The Wigan Observer published a photograph of the Worswick Motorplane Type C Number 1 in the issue of 16 April 1910 (figure 8). Presumably the person at the front end of the aircraft is Alfred (or seated inside), and likewise, at the rear, are two of the hired help clad in aprons. Papers often went into great detail in those days (a report of a wedding might even list the wedding presents!) and the "vital statistics" of the aircraft were given (see Appendix 1).

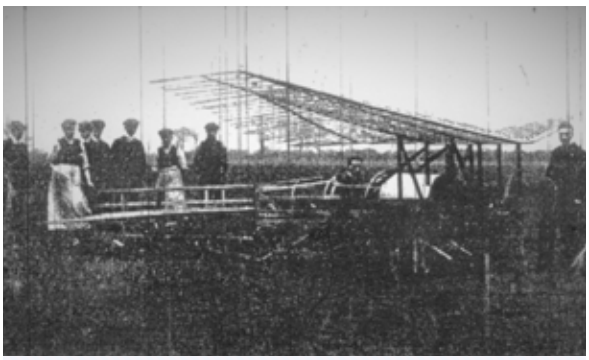

Figure 8. An image of Motorplane Type C No.1 printed from a microfilm reader, hence the poor quality (Wigan Observer 16 April 1910)

In the *Aeronautics* article of May 1909, the aeroplane works at Gathurst is described as being "... in a fine open space, well clear of trees and obstructions, and in an elevated position." Figure 9 shows a group of ten houses at the top of the map. They were once identified by house names, which have now mostly vanished. It is believed that one of these is The Woodlands and that the works occupied one of the fields behind the houses or just to the south.

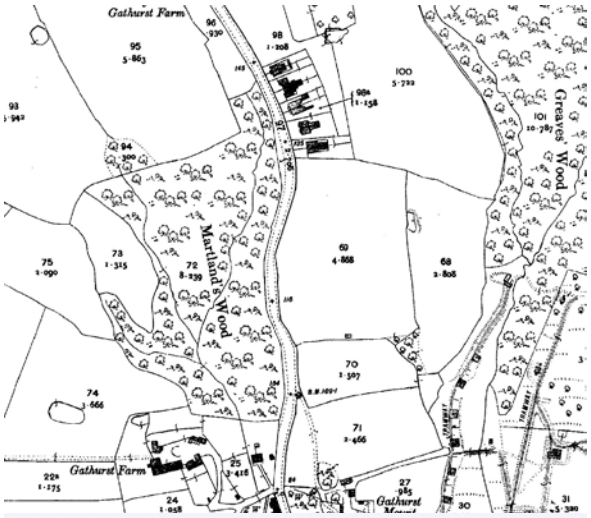

Figure 9. Gathurst Lane (OS map of 1908)

It is interesting to compare the short-lived Worswick aircraft enterprise with that of A.V. Roe & Company, a firm that gained fame with numerous well-known and respected Avro machines.[14] Roe made his mark in aviation by winning the highest award in the *Daily Mail* Model Aeroplane Competition of April 1907. He and Alfred Worswick were contemporaries differing in age by under two years.[15] Both formed their companies officially in 1910, and against a background of established family businesses. While Roe is well-recorded as an active aviator at the forefront of aircraft development, there is no evidence that a Worswick plane ever left the ground or that Alfred flew in an aeroplane of any description. Not that it was a quick success for A.V. Roe, his nickname "Roe the hopper" testimony to many abortive attempts to remain airborne for more than a few yards. The short life of Motorplanes Ltd meant that the intention to offer viable aircraft never materialised. Did Alfred lose heart after several failures, or did the after-effects of a motorcar accident cause him to move away from the area, relocating some 200 miles away?

A tragic event

Alfred, accompanied by Elizabeth and a friend, drove his car along Park Road, Wigan. As they approached the junction leading to Woodhouse Lane, a little girl called Clara Gibson reached the lane by way of Waterloo Street. By chance a horse-drawn lorry had taken up a position intercepting Clara's path and obscured the view as she stepped out into the road. At that very moment, Alfred approached, struck and fatally injured the child. The inquest held in August 1909 returned a verdict of "pure accident" but it might explain why Alfred left the area a year later and subsequently had mental issues.

An advertisement appeared in July's issue of *Aeronautics* (figure 4), but by the end of the following month Motorplanes Ltd had closed. On 20 March 1911, Reginald Gee Taylor wrote to the Registrar of Joint Stock Companies: "The above named Company [Motorplanes Ltd] ceased to carry on business on August 31st last, owing to the failure of the patent for the exploitation of which the company was formed". From registration to termination, the company had lasted precisely six months and one week. Alfred Worswick departed from Gathurst, to reappear in Surrey.

Messrs Worswick of Croydon

The title of "job master" is no longer in common use. It originally referred to a person (or firm) who hired-out horse-drawn vehicles, generally for specific events such as weddings and funerals. With the advent of the petrol engine, the term "motor job master" appeared. Alfred abandoned his venture in aeronautics to take up this profession. It is not clear if the Worswick family already had the business in place as an extension of the Wigan vehicle hire operation, or suitable property was acquired for the express purpose of giving Alfred a job. What is known for sure is that by 1922, when the Croyden-based business came on the market for sale, there had been considerable expansion. Addresses were given as: 30a & 40 Croham Road and 128, 130, 134 & 136 Southbridge Road, Croydon; 2a Norbury Cresent, Norbury.[16]

Alfred took up residence at 54 Heybridge Avenue, Streatham, later moving to The Nook, Woodcote Green, Wallington. The house in Streatham stood just over half a mile north of the firm's branch on Norbury Crescent (then called Melfort Road). Apart from vehicle hire, car spares were sold and repairs undertaken. One of the chauffeurs employed for a time at Norbury received a month in prison for driving under the influence of alcohol. Worswick's general manager, J. Parsons, wrote a disclaimer for the *Norwood News* stating that the offence occurred after the chauffeur's employment had ended.[17]

No records have been found to suggest that Alfred joined the armed forces at or after the start of World War One. Presumably his position as head of the firm would have given exemption from being conscripted. Meanwhile, back in Wigan, Alfred's sisters were doing

their bit for the war effort by entertaining wounded soldiers with concert singing. Alfred's brother John, however, fell foul of wartime restrictions. He received a summons for having his house lights unduly visible, contravening the Subdued Lights Order, and compounded the offence by verbally abusing one of the special constables responsible for reporting the incident. Another event was the marriage of sister Annie to solicitor Charles Bradley. *The Wigan Observer* 10 February 1917 reported: "The presents were numerous and costly". An unhappy event occurred on the 23 July 1918 with the death of Josephine Doris Worswick from influenza, possibly the strain know as Spanish Flu that killed over 50 million people worldwide during 1918-1919. But Alfred was no longer present to mourn the death of his young cousin.[18]

Alfred suffered from a mental breakdown and returned north to be treated at Haydock Lodge, a private lunatic asylum near Newton-le-Willows, about halfway between Manchester and Liverpool. Very soon after its foundation the institution gained a reputation for the maltreatment of pauper patients and this prompted a Parliamentary investigation at the time.[19] What might have been expected to be a treatable condition worsened and Alfred passed away just before his 38th birthday.[20] Doctor Charles F. Street certified the causes as: "(1) Pneumonia 7 days (2) Acute Mania 1 month 4 days". There was no post mortem. Alfred's remains were laid to rest in the family crypt at St. Joseph's Catholic church in the parish of Wrightington, near Wigan.

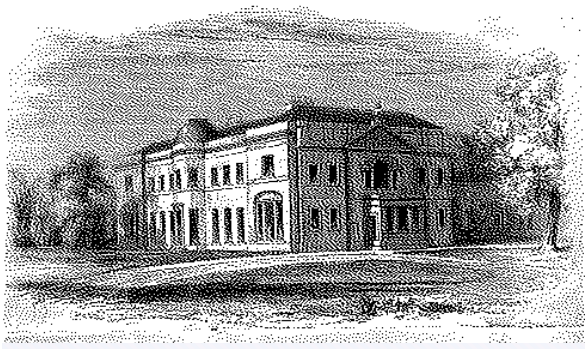

Figure 10. Haydock Lodge shown on an 1845 pamphlet (courtesy of Andrew Roberts.)

Acknowledgements

Thanks go to:

Ron Hunt of the Wigan World website for the Royal Court Theatre programme cover.

Pauline Hurst, Secretary of the St Helens Townships Family History Society, for information on Haydock Lodge.

Brian Riddle, Chief Librarian, National Aerospace Library, for supplying a copy of the *Aeronautics* article on the Worswick monoplane.

Andrew Roberts of the website studymore.org.uk for the image of Haydock Lodge

Dave Robinson of AviationAncestry.co.uk, for the Monoplanes Ltd advertisements.

Appendix 1

Description of the Worswick Motorplane Type C Number 1 from the *Wigan Observer* 16 April 1910.

Areas: Main plane 190 square feet, elevators 40 square feet, rudder 22 square feet.
Lengths: Span 31 feet, chord 9 feet to 3 feet 3 inches at tips, camber top surfaces, 7 feet, 20 feet at loading edge, tapering to zero at tips, bottom surface flat, rear edge flexibility 2 feet 6 inches.
Angles: Dihedral 7 degrees.
Materials: Steel tube, ash, pine and mahogany, chassis of steel tube and steel spiral springs.
Engine: 10-12 h.p. Humber.
Propellers: Two, diameter 4 feet, two bladed, guaranteed thrust each 200 lb at 1,000 revolutions in any wind.
Weight: Machine 450 lbs, pilot, oil, petrol and water 200 lbs, total flying weight 850 lbs.
Speed: At beginning of flight 40 miles per hour.
System of control; Nature, lateral and longitudinal stability, with hand auxiliary balancing, elevating and steering by irreversible worm gears. Ratio: 4.7 lbs per square foot of area of main wings.

Appendix 2

The Observer of 2 January 1910 published a list of "Eighty Englishmen with Flying Machines" commenting "The list does not include two or three quite obvious 'cranks'."

Asterisks indicates those who were known to have actually flown. Alfred Worswick is not mentioned.

Appendix 2 continued

H. J. D. Astley, monoplane (Antoinette type), Brooklands
Graham Bell*, a tetrahedral-cell machine, Canada
Messrs. A. W. and C. Barnard, a biplane, New Zealand
George Barnes*, a monoplane, Abbeywood, Kent
Harry Berfan, a monoplane, Accrington
Major Baden-Powell, the Baden-Powell monoplane, Barking
Mr. Barnwell, a monoplane, Stirling
Mr. Baldwin*, the McCurdy biplane, Nova Scotia
S. F. Cody*, the Cody biplane, Wembly
G. B. Cockburn*, a Voisin biplane, Salisbury Plain
W. E. Cook, a monoplane, Burnley
Mr Defries*, a Wright biplane, Sydney
Captain J. W. Dunne*, a biplane, Shellbeach
Maurice Egerton*, Wright biplane, Shellbeach
W. Foulis, a biplane (Wright type), Edinburgh
H. Farman*, a Farman biplane, Mourmelon
M. Farman*, a Farman biplane, Bue
H. G. Furguson*, the Furguson monoplane, Lisburn, Ireland
A. E. George*, a Voisin biplane, Shellbeach
Percy Grace*, a Short biplane
A. Lee Guinness*, an Antoinette monoplane, Mourmelon
Mr Harkness*, an Antoinette monoplane, Mourmelon
Professor Huntington, biplane (Voisin type), Shellbeach
Ballin Hinde*, a Blériot monoplane, Coventry
J. Humphreys, Humphrey's monoplane, Wyvenhoe
J. H. Jones, a Blériot monoplane, Adelaide
Mr Kimmerling, Voisin biplane, South Africa
H. C. Lobnitz, a biplane, Cowes
Guy Laking*, the Laking monoplane, Clackton-on-Sea
Captain E. M. Maitland, a Voisin biplane, Brooklands
Captain Mackworth, a biplane, Shorncliffe
Sir Hiram Maxim, the Maxim biplane, Crayford
Mr Moreing, a Voisin biplane, Dagenham
F. McClean*, a Wright biplane, Shellbeach
G. J. Mason, a monoplane, Hanwell
G. Manning*, the Howard-Wright biplane, Rye
R. F. McFie*, a monoplane (Blériot type), Foulness I., Essex
J. T. C. Moore-Brabazon*, a Short biplane, Shellbeach
Mr McCurdy*, the McCurdy biplane, Nova Scotia
A. J. Milne-Wilson*, a Blériot monoplane, Pau
Mr Neale*, the Neale monoplane, Brooklands
A. Ogilvie*, a Wright biplane, Rye
G. W. Parkinson*, a Blériot monoplane, Newcastle
Mr Pickersgill*, the Pickersgill monoplane, at Keighley
C. Pride, a monoplane, Bristol
M. H. Fentum Philips, a Helicopter aeroplane, Guildford
A. V. Roe*, the Roe triplane, Wembly
Hon. C. S. Rolls*, a Wright biplane, Shellbeach
Henry Rawlinson*, a Farman biplane, Mourmelon
H. Deverall Saul, the Saul quadruplane, Barking
Captain H. A. Sanders, a biplane, Benacre, Suffolk
H. P. Saunderson, a monoplane, Elstow, Beds
A. M. Singer*, a Farman biplane, Mourmelon
Malcolm Seton-Karr, a Voisin biplane, Hastings
Arthur Smyth, a biplane, Eastbourne
Somers Somerset*,an Antoinette monoplane, Mourmelon
Rev. Sidney Swann, a monoplane, Ravensworth
Mr Stirling, Spencer-Stirling monoplane, Brooklands
Crosland Taylor*, a monoplane, Helsby, Chester
Graham White*, a Blériot monoplane, Pau
Duke of Westminster*, an Antoinette monoplane and Farman biplane, Mourmelon
Mr Windham, a monoplane (Blériot type), Wembly.

Mr J. Lumb has a monoplane of his own design; Mr More has a Voisin biplane; Mr Piffard has a monoplane; Mr E. Sanderson the Sanderson monoplane; Mr W. A. Seymour, a Voisin biplane; Mr Harry Simpson, a Voisin biplane; Mr Jose Weiss, the Weiss monoplane; Mr A. G. Creese, the Creese-Diderich monoplane; and Mr Gratze, the Gratze monoplane. In addition, there are Sir George Abercromby at Brooklands, Lieutenant Cochrane at Portsmouth, Captain Carden at Farnborough, Mr N. A. Feary, Mr A. M. Grose, Mr E. M. Ling, Mr Maxfield at Birmingham, Mr E. Pitman, Lieutenant Stocks at Portsmouth, Mr A. Watson in Perthshire and Mr H. K. Hales at Burslem.

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Other sources are given in the notes and the text.

Notes

[1] Correspondence of Lord Kelvin at https://zapatopi.net/kelvin/papers/letters.html [accessed 07/04/2019]

[2] H. Penrose, *An Ancient Air: A Biography of John Stringfellow of Chard, the Victorian Aeronautical Pioneer* (Shrewsbury: Airlife Publishing, 1988).

[3] Robert Stephenson Smyth Baden-Powell, founder of the Boy Scouts and Girls Guides 1908. Born 22 February 1857, died 8 January 1941.

[4] There were two magazines called Aeronautics, one American and one British.

[5] Kew Gardens was once one of Southport's top attractions. It did not survive beyond the 1930s.

[6] *The Wigan Observer* 10 October 1902 reports that, at various times, John Gee was a director of Timberlake and of Kew Gardens, a large shareholder in the Isle of Man Steam Packet Company, operated as Wood & Gee (engineers and iron founders), partnered a brickmaker called Ormrod, and held a directorship in the Wigan & District Tramways Company.

[7] *The Era*, 26 July 1884.

[8] *Aeronautics*, May 1909.

[9] E. Charles Vivian (1921), 198.

[10] The Honourable Charles Stewart Rolls (of Rolls-Royce fame) went one better than Blériot by flying both ways without stopping (2 June 1910). He set an unenviable record, however, when he became the first Briton to die in an aeroplane crash on 12 July 1910.

[11] Starting on 27 April 1910 and making one stop along the way.

[12] Archibald Williams, *How it Works*, 7th Edition (London: Thomas Nelson & Sons, c.1910)

[13] Patent 5525 "Improvements in Propellers and the Like" accepted 23 December 1909.

[14] A.V. Roe left the business in 1928 to form Saunders-Roe Ltd. Later on, came the most famous models, of which the best-known are probably the Shackleton, Lancaster and Vulcan bombers, and the Avro 748 airliner.

[15] Alliott Verdon Roe born 26 April 1877.

[16] *Surrey Mirror* 15 September 1922.

[17] *Norwood News*, 28 December 1912.

[18] *The Wigan Observer* of 1 August 1918 reported the death. She would not yet have reached her 18th birthday.

[19] An account of the notoriety of Haydock lodge in the mid-1840s is given in Allan Smith, *Mr. Mott's Madhouse: Haydock Lodge and the Insanity Trade* (Welshpool: Amperstrand Books, 2009).

[20] Alfred Worswick's death certificate incorrectly gives his age as 36.

[21] Dr Street ran and owned Haydock Lodge.

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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.

IST One-Day Technical Conference 2019 Review

On 18th September 2019, delegates arrived from across the country to attend the IST Annual Technical Conference at the state-of-the-art Birmingham Conference and Events Centre.

The convenience of the BCEC being less than five minutes' walk from the train station allowed many of our delegates to arrive by train, along with several especially organised coaches. The staff at the conference centre were extremely helpful in directing attendees to the registration desk, where they collected their lanyards and delegate bags.

Refreshments were provided as everyone made their way through the door, allowing the early arrivals to start making their way around our sponsors and exhibitors who had eagerly arrived the night before.

After everyone had arrived, IST Chair, Terry Croft, made a prompt start and welcomed everyone to the conference along with IST Registrar Michelle Jackson. Deputy Chair and Finance Officer, Joan Ward, then updated us on what the IST has been up to over the last year, which included workshops, talks and conferences across the

country. Natalie Kennerley, IST Secretary, followed with an overview of our Creative Industries Pilot Project, which provides a professional registration framework for technicians within the creative industries.

How to Discover Black Holes with a (Pretty Damn Good) Ruler

Dr Helen Sharman CMG OBE, the President of the IST, then formally opened the conference and introduced our first Keynote Speaker, Professor Alberto Vecchio. His fascinating talk on the first ever detection of gravitational waves in 2015 received consistently positive feedback following the conference:

"The keynote address was an eye-opener to the field of physics and astronomy." "Excellent, very much enjoyed the first keynote speaker, Professor Alberto Vecchio."

"He made the complex and, for me, unfathomable science of astrophysics, a tad more understandable and fun."

"I never thought I'd understand anything linked to that area of science." "Perfectly chosen talk and speaker."

Following Professor Vecchio's keynote talk, we all split up for the first session of workshops. This year, we made sure to identify themes throughout the workshops, both to ensure we covered a broad range of industries and to help delegates select which workshops would be of most interest to them.

The themes were:

Creative Technologies

Science & Engineering

Technology (all areas)

Professional Development

Supporting Individuals/ Inclusivity

Health and Safety

> **"The topics were well chosen and really show the Institute is really advancing science and Technology with it is workshops and conferences. All the speakers are well verse in the topics delivered."**
>
> **"Very relevant and something here for everyone!"**
>
> **"The variety of options across all scientific disciplines was welcome, as the introduction to other technology areas such as in the Arts and Design sphere."**

The workshops available in the first session were:

The Molecular Biology Workflow

Peter Rignall (Eppendorf)

"It was really interesting. With this lecture, I'm developing interest in molecular Biology and Forensic Science."

Hydrogen Fuelled Trains

Stuart Hillmansen (University of Birmingham)

"Very nice to hear about recent innovations and technical advance in an area at the forefront of the media and scientific world."

Our Technical Services Apprenticeship Programme

Natalie Kennerley (Manchester Metropolitan University)

"Enlightening discussion indicating how future technician roles will be supported for people new to work & career path."

Photography in 2019

Glynis Johnston & Gemma McKay (Manchester Metropolitan University)

"I found this all very valuable and enjoyable. I think a key point for me was that I could attend sessions relating to aspects I don't normally see - such as this creative photography one."

A Journey to ensure recognition for technical staff at Newcastle University

Mel Leitch & Calum Kirk (Newcastle University)

"An interesting talk with interactive voting involved which I thought was a really good way to engage with the audience."

After the success of these first workshop sessions, a very welcome refreshment break was provided. This gave delegates a further opportunity to visit our exhibitor stands, network and view the posters that had been entered into this years' Roger Dainty Best Poster Competition.

The morning ended with a second session of workshops:

Demonstration of Mobile Eye Tracking

Paul Aldcroft (Manchester Metropolitan University)

"Really enjoyed this - presenter was knowledgeable and asked Qs to audience."

How can we improve Equality, Diversity and Inclusion for Technical Staff?

Denise McLean & Tamsin Majerus (University of Nottingham)

"Loved the group discussions and how passionate the guys were who ran the workshop. Maybe a little more time for discussion would be good. But loads of advice was given in terms of courses or trainings to participate in for personal development. Very encouraging!"

Sharing Best Practice for Risk Assessments

Pamela Lithgow (Canterbury Christ Church University)

"A great discussion of the topic that brought out some good ideas for sharing."

Technician Commitment: Impact and Progress

Jane Banks (Science Council)

"It was interesting to discuss how other institutions are getting along and what issues they too are experiencing (as well as the successes!)"

pH measurement in Theory and Practice

Scott Marsden (Mettler Toledo)

"Did exactly what it said on the tin – the speaker was very clear and I now know how to maintain my pH meter properly so 10/10 for this one! Wasn't a sales pitch either."

This led us into lunch, which was supplied by the BCEC. Again, this provided delegates with ample time to make their way around the exhibitor stands, view poster submissions and get to know one another, as well as the keynote speakers and workshop givers. It was also time for the Roger Dainty Poster Prize committee (made up of IST members and executives, including Dr Helen Sharman, and representatives from the key sponsors) to independently judge the competition.

Technical Lessons from Astronaut Training

Helen Sharman

After lunch, it was time for the second keynote speech from our very own Helen Sharman, *Technical Lessons from Astronaut Training*. Once again, our second keynote speaker received great feedback:

"Really inspirational talk from Helen – thank you!"

"I loved hearing from the first British cosmonaut Helen Sharman and her "ordinary" life/career path before the training. Both speakers were very approachable and totally likeable. Good choice!"

"Really enjoyed this session, interesting and engaging speaker."

"Very relevant, very interesting and great presentation."

This keynote talk was followed by the final session of workshops of the day. Again, the team at the IST worked hard to ensure a variety of topics were covered in each workshop session.

Acid Digestion through to Solvent Extraction: Versatility is Key

Vincent Cordon (CEM)

"Superb. I fell I love with the acid digestion device and solvent extraction. A new technique that will add value to the world of science".

Influencing Strategy in Government

Marie Oldfield (Oldfield Consultancy)

"Although not being involved with Government, I entered this talk on the assumption that 'Government' could be swapped for any 'decision maker' and I was not disappointed."

Celebrating Technical Staff in the Creative Industries

Natalie Kennerley (Manchester Metropolitan University)

"Very interesting to hear about plans for the new register."

"Herding Cats" – Reflections on Leading Technical Teams

Kate Dixon (Manchester Metropolitan University)

"Another good example to hear about and how they are working to encourage technicians to gain recognition. I really enjoyed listening to another case example of this."

Zine Making with Team Trident Press

Lisa Lorenz (Trident Press, MMU)

"Very good practical involvement and promoted interaction between delegates."

After the third workshop session we had one final refreshment break before heading back into the main theatre, where our prize winners were announced.

The Roger Dainty award recognises the hard work of technical staff who create and deliver these presentations. These are then judged based on the clarity of submitted material, the novelty and the visual impact. Congratulations to the three prize winners which were awarded by Dr Helen Sharman and received £150, £100 and £50 Amazon vouchers respectively.

1st Prize:
Emma Monaghan, University of Birmingham

2nd Prize:
Mohammad Ali Salik, University of Glasgow

3rd Prize:
Jing Wood, University of York, Accepted by colleague Simon Breeden

As we had so many fantastic posters we also award commendations for posters that stand out to our judges.

Commendations:
Mari Pattison, University of Edinburgh *(right)*
Gillian Riddell, Queen's University Belfast
Lisa Van Hateren, University of Sheffield
Gemma Warren, University of Birmingham *(left)*

This year we also held the Outstanding Apprentice/ Trainee Award which was judged by John Robinson Fund representatives.

Nominations came in and were made by technical staff recommending an apprentice or trainee who had played a key role in their workplace. Congratulations to Harrison Barnett, University of Salford for winning this award.

Lloyd Halligan, Manchester Metropolitan University as a close runner up was highly commended with an award also to recognise their outstanding contributions.

After presenting each of the award winners with their prizes, Helen brought the conference to a close and announced that next years' conference will be held in collaboration with the University of York during their technician week on Wednesday 16th September 2020.

We hope everyone had a safe journey home from the conference we hope you had a great day – we know we did! We would like to say a very special thank you to our sponsors, exhibitors and career zone supporters. The conference would not happen without every single person who attended this year, and we hope to see you all next year in York.

See you next year!

Photos Credited to Mr Keith Barber, CPAGD FIScT LRSP, Official IST Photographer.

The IST One-day Technical Conference 2020

IST Conference 2020

Wednesday 16th September 2020
University of York

Save the date

Spring Lane Building
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University of York

Book and secure your place at:
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AHRC launches a dialogue with the arts and humanities technical specialists

Image courtesy of TMiH (Technicians Make it Happen)

The Art and Humanities Research Council would like to understand more about the community of research technical professionals supporting the arts and humanities. They want to engage with these highly skilled individuals who play a crucial role in delivering research outputs and impacts and developing new methodologies.

Following UKRI's signing of the Technician Commitment, AHRC is undertaking a broad consultation with its research technical professionals' community to better understand the multiple roles and contributions made by technical specialists to arts and humanities research.

Defining "technical specialists" within the arts and humanities context

In July 2017 Research Councils UK (predecessor of UKRI) issued a **"Statement of expectations for technology/skills specialists".**

This document describes technology/skills specialists as those who *"maintain and develop new and improved approaches to implement technologies and methodologies to better address research questions. Technology / skills specialists have specialist knowledge and expertise and they often work as part of co-ordinated teams spanning different disciplines and geographical centres, which work together to tackle contemporary research questions. May include, but not limited to: data scientists, data engineers, archivists, informaticians, statisticians, software developers, audio-visual technologists, technical professional staff and individuals staffing core facilities, across all disciplines"*.

In this context AHRC is launching an external consultation to:

a. Develop the list of examples in the above definition, currently used by UKRI, to include relevant examples of research technical professionals representing the arts and humanities landscape, and ensure that the list is as comprehensive as possible;

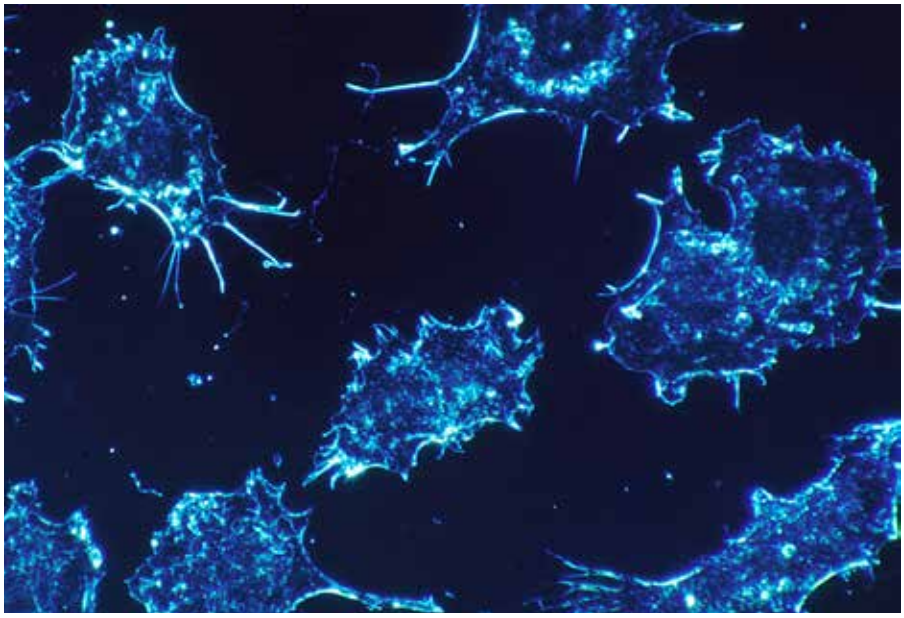
b. Engage with the arts and humanities technical community to understand how they are currently supported and engaged in research, to feed into the UKRI work on implementing the Technician Commitment.

Get involved

A starting point for AHRC's dialogue with the technical community is this short questionnaire: **www.smartsurvey.co.uk/s/ResearchTechnicalProfessionalsRTPsintheartsandhumanities**. Feedback obtained through it will help shape the way AHRC defines, recognises and supports technicians.

Please take part in the survey if you are a technical specialist working in the arts and humanities landscape, or if you frequently collaborate with technicians on arts and humanities research projects. Please forward this information to anyone else who is relevant to this area.

Light-activated compound destroys cancer cells' energy source



UKRI-funded researchers use light to activate a cancer-killing compound which attacks the NADH co-enzyme – a vital energy-producing machinery in the cancer cells.

Scientists at the University of Warwick in collaboration with colleagues in China, France, Switzerland and Heriot-Watt University have developed a technique that uses light to activate a cancer-killing compound of Iridium. While current treatment methods mainly rely on the presence of oxygen, this compound will kill cancer cells in culture even when oxygen concentration is low (hypoxia).

The technique is detailed in a paper published in *Nature Chemistry* and could lead to another tool for clinicians to use in the fight against cancer, and potentially even vaccinate patients against future cancers. The research was supported by the Engineering and Physical Sciences Research Council, part of UK Research and Innovation.

Photodynamic therapy (PDT) uses light to kill cancer tumours in the body by activating a chemical compound called a photosensitiser, which creates species that can attack cancer cells in the presence of light. Using this method, clinicians can direct the light to specific regions of the cancer tumour and spare normal tissue from damage.

The technique can treat any tumours where light can be administered, and would be particularly suited to treat bladder, lung, oesophageal, brain and skin cancers. There are around 10,000 bladder cancer cases in the UK per year, of which about 5,000 might potentially benefit from this kind of treatment.

Once light-activated, the Iridium compound attacks the energy-producing machinery in the cancer cells – a vital co-enzyme called nicotinamide adenine dinucleotide (NADH) - and catalytically destroys that co-enzyme or changes it into its oxidised form. Cancer cells have a very high requirement for NADH, because they need a lot of energy to divide and multiple rapidly.

Professor Peter Sadler from the University of Warwick's Department of Chemistry said:

"There is an increasing interest in reducing the side effects of cancer treatment as much as possible and anything that can be selective in what it targets will help with that. The compound that we have developed would not be very toxic at all, we would give it to the cancer cells, allow a little time for it to be taken up, then we would irradiate it with light and activate it in those cells. We would expect killing of those cancer cells to occur very quickly compared with current methods."

The team of scientists also noted that as the cancer cells die, they change their chemistry in such a way that they will generate an immune reaction in the body, what is known as an immunotherapeutic response. This suggests that those treated by this technique might be immunised against attack by that cancer, and will be investigated further in future research.

Sun explorer spacecraft launch

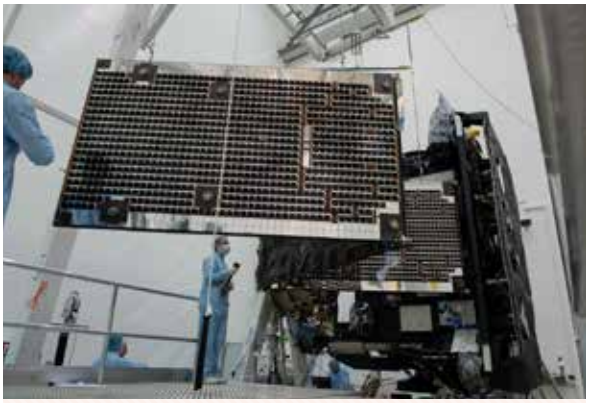
The UK-built Solar Orbiter spacecraft, which will investigate the workings of our Sun, was launched by the US Atlas V 411 rocket from NASA's Kennedy Space Centre in Cape Canaveral, Florida on 10th February 2020. Solar Orbiter will perform unprecedented close-up observations of the Sun. It will allow scientists to study the Sun in much more detail than previously possible and to observe specific features for longer periods than can be reached by any spacecraft circling the Earth. In addition, Solar Orbiter will measure the solar wind close to the Sun and provide high-resolution images of the uncharted polar regions of the Sun.

The UK has played a vital role in the conception and creation of this satellite, with STFC's RAL Space, University College London and Imperial College London leading international teams to design and build three instruments. UK scientists, including those from RAL Space, were instrumental in proposing the Solar Orbiter mission to ESA. The UK Space Agency funded the development of two out of the 10 scientific instruments on board the spacecraft, and contributed to a further two.

Solar Orbiter will carry 10 state-of-the-art instruments. Remote sensing payloads will perform high-resolution imaging of the Sun's atmosphere – the corona – as well as the solar disk. Other instruments will measure the solar wind and the solar magnetic fields in the vicinity of the orbiter. This will give us unprecedented insight into how the Sun works, and how we can better predict periods of stormy space weather, which are related to coronal mass ejections (CMEs) that the Sun throws towards Earth from time to time.

The Spectral Investigation of the Coronal Environment (SPICE) instrument, which was built by RAL Space, is a high-resolution imaging spectrometer observing at extreme ultraviolet wavelengths. It will help solve one of the secrets of the Sun - where exactly does the solar wind come from and how does it speed up and escape from the Sun. RAL Space led the international consortium, under contract to ESA and with contributions from the UK Space Agency and other European countries.

From the spacecraft's unique vantage point, SPICE will carry out the first-ever spectral observations of the solar polar regions. SPICE will help trace solar wind structures measured at the spacecraft to their sources at the poles inside dark, slightly cooler areas of the Sun known as coronal holes.



Solar orbiter array deployment test. Credit ESA

By recording the "fingerprint" at extreme ultraviolet wavelengths from a wide range of ionized atoms including carbon, neon, oxygen and iron, SPICE will measure the composition and speed of plasma flowing out from the Sun and help us find where it comes from.

These ions are formed at temperatures from 10,000 to 10 million Kelvin, covering different layers of the solar atmosphere, from the chromosphere up to the corona.

Solar Orbiter, which will take just under two years to reach its initial operational orbit, will follow in the footsteps of NASA's Solar Parker Probe, which launched in 2018. The two missions will offer complementary perspectives of the Sun – Parker Solar Probe will travel through the Sun's atmosphere, while Solar Orbiter will observe the surface.

The UK is a global leader in solar science with organisations like RAL Space working at the forefront of efforts to understand our nearest star and assess and mitigate the impact of space weather on Earth.

As well as leading instrumentation for science missions like ESA's Solar Orbiter and NASA's STEREO mission, RAL Space is leading an international team developing instruments for ESA's Lagrange mission which will be part of an early warning system for severe space weather and working with the Natural Environment Research Council on a new £20 million fund to connect the space weather research community with the Met Office Space Weather Operations Centre.

UK involvement

UK teams from University College London, Imperial College London and the Science and Technology Facilities Council's RAL Space are involved in 4 out of the 10 instruments. The UK Space Agency is funding the UK involvement.

- **SPICE (Spectral Imaging of the Coronal Environment)** is a telescope with a grating spectrograph and two active pixel sensor detectors that will provide images of the solar disk and corona. SPICE will be able to study features both on the surface and out in the corona and to look at the connection between them. RAL Space, part of UK Research and Innovation, leads an ESA funded consortium that developed and built this instrument. The UK Space Agency contributed one of the subsystems to SPICE.

- **SWA (Solar Wind Analyser)** uses three sensors and a processing unit to measure the different elements of the solar wind and characterise their behaviour under different solar conditions. As Principle Investigators, MSSL of the University of College London led the development of this instrument suite and built one of the sensors.

- **MAG (Magnetometer)** comprises two sensors located on a deployable boom in the shadow of the spacecraft, i.e. away from the Sun and an electronics box within the spacecraft body, enabling in situ sampling of the magnetic field and providing important diagnostic information. Imperial College London have led the development of this instrument.

- **EUI (Extreme Ultraviolet Imager)** is a suite of imaging telescopes that will provide images of the hot and cold layers of the solar atmosphere and of the solar corona showing the dynamics in fine detail and providing the link between the solar surface and outer corona. MSSL of the University College London is a Co-Investigator for this instrument.

- Engineers at Airbus Defence and Space UK have designed and built the spacecraft to withstand the scorching heat from the Sun that will hit one side, while the other is frozen as the orbit keeps it in shadow. The design is based on ESA's BepiColombo mission to Mercury, the closest planet to the Sun, which launched in 2018 with significant involvement from UK engineers and scientists.

Mission facts

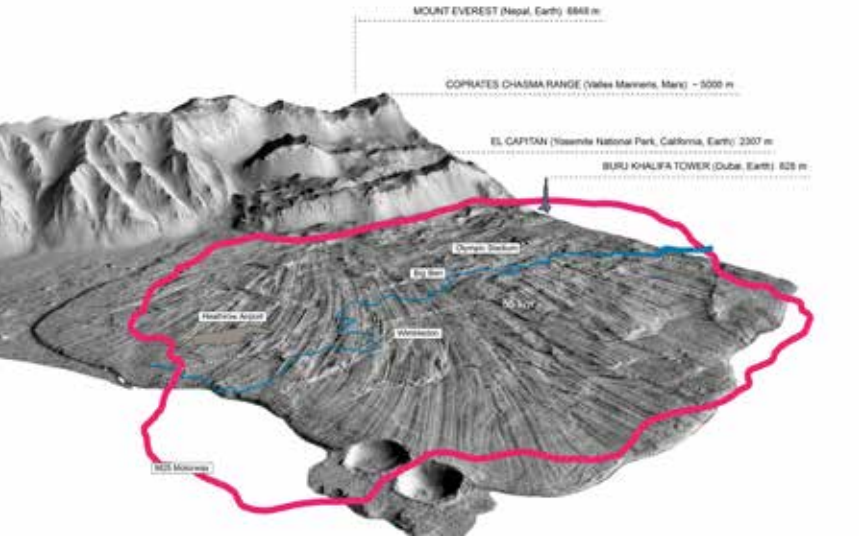
The mission orbit is designed to be synchronous with the Sun's rotation, providing long duration observations for the first time. This will enable the mission to observe the build-up of events such as solar storms.

The instruments on board will undertake remote sensing observations of solar features and in situ measurements of the solar wind bombarding the spacecraft. This combination of remote and in situ instruments will enable in-depth studies of the close link between the origin of solar features such as solar eruptions and their emergence into space. This unique mission could provide major breakthroughs in our understanding of how the inner solar system works and is driven by the solar activity.

The three-axis stabilised design of the spacecraft is being developed to withstand the scorching heat from the Sun that will hit one side and the cold of space on the opposite side which will usually be in shadow.

Solar Orbiter is managed and financed mainly by ESA with strong international collaboration with NASA as part of the International Living with a Star initiative.

UK research challenges Martian ice theory



"Landslides on Earth, particularly those on top of glaciers, have been studied by scientists as a proxy for those on Mars because they show similarly shaped ridges and furrows, inferring that Martian landslides also depended on an icy substrate.

However, we've shown that ice is not a prerequisite for such geological structures on Mars, which can form on rough, rocky surfaces. This helps us better understand the shaping of Martian landscapes and has implications for how landslides form on other planetary bodies including Earth and the Moon."

Research published from a UK-led team challenges the theory that landslides on Mars were caused by ice – despite scientists previously suggesting that their presence provides unequivocal evidence of past ice on the red planet.

The UCL-led team have used detailed three-dimensional images of an extensive landslide on Mars, which spans an area more than 55 kilometres wide, to understand how the unusually large and long ridges and furrows formed about 400 million years ago.

Martian landscape annotated with London and global landmarks for scale (credit: Giulia Magnarini)

Until now, it has been suggested that the landslides were formed by layers of rapidly-cooled water, but the STFC-funded research recently published shows for the first time that the unique structures on Martian landslides from mountains several kilometres high could have formed at high speeds of up to 360 kilometres per hour due to underlying layers of unstable, fragmented rocks.

This challenges the idea that underlying layers of slippery ice can only explain such long vast ridges, which are found on landslides throughout the Solar System.

First author, PhD student Giulia Magnarini of UCL, said:

The team, from UCL, the Natural History Museum in London, Ben Gurion University of Negev in Israel and the University of Wisconsin Madison in the United States, used images taken by NASA's Mars Reconnaissance Orbiter to analyse some of the best-defined landslides remotely.

Co-author, Dr Tom Mitchell, from UCL, said: "The Martian landslide we studied covers an area larger than Greater London and the structures within it are huge. Earth might harbour comparable structures but they are harder to see and our landforms erode much faster than those on Mars due to rain.

"While we aren't ruling out the presence of ice, we know that ice wasn't needed to form the long run-outs we analysed on Mars. The vibrations of rock particles initiate a convection process that caused upper denser and heavier layers of rock to fall and lighter rocks to rise, similar to what happens in your home where warmed less dense air rises above the radiator. This mechanism drove the flow of deposits up to 40 km away from the mountain source and at phenomenally high speeds."

The research team includes Apollo 17 astronaut, Professor Harrison Schmitt of the University of Wisconsin Madison, who walked on the Moon in December 1972 and completed geologic fieldwork while on the lunar surface.

More information is available on the UCL website.

Leading Your Technical Team

istonline.org.uk/training

The **Leading Your Technical Team Programme** (LYTT) consisting of the **Leading Your Technical Team** and **Building on Your Leadership Skills** courses is now offered through the IST.

The **Leading Your Technical Team** programme has a long and highly respected history. It has been running for well over 30 years. 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.

The courses are geared toward delivering the fundamental and key skill elements for leading and managing people, particularly in a technical team. Both programmes 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.

Each programme is delivered in the context of a higher education environment, but is not aimed at any specific job role or discipline. Participants are from a very broad range of higher education institutions, and from a very diverse range of academic disciplines and departments or service sections.

Leading Your Technical Team is intended for anyone, who might now or in the future, have technical management or supervisory responsibilities and is interested in developing their fundamental management/ leadership skills. It is a two-day programme that introduces the fundamental building blocks of management and leadership specifically in the context of technical support in universities and higher education colleges. The programme links practical leadership theories to dynamic team leading in context with the reality of managing in a technical university environment.

Deligate feedback

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

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

Building on Your Leadership Skills 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 is applicable to support staff from academic and service areas. 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. The programme again puts practical leadership theories into context with the reality of managing and leading a technical team in a university environment.

Deligate feedback

"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."

For full course details and presenter profiles please see **istonline.org.uk/training** or contact:
E: office@istonline.org.uk

Members comment: Grow your role

I wanted to write a short piece that would describe how many university technicians can often have other roles within their main job that interact with other departments and/or schools in their organisations.

I have previously written about my own technical roles at the University of Loughborough in past editions of the IST journal (Spring 2016), but I would like to highlight by way of example how I also became engaged in other activities that involved technical staff in other areas of university life.

Those other roles

From the beginning of my working life I was a member of the technical staff union on campus. The union looked after a wide variety of technical staff issues across the university site, and over the time I worked there I became involved in some of their activities.

- As a member of Unite the union representation on University Health, Safety & Environment Committee (HSE)
- As a member of the union sitting on the University Diversity Committee.
- As a member of the union sitting on the university's job evaluation panels.
- As a union member sitting on discipline appeal panels.
- As a departmental advisor to other university schools.
- As the go between in relation to import taxes.

HSE Committee

I sat on this committee for about 10 years. Health and Safety issues were discussed at length and accidents and near miss statistics were drawn to our attention. Any contentious claims were also debated and reviewed to see if further action was needed to address any issues which led up to them.

Diversity Committee

I attended several meetings of the university's Diversity Committee as a delegate from Unite the union. The committee looked at issues that came out of the 2010 Equality Act and reviewed how the University was putting into practise its requirements. We also a monitored how the diverse population of the university was being catered for by its Equality Policy.

I did raise my concern over the perceived inequality suffered by technical staff, who at that time, did not have a proper career ladder structure, unlike their academic colleagues. This had thought to be one of the major reasons for an increased turnover of technical staff in some departments as there was no clear pathway for promotion. The Director of Human Resources did agree on that point and the findings of the then 2012 Staff Survey led to changes and improvements.

Job evaluation panels

These were set up sometime after the university adopted the 2006 Hay Scheme on which job evaluations were based together with Job Descriptions.

I received relevant training and then started sitting on panels from about 2007 onwards until I retired. We reviewed job details before and during meetings and used role and job guides to help us reach a consensus.

Some cases we had to resolve were easy and clear cut, some were over stated in terms of what grades were being requested when related to the supplied job descriptions. Some cases had representatives from departments giving an overview of the job and areas of concern that needed to be taken in to consideration.

I felt that I was able to offer a good insight into many of the technical management jobs based on my own experience in that type of role. I was particularly pleased to be able to contribute where there were questions over the qualifications needed for health and safety aspects of scientific or engineering roles.

Union member on discipline appeal panels

These were convened to consider the appeals from members of the technical staff who had been disciplined or who were at risk of losing their jobs following a charge of misconduct. My role was to make sure that management were being fair in their approach.

As a departmental advisor

My role was to advise those departments who needed specific information on chemicals which they needed, and those that could only be purchased via my department due to compliance issues.

As the go between

Some specialist products were sourced from overseas (beyond the EU) and would therefore incur import taxes. My role was to set up the financial arrangements to facilitate payment and quick release from HM Revenue and Customs.

In conclusion, I hope I have shown that, simply by getting involved, a solitary university technical staff role can evolve into a much wider one. Developing interactions with others working in an organisation is a great opportunity to contribute your knowledge and experience and also grow your job.

Flexibility of approach needs to prevail in order to reach higher goals.

Andy Kowalski MRSC MIScT FCMI

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