The Institute of Science & Technology

The Professional Body for Technical, Specialist, and Managerial Staff

The Journal

Winter 2021

Contents

The Journal

The Official Journal of The Institute of Science & Technology

December 2021

The Professional Body for Technical, Specialist, and Managerial Staff

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Editor's welcome

Joan Ward MBA FIScT,
IST Deputy Chair & Acting Editor

Welcome to the 2021 edition of IST 's The Journal. The Journal is now published annually, and although the plan for this year's edition was for a Summer publication, circumstances consequent upon Covid caused a significant delay. We are repeating our publication as an e-Journal for this edition, and we are currently considering whether the demand for a hard copy version is strong enough to merit returning to that format for future editions. Clearly membership preferences and environmental considerations play significant parts in our discussions, and we aim to decide in the New Year. In addition to our Journal, we will publish articles in our quarterly online TechMag and on our website. The "IST Journal Publication" page in this edition gives you further details for article submission and deadlines. We also publish and circulate an e-bulletin, which comprises and series of short links to articles, events and news relevant to the technical community.

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

In this edition there is an interesting book review by Amro Heikal about how Egyptian cotton could play a vital role in reducing global warming. We also include an excellent article from Colin Neve about the potential for life beyond earth in the solar system, Sadly Colin passed away in the Summer and we will miss his frequent and fascinating articles in the future, and we would like to voice our sincere appreciation for his support and contributions over many years, and offer our condolences to his family and friends. Kevin Fletcher continues his series by looking at inductive & deductive approaches to teaching & learning in science and technology. Tim Sandle brings us a scientific, cultural, and epidemiological history of facemasks and face coverings, and Ibrahim Adekunle offers a paper about machine learning and its use in plant disease detection. Simon Breeden and Lucy Hudson from University of York provide an excellent view on the use and benefits of reverse mentoring. We also have an information update on developments in T-Levels from Suzanna Butler. The IST team also provide a brief summary of our Annual Technical Conference, held in September.

In our Members Comment piece Andy Kowalski gives us and update on his activities since the last Journal publication.

We said an 'Au Revoir' last year to our previous Editor, Ian Moulson, and although Ian is no longer acting as our Editor, we thank him for his continuing support in reviewing our articles, along with other members of our Editorial Team. We would also like to offer our sincere thanks and appreciation to John-Paul Ashton, who played a key role in collecting and collating articles prior to his leaving us at the end of the summer. The IST's Executive is actively seeking out a replacement Editor(s) and will very much welcome enquiries from any member who may be interested in the role.

We like to think our publications have evolved into what are now quality publications, with a style and content that reflects our unique standing as a professional body with an extremely diverse and vibrant technical community membership. Our publications provide us with opportunities to invite our members and guests to present and publish articles, papers, and news items that will be of interest/relevance to our broad ranging membership. We welcome article submissions from all and any areas of technical interest, eg. creative industries, digital, engineering and science technologies. We like to cover existing, historical, and new technological advances and also unusual aspects of science, technology and the arts. 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 shorter, periodic TechMag magazine, and get up to date news of what is happening in the technician community. Subscribe free and follow the links to our series of periodicals, and have a look at what we have been doing and the things we have planned for the near future

istonline.org.uk/the-tech-magazine

We are always happy to include short articles and news items in the IST's TechMag 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 our IST Office at **office@istonline.org.uk**

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

I hope you enjoy this edition.

Joan

Chairman's view

Terry Croft, MBE, FIScT, CSci,
IST Chairman

A Christmas Message from the Chair

Another year has flown by, Christmas is approaching and sadly we are still fighting the battle against Covid twelve months on. The good news is that the UK's excellent vaccination programme is reducing the devasting impact of this terrible pandemic and early signs indicate we are returning to "some kind of normal," thank goodness. However, we mustn't forget that members, colleagues and friends are still being impacted in different ways and our thoughts go to everyone affected.

Despite these challenges, what a busy year it has been for the IST. Our dedicated team of volunteers have delivered many webinars and presentations to keep our members up to speed with the latest news and developments affecting the technical community across all sectors. Marie Oldfield FIScT has been working in conjunction with IST Executives and one of our IST Fellows; Margaret Ross FIScT, to further develop our **Women in Tech Group**. 'Further information is now available on our website.

The IST's **AI Group** has been very active across the year and have organised a great series of exciting seminars. Further information is now available on our website

The IST has promoted and supported the technical community since 1948 and has always been actively involved in many initiatives over the last 73 years. Therefore, it gave me great pleasure to sign on your behalf our pledge to officially support the Technician Commitment and received the official supporter status earlier in the year.

This year's IST Conference was held on a virtual platform again with Covid still being the restrictive factor in delaying a return to face-to-face events. The IST Conference team, our volunteers and this year's contributors once again delivered a highly successful event, with over 450 registrants attending the many workshop and presentation options on the day. The feedback has been excellent. Work has now started on the 2022 Annual Conference with the event being "in person" at **York University on Wednesday 14th September 2022**. Many thanks go to Simon, Lucy and York University for their continued support in delivering what will be an excellent conference for our members and the technical community. I look forward to catching up with you all at what will be an excellent day and opportunity to network with colleagues. So, one for the diary!

Once again, we are proud to celebrate our Science Council CPD Awards winners and those that were highly commended.

A huge thank you goes to John-Paul Ashton for his services as our Executive Support Officer and Social

Media Advisor who has stepped down from his role after many years of hard work in supporting our members, the Executive and myself. Also, we are sad to lose Natalie Kennerley, who has made significant contributions to the work of the IST through her role as Secretary and Executive member over many years. I wish them both every success for the future.

A warm welcome to Sandra Taylor, who is taking over the role of IST Secretary. Sandra has been a member for many years and has supported many of our activities and is a current member of the 2022 Conference Committee. I look forward to working with her as she takes up her new role at the next meeting of the Executive Board to be held in December.

In addition, I also welcome Laurence Dawkins-Hall who has taken up the role of Assistant Registrar. Laurence has been a highly active member of the IST as well as making significant contributions to the technical community nationally. He was recently highly commended in the Papin Prizes 2021. The team and I are looking forward to continuing working with Laurence in his new role.

If you would like to join Sandra, Laurence and the team, we are always interested in hearing from members who would like to become more involved with the IST and we welcome any such offers of support. The IST is a not-for-profit organisation, and we rely heavily on the support from our many volunteers, from our Executive Board (all members of the Board occupying voluntary, elected roles), committee members and project teams, through to contributors to our Journal, TechMag and website. If you would like to play a part in **YOUR** professional body, then please contact us via **office@istonline.org.uk**

I am looking forward to a busy and exciting new year for the IST and its members. I am hopeful that we will see a return to normality and 2022 will be a good time to be a technician, specialist and technical manager. The IST is here to support you on your journey so please remember to visit the IST website to keep up to date with news and activities.

I wish you all a Very Happy Christmas and a Peaceful and Rewarding New Year.

With best wishes,

Terry

President's view

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

What a year it has been for technicians, with events highlighting and celebrating technicians' skills, roles and value to society: there have been festivals and summits, awards and prizes, not to mention workshops, training days, conferences and symposia with a load of practical development material and networking opportunities, all specifically designed around technicians.

I know many of these events have been virtual, though there have also been opportunities for in-person meetings, and I imagine there will be an increasing amount of hybrid events in the coming years, which will allow people easier access especially to events that otherwise might involve significant travel time. Word on the 'virtual street' says that people will attend more conferences in future years, some in-person and some virtually, with some that may be a hybrid of both. This will be great for flexibility and enhance the opportunities we can access, especially as technicians in particular are often required at work in-person, when it can be harder to organise the time to be away.

Has COP26 given you any food for thought about the changes you could make to your own environment at work and at home? Let us know what you are doing, whether it's being more energy efficient at work, working on an emissions or climate-positive research project, communicating with art or something else, and we might feature you in a future magazine. Technicians are wonderfully pragmatic and practical-minded and many others will value your ideas, however intuitive you think those actions are.

Finally, I wish you a peaceful end to the year, a happy Christmas, and a New Year that is full of hope for what 2022 might bring.

Best Wishes

Helen

New members and registrations

New members April 2020-November 2021

No.	Name	Grade
T16395	Mr S J Reid	MIScT
T16396	Mrs V Senthruan	MIScT
T16397	Dr K J Thurlow-Criss	MIScT
T16398	Mr R P Andrews	MIScT
T16399	Dr J E Warren	MIScT
T16400	Miss A K Bhumber	MIScT
T16401	Dr Li PhD MEng	MIScT
T16402	Dr J D Hughes	MIScT
T16403	Mr M Saleh	MIScT
T16404	Dr P S Tuladhar	MIScT
T16405	Ms H S Fisk	MIScT
T16406	Mr M Brimmell	MIScT
T16407	Miss D L A Bain	MIScT
T16408	Miss S B Choudhury	MIScT
T16409	Mrs J Liddell	MIScT
T16410	Mr R Murphy	MIScT
T16411	Ms J Williams	MIScT
T16412	Miss R Denney	MIScT
T16413	Mr R S Wilson	MIScT
T16414	Mr S J Baybutt	MIScT
T16415	Mr M Brightwell	MIScT
T16416	Miss J Harris	MIScT
T16417	Miss S Hussain	MIScT
T16418	Mr T Carter	MIScT
T16419	Dr A Wittner	MIScT
T16420	Mr D Tupchiienko	MIScT
T16422	Mr A Stiff	MIScT
T16423	Mr J A Ward	MIScT
T16424	Mr K D Bramley	MIScT
T16425	Mr D M Green	MIScT
T16427	Mrs J Taggart	MIScT
T16428	Mr J D Watson	MIScT
T16430	Dr S J Hooper	MIScT
T16431	Mr S W M Dye	MIScT
T16432	Mr A O Ayoola	MIScT
T16433	Mr M Chaudhary	MIScT
T16434	Dr D P M McCabe	MIScT
T16435	Mr S P Hibberd	MIScT
T16436	Mr R S Clark	MIScT
T16437	Mr A P M Hartfield	MIScT
T16438	Mr Z Hughes	AssocIScT
T16439	Ms N Parr	MIScT
T16440	Dr M J Southgate	MIScT
T16441	Mr D Fillingham	MIScT
T16442	Mr V W Zaferson Quiroz	MIScT
T16443	Miss D Nichols	MIScT
T16444	Mr R Palmer	MIScT
T16445	Dr L Lu	MIScT
T16446	Mrs C Cairns	MIScT

No.	Name	Grade
T16447	Mrs Collins	MIScT
T16448	Miss A Libori Sánchez	MIScT
T16449	Mrs S Riddles Thomson	MIScT
T16450	Dr K K Atwal	MIScT
T16451	Miss L Katonova	MIScT
T16452	Prof. Z M Hussain	MIScT
T16453	Miss E T Francis	MIScT
T16454	Mrs S Begum	MIScT
T16455	Miss K Craigie	MIScT
T16456	Mr S G Denham	MIScT
T16457	Mrs C Dillon	MIScT
T16458	Dr M L Sterry	MIScT
T16459	Miss A S Hunter	FIScT
T16460	Dr U Fadayiro	MIScT
T16461	Mr P A Jepson	MIScT
T16462	Miss L Grout	MIScT
T16463	Mr C Stothard	MIScT
T16464	Mr F Giammaria	MIScT
T16465	Mr M Bilton	MIScT
T16466	Mr W He	MIScT
T16467	Dr T Fujisawa	MIScT
T16468	Mr A Chau	FIScT
T16469	Dr H X Cheah	MIScT
T16470	Mrs H E Blakes	MIScT
T16471	Dr K H Yeap	MIScT
T16472	Mr O M Mbachie	MIScT
T16473	Mr Fahad Abdulazeez	MIScT
T16474	Ms R Rajaratnam	MIScT
T16475	Miss J Sammut	MIScT
T16476	Dr J Simpson	MIScT
T16477	Mr C R McNeill	MIScT
T16478	Ms M A Esnal-Zufiaurre	MIScT
T16479	Dr A Kemp	MIScT
T16480	Mrs J Abdullahi	MIScT
T16481	Mr J E Morley	MIScT
T16482	Mr Sanusi N Banani	MIScT
T16483	Mr A Bright	MIScT
T16484	Miss R L Coxhill	MIScT
T16485	Mrs J M Dodds	MIScT
T16486	Mr B A Maikano	MIScT
T16487	Dr S S Raza	MIScT
T16488	Dr A G Firth	MIScT
T16489	Ms H L Sharp	MIScT
T16490	Lt Col A Saunders	MIScT
T16491	Mr I M Alasan	MIScT
T16492	Mr E O Kasumu	MIScT
T16493	Mr A T Blance	MIScT
T16494	Dr A Roy	MIScT
T16495	Mrs T W Olorunfunmi	MIScT

No.	Name	Grade
T16497	Mr D N Evans	MIScT
T16498	Dr A M Welhenge	MIScT
T16499	Ms C Ching	MIScT
T16500	Dr K Bailey-Smith	MIScT
T16501	Mrs R Welsh	MIScT
T16502	Dr J Bailey	MIScT
T16503	Ms A Sultana	MIScT
T16504	Dr S Golbabapour	MIScT
T16505	Mrs S Stevenson-Jones	MIScT
T16506	Mr I G Williams	MIScT
T16507	Mr D Gormley	MIScT
T16508	Dr M A George	MIScT
T16509	Dr P Mitra	MIScT
T16510	Dr Omar Abdulghafoor	MIScT
T16511	Mr P Beasley	MIScT
T16512	Mrs S L Morris	MIScT
T16513	Mr B Coles	MIScT
T16514	Mrs M L Doherty	MIScT
T16515	Mr P Sinnock	MIScT
T16516	Ms O O Akintewe	MIScT
T16517	Mr D Mifsud	MIScT
T16518	Mr N Salisu	MIScT
T16519	Dr S C Pereira Cachinho	MIScT
T16520	Ms J M Tanianis-Hughes	MIScT
T16521	Mrs K Ryan	MIScT
T16522	Dr S L Bonner	MIScT
T16523	Mt G R Mackenzie	MIScT
T16524	Ms A H Turaj	MIScT
T16525	Mr EM Carbonell	MIScT
T16526	Mr P E Vasquez-Aguilar	MIScT
T16527	Mr M L Barton	MIScT
T16528	Dr J A Armstrong	MIScT
T16529	Mr D N Jones	MIScT
T16530	Mr W F Northrup	MIScT
T16531	Miss A Crastin	MIScT
T16532	Mrs G H Duong	MIScT
T16533	Miss S Ho	MIScT
T16534	Mr M Abubakar	MIScT
T16535	Mr J B Morgan	MIScT
T16536	Mr S L Abdul-Hakim	MIScT
T16537	Dr M Loon	MIScT
T16538	Mrs F Oliver	MIScT
T16539	Ms R Parmar	MIScT
T16540	Mr A O Olowoyeye	MIScT
T16541	Mr A Birkett	MIScT
T16542	Miss C Poxon	MIScT
T16543	Dr R A Saldanha	MIScT
T16544	Dr J S McGrath	MIScT
T16545	Dr M S Cross	MIScT
T16546	Dr C M Santosh Kumar	MIScT
T16547	Prof Dr C. Vincent	MIScT
T16548	Mr A D Thomas	MIScT
T16549	Dr S Mukherjee	MIScT
T16552	Dr M M Chatzimichailidou	MIScT
T16553	Mr M Baker	MIScT
T16554	Miss Inaku Lydia Odoma	MIScT
T16555	Mr M J McMonies	MIScT
T165550	Mr M O'Brien	MIScT
T16556	Miss K Bhargava	MIScT

No.	Name	Grade
T16557	Mr R Mannepalli	MIScT
T16558	Mr Faisal D Radda	MIScT
T16559	Mrs H Babangida	AssocIScT
T16560	Mr M C Gbagir	MIScT
T16561	Dr H J Goring-Harford	MIScT
T16562	Mr L E Willie	MIScT
T16563	Ms J O'Shaughnessy	MIScT
T16564	Ms T Clayton	MIScT
T16565	Mr L Thompson	MIScT
T16566	Mr I R Davis	MIScT
T16567	Mrs Latifa T Ojikutu	MIScT
T16568	Mr Philip A Gbum	MIScT
T16569	Mr C Baker	MIScT
T16571	Mr Abdullahi A Abdulrazaq	MIScT
T16572	Miss Patricia O Asemota	MIScT
T16573	Mr Syahrul Salehudin	MIScT
T16574	Dr J Karanka	MIScT
T16575	Miss A E Ward	MIScT
T16576	Mrs R Islam	MIScT
T16577	Mr A Miller	MIScT
T16578	Mr S M Seghatoleslam	MIScT
T16579	Mr Isaac B Ekong	MIScT
T16580	Mr J Gill	MIScT
T16581	Miss G E Davies	MIScT
T16582	Mr Muideen K Raifu	MIScT
T16583	Mr Emmanuel I Abuka	MIScT
T16584	Ms L Y Wong	MIScT
T16585	Mr Adulazeez I Bashir	MIScT
T16586	Miss S Kimpton	AssocIScT
T16587	Miss A R F Cliffen	MIScT
T16588	Dr A J M Colson	MIScT
T16589	Dr V Infante	MIScT
T16590	Miss L Jarvis	MIScT
T16591	Ms J M Lord	MIScT
T16592	Mr A O Bassey	MIScT
T16593	Mr N M Rigby	MIScT
T16594	Dr Evason	MIScT
T16595	Dr C F Taylor	MIScT
T16596	Mr Ese L Ekanem	MIScT
T16597	Miss M Pintea	MIScT
T16598	Mr D Egan	MIScT
T16599	Dr K Sugand	MIScT
T16600	Miss A Kowalewska	MIScT
T16601	Mrs M Marshall	MIScT
T16602	Dr S Tomo	MIScT
T16603	Mr T Gregory	AssocIScT
T16604	Miss S Whittle	AssocIScT
T16605	Miss S Askre	AssocIScT
T16606	Mr O Jowett	AssocIScT
T16607	Mr R B Pears	AssocIScT
T16608	Miss G R Eklid	AssocIScT
T16609	Dr V Rajasekaran	MIScT
T16610	Mrs C E Aigbologa	MIScT
T16611	Mr R E Hartley	MIScT
T16612	Dr E D O Ansa	MIScT
T16613	Mr O O Ogbeche	MIScT

Total 213

Fellowship Upgrades

No.	Name	Grade
T10711	Dr N COOK	FIScT
T14866	Mrs K Vere	FIScT
T16086	Dr W Y Mung	FIScT
T16230	Ms M Oldfield	FIScT
T16259	Dr R G Segumpan	FIScT
T16279	Dr K A Tree	FIScT
T16321	Dr D Sun	FIScT
T16376	Dr M F LO	FIScT
T16384	Eur Ing L Campbell	FIScT
T16394	Mr A Heikal	FIScT
T16459	Miss A S Hunter	FIScT
T16468	Mr A Chau	FIScT

Total 12

IST Journal Publication

Back copies of our journal publication are viewable online: **istonline.org.uk/ist-journal-publication**

Article submissions for the IST Journal & TechMag

The IST Journal is a quality annual 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: office@istonline.org.uk

The guidelines for article submissions for the IST Journal and TechMag are:

1. Article submission deadline for our annual Journal edition is 31st March. Deadlines for the TechMag 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.

Science Council New Registrations

Membership No.	Name	Grade
T16086	Dr W Y Mung	CSci
T16176	Dr F Crawford	CSci
T16180	Dr J M Fox MPharmacol	CSci
T16276	Mrs A E A Jordan	CSci
T16332	Mr F H Shayor	CSci
T16394	Mr A Heikal	CSci
T16405	Ms H S Fisk	CSci
T16417	Miss S Hussain	CSci
T16433	Mr M Chaudhary	CSci
T16447	Mrs Collins	CSci
T16452	Prof. Z M Hussain	CSci
T16454	Mrs S Begum	CSci
T16456	Mr S G Denham	CSci
T16458	Dr M L Sterry	CSci
T16462	Miss L Grout	CSci
T16464	Mr F Giammaria	CSci
T16466	Mr W He	CSci
T16467	Dr T Fujisawa	CSci
T16468	Mr A Chau	CSci
T16476	Dr J Simpson	CSci
T16505	Mrs S Stevenson-Jones	CSci
T16507	Mr D Gormley	CSci
T16510	Dr Omar Abdulghafoor	CSci
T16519	Dr S C Pereira Cachinho	CSci
T16522	Dr S L Bonner	CSci
T16524	Ms A H Turaj	CSci
T16528	Dr J A Armstrong	CSci
T16537	Dr M Loon	CSci
T16552	Dr M M Chatzimichailidou	CSci
T16599	Dr K Sugand	CSci
T16611	Mr R E Hartley	CSci
T14911	Miss K Chamberlain	RSci
T15608	Dr Y K Ng	RSci
T15840	Mr A Wood	RSci
T15949	Miss S J Viney	RSci
T16020	Dr H F Stanyon	RSci
T16335	Miss J R Phillips	RSci
T16344	Mrs N J Keitch	RSci
T16362	Mrs J A Freeman	RSci
T16382	Mr G M Platt	RSci
T16408	Miss S B Choudhury	RSci
T16411	Ms J Williams	RSci
T16413	Mr R S Wilson	RSci
T16419	Dr A Wittner	RSci
T16423	Mr J A Ward	RSci
T16425	Mr D M Green	RSci
T16434	Dr D P M McCabe	RSci
T16435	Mr S P Hibberd	RSci
T16436	Mr R S Clark	RSci
T16443	Miss D Nichols	RSci
T16445	Dr L Lu	RSci
T16446	Mrs C Cairns	RSci
T16448	Miss A Libori Sánchez	RSci
T16449	Mrs S Riddles Thomson	RSci
T16450	Dr K K Atwal	RSci
T16451	Miss L Katonova	RSci
T16453	Miss E T Francis	RSci
T16455	Miss K Craigie	RSci
T16457	Mrs C Dillon	RSci
T16470	Mrs H E Blakes	RSci
T16474	Ms R Rajaratnam	RSci
T16478	Ms M A Esnal-Zufiaurre	RSci
T16479	Dr A Kemp	RSci
T16484	Miss R L Coxhill	RSci
T16508	Dr M A George	RSci
T16516	Ms O O Akintewe	RSci
T16521	Mrs K Ryan	RSci
T16525	Mr EM Carbonell	RSci
T16532	Mrs G H Duong	RSci
T16538	Mrs F Oliver	RSci
T16539	Ms R Parmar	RSci
T16542	Miss C Poxon	RSci
T16553	Mr M Baker	RSci
T16576	Mrs R Islam	RSci
T16597	Miss M Pintea	RSci
T16600	Miss A Kowalewska	RSci
T15158	Mr A L Smalley	RSciTech
T15622	Mr J A Nicolson	RSciTech
T16077	Ms H R Evans	RSciTech
T16104	Mr L Drezet	RSciTech
T16107	Miss H Massey	RSciTech
T16108	Mr S Mikula	RSciTech
T16109	Mr T P Peace	RSciTech
T16110	Mr C Pennington	RSciTech
T16126	Mrs J Kaur	RSciTech
T16196	Mr Pineda	RSciTech
T16269	Miss T Cowley	RSciTech
T16290	Dr A Burns	RSciTech
T16291	Mr C A Wilkinson	RSciTech
T16292	Mr A J Smith	RSciTech
T16320	Mrs L Binnington	RSciTech
T16356	Miss T R Howe	RSciTech
T16398	Mr R P Andrews	RSciTech
T16412	Miss R Denney	RSciTech
T16416	Miss J Harris	RSciTech
T16418	Mr T Carter	RSciTech
T16422	Mr A Stiff	RSciTech
T16444	Mr R Palmer	RSciTech
T16475	Miss J Sammut	RSciTech
T16477	Mr C R McNeill	RSciTech
T16489	Ms H L Sharp	RSciTech
T16503	Ms A Sultana	RSciTech
T16504	Dr S Golbabapour	RSciTech
T16512	Mrs S L Morris	RSciTech
T16523	Mt G R Mackenzie	RSciTech
T16590	Miss L Jarvis	RSciTech
T16591	Ms J M Lord	RSciTech
T16598	Mr D Egan	RSciTech
T16601	Mrs M Marshall	RSciTech

Total 109

IST Organisation

Executive Board (December 2021)

President: Helen Sharman CMG OBE FRSC FIScT

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.

E: office@istonline.org.uk

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.

E: t.croft@istonline.org.uk

Secretary: Sandra Tayor MIScT RSci

Sandra is the IST Secretary, and has responsibility for ensuring that we comply with legislative requirements and that we maintain suitable official records, and also for the corrdination of our Executive meetings and documentation. She is Senior Research Technician on Synthetic Biology, at the University of Manchester and is Secretary for the UoM Manchester Technical Excellence network TE@M. Sandra has been an IST member since 2013, and has supported the IST in a variety of ways prior to taking up her role as Secretary. She currently is a Registered Scientist and plays an important role in our registration application assessment processes. Sandra is also a Science Council Registrant Champion.

E: sandrataylor@istonline.org.uk

Deputy Chair & Finance Officer: Joan Ward FIScT

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.

E: joanward@istonline.org.uk

Education Officer: Arthur Nicholas FIScT

As Education Officer, Arthur maintains knowledge of vocational training and qualifications for technical practitioners. He also participates in regional and national development programmes. Arthur is involved in the development and delivery of technician training and manages the IST's service to employers to validate their in-house training schemes. Arthur is a Trustee of the Science Council and a Specialist Advisor to the National Technician Development Centre (NTDC). During a long career as a professional Technician, Scientist and Management practitioner, Arthur became highly knowledgeable of and skilled in the effective delivery of research, teaching and professional services in the UK's Higher Education Institution (HEI) sector.

E: arthurnicholas@istonline.org.uk

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

IST Advisors

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.

Conference Support: 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.

Industry Liaison/Advisor: James Trout FIScT CMgr RSci

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.

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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Melanie Hannah MIScT, RSci

Joan Ward FIScT

Michelle Jackson FIScT CSci

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Kevin Oxley FIScT CSci

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Derek Sayers FIScT

The Potential for Life Beyond Earth in the Solar System

Colin Neve

Introduction

The search for extra-terrestrial life beyond Earth, on other Worlds or moons in our solar system has been ongoing for decades by the USA National Aeronautics and Space Administration (NASA) since space exploration began in 1957 (Sputnik), and then in 1960's when the first humans ventured to Earth's moon. Afterwards robotic space probes were sent to explore Mars for signs of life, which led to further robotic probes being sent to Jupiter, Saturn, Uranus and Neptune to study their moons, and eventually to the dwarf planet Pluto in the Keiper Belt. These journeys of exploration to seek alien life and their potential habitats has spawned advanced technologies and scientific theories that make this quest possible.

The Planet Mars

NASA is still exploring the planet Mars for potential signs of life that might have existed in its distant past or may exist hidden beneath its surface in the form of bacteria. If these bacteria did exist at a time when Mars was more hospitable to life, a fossil record might be found as proof of its existence. The poles of Mars show signs of frozen water which is considered to be one of the main essential elements required for life to exist, and therefore possibly the best place to start searching. Mars is considered to be a dead world with no active volcanism or plate tectonics to create heat and recycling of the landscape, and also, it has an extremely thin atmosphere making it unable to retain water molecules to form rain clouds that are needed to create liquid oceans.

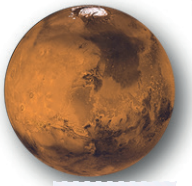


Figure-1: Mars (Second) Credit: Wikipedia

The Mars Rovers have rolled across the Martian landscape in search for signs of life, and even drilled beneath its surface in hope of digging up fossils that would indicate that life had existed. Future exploration of Mars may eventually discover that life is existing deep beneath its surface in hidden caverns.

Mars Mission Probes and Vehicles

These are some of the space vehicles that have visited Mars, and many more will follow in the future if humans are going to colonise the Martian landscape.

- Mariner 9 (1972)
- Viking Program (1975): Viking-1 and Viking-2
- Mars Odyssey (2001)
- Opportunity (2004)
- Mars Global Surveyor (2006)
- Phoenix Lander (2008)
- Curiosity Rover (2012): Sent to investigate the Martian climate and geology.

Jupiter's Icy Moons

The icy moons of **Jupiter** are also potential places where life might exist hidden beneath ice surfaces which may cover a watery ocean capable of supporting some form of life. NASA is already planning to send a spacecraft probe to Europa, a frozen moon covered with an ice-shell and possibly a deep global ocean beneath it that is heated by tidal friction caused by its closeness to Jupiter.

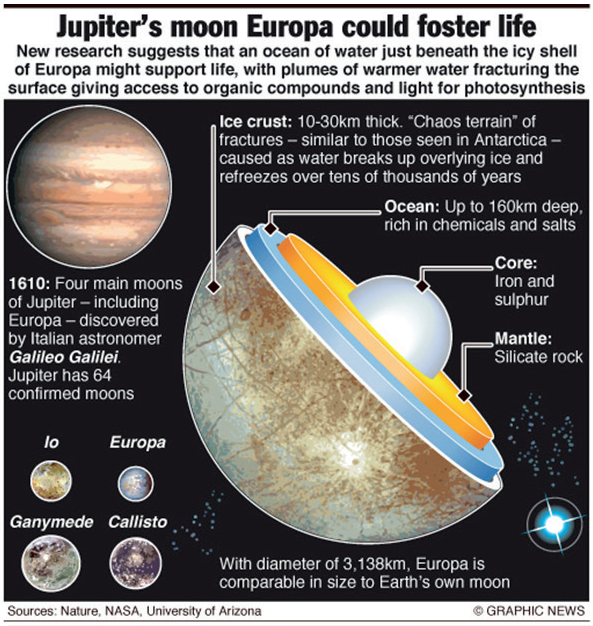


Figure-2: Europa (Second) Credit: spyhollywood.com

Europa is tidal-locked and stretched by Jupiter's gravitational forces that keep it in a constant state of stress which creates its internal heating. It has been theorised that hydrothermal vents may exist on the ocean floor where potential life might exist, where chemical reactions of heat on rock produce the nutrients for simple bacteria or some form of complex life.

Another moon of Jupiter is Ganymede that is covered in an ice-shell covering a deep ocean where hydrothermal vents might also exist. The surface of Ganymede consists of two types of terrain, where the darker older regions are heavily cratered, and the lighter regions have many grooves and ridges. The dark terrain is about one-third the surface area and consists of surface ice, which contains organic material and clays that give it its darker features. These organics and clay material have been left by meteorites that created many impact craters in these dark areas. The light terrain is considered to have been grooved and ridged by tidal heating due to tidal flexing that heated the interior that led to the development of cracks and faults that erased about 70% of the dark terrain on the surface. The polar caps on Ganymede are considered to be made of water frost as spotted by the Voyager spacecraft flyby, which was theorised as possibly being created by thermal migration of water vapour or due to plasma bombardment that turned the ice bright.

The surface of Ganymede is covered by an icy spherical shell surrounding a deep Ocean. A deep salt-water Ocean is wedged between two ice shells, the Hexagonal (surface) ice and the Tetragonal ice (sub-surface of the rocky mantle) as illustrated in the picture. The rocky mantle consists of silicate rock possibly made up of chondrites and iron, and iron sulphide core is in the form of liquid surrounding the solid iron core.

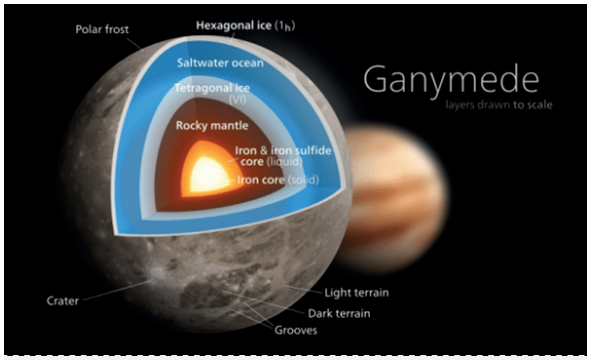


Figure-3 Picture (Second) Credit: Wikipedia Common/kelvinsong

The following cut-away image of Callisto shows a completely different internal structuring than that shown in the Ganymede image, where the small central silicate core is surrounded by compressed ice and rock as a large portion of Callisto's interior. It is believed that a salty ocean about 200+ kilometres deep of highly conductive fluid, possibly containing ammonia exists beneath the icy surface of Callisto.

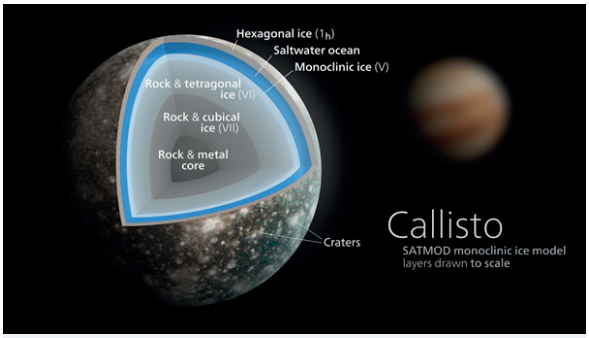


Figure-4 Picture Credit: NASA/JPL Callisto image showing its internal structure.

The Icy Moons of Planet Saturn

Some moons of Saturn could also have alien life in subsurface oceans deep beneath their frozen surface, where the water or other heated liquid is an ideal environment for these types of lifeforms to exist.

The Moon Enceladus is another prime candidate for the search of potential life to exist on another place in the Solar System. It has similar conditions as Earth, where water is found beneath its icy crust in the form of a deep ocean and it has hydrothermal vents that are heated by its internal tidal stressing caused by Saturn's mass.

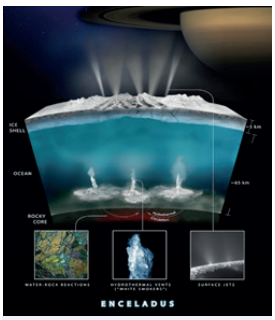


Figure-5 Enceladus Credit: AGU

On Earth we find bacterial life is also found near Hydrothermal Vents deep in the Ocean where heated water is boiling at temperatures of 340 Celsius.

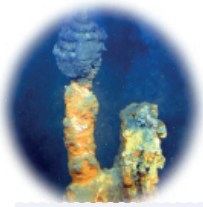


Figure-6: (Hydrothermal Vent Image: Credit: NOAA).

These bacteria are thriving on energy and Carbon Dioxide provided by the Hydrothermal Vents, and not by photosynthesis.

Another satellite of Saturn with the potential for some form of alien life is Titan, which is shrouded in Methane gas and has surface oceans of Methane liquid. Titan is the second largest moon in the solar system and is the only satellite of a planet to have a dense atmosphere with clouds. Titan is very similar to what Earth was like in its early years as discovered by the Cassini mission in 2004. Its atmosphere consists of Nitrogen (95%) and Methane (5%) and is complex and very active, and show signs of organic molecules such as Hydrogen, Carbon, Oxygen and other Earth-like elements that are found in Earth's atmosphere which are essential for life.

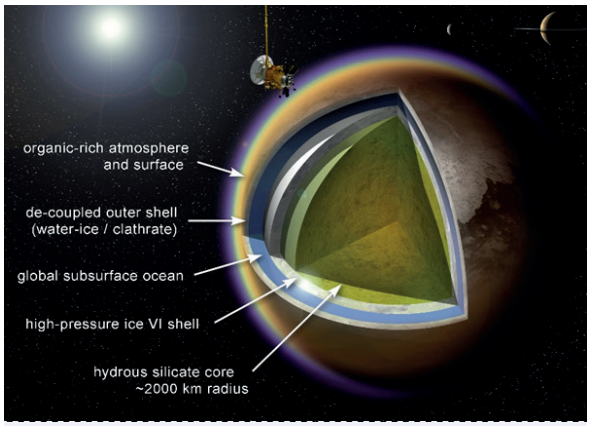
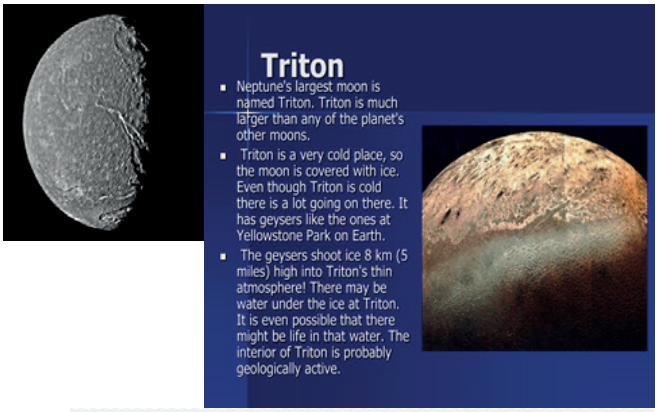


Figure-7 Titan (Second) Credit: SciTech Daily

Titan has liquid methane and Ethane lakes and seas found on its surface and hydrological rain cycle similar to Earth's hydrological cycle. It also has Hydrocarbon dunes and liquid Methane rain clouds of Methane ice and cyanide gas floating above its surface. In 2005 the Huygens probe landed on Titan to look for an internal ocean of water and ammonia, also for any signs of volcanic activity and seasonal changes. Titan may have potential for the existence of life, because of its complex organic chemistry and similarity to early Earth which eventually gave birth to its own organic life.

The Icy Moons of Planets Uranus and Neptune

Uranus and Neptune have many moons in orbit around them, and some icy ones may have the potential for life if the right conditions are found. The icy moon Titania of Uranus is its largest satellite and has a scarred icy crust surface, and the ice moon Triton of Neptune with a surface temperature of minus 391 degrees C, where Voyager-2 detected geysers spewing icy matter that may indicate a warm internal water ocean beneath its ice crust.



Left: Figure-8 Credit: Titania's Surface. ©NASA

Right: Figure-9 (second) Credit: Triton Slideserve.com

The Icy Moons of Dwarf Planet Pluto

The small planet Pluto is in the Kuiper-belt at the extreme edge of our solar system and has its own group of moons, its nearest satellite is 'Sharon' which is about half the size of Pluto and is tidally-locked and shows signs of cryo-volcanism on its surface. Which could indicate a sub-surface ocean of water may exist that could have the potential for some form of alien life existing in this type of environment.

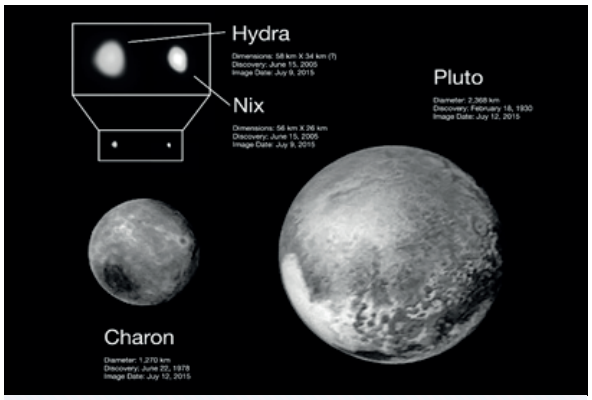


Figure-10 Pluto and Moons Picture – (Second) Credit: to Reddit

Conclusion

The "JUpiter Icy" moons Explorer (JUICE) developed by the European Space Agency hope to study three of Jupiter's icy moons, Ganymede, Callisto, and Europa for signs of life, and will be launched in 2024. Onboard this spacecraft will be a whole range of instruments designed to test the atmosphere, the surface and the subsurface for signs of salt water on these three ice-covered satellites.

The search for life in the solar system and beyond has discovered many ice moons orbiting planets in our galaxy, which might suggest we have a better chance of finding life on these icy satellites than on their planets.

Author: Colin Neve MIScT Sadly we have to report that Colin passed away a little while after the submission of this article, and we thank his family for their permission to publish posthumously. Colin had been an active members of the IST for many years and his support will be much missed. He was a well-respected, self-employed IT Technician for a significant proportion of his working life. He studied for a BSc (Hons) degree in Astronomy with the University of Central Lancashire and had Certificates of Professional Development in Astronomy, Cosmology, and Planetary Geology from Liverpool John Moores University (Astrophysics Research Institute).

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Images of Planets and their Satellites found at https://www.bing.com/search?q=PLANETS+AND+THEIR+SATELLITES+PICTURES

How Egyptian cotton could play a vital role in reducing global warming.

Amr Heikal, Operation Coordinator – Baker Hughes, Kuwait

Book Review:
***Egyptian Cotton – A Strategy to Reduce Global Warming* By Amr Heikal**

The book "Egyptian Cotton – A Strategy to Reduce Global Warming" was recently published by Amr Heikal, a technology and energy expert from the Centre for Arab Civilization in Cairo. At the start of the research, Amr Heikal confirmed that clothes account for 6.7% of global greenhouse gas emissions, equivalent to every person on the planet making a long-distance journey of 4,100 km every year, according to a new report issued by the Environmental Justice Foundation EJF. Organic cotton is an easily available solution – a versatile fabric that has a fraction of the climate's impact on other textiles and is more equitable to farmers. Government, manufacturers, and retailers must work together to ensure that it gets the market share it deserves. The author noted that our clothes play an important role in global heating. Manufacturing a ton of textiles requires between 15 and 35 tons of carbon dioxide, depending on the cloth, compared to just one ton of carbon dioxide to produce a ton of paper. In general, the textile industry pumps between 1.22 and 2.93 billion tons of carbon dioxide in the atmosphere each year. Textile production and consumption has also increased dramatically, and the problem is expected to worsen. Since 1975, global textile production has almost tripled. Europeans now consume an average of 31 kg of textiles per person every year. The industry and technology expert explained that cotton grown in the traditional way is not the answer. Globally, traditional cotton accounts for 220 million tons of carbon dioxide every year and 8.2 million tons of pesticides and synthetic fertilisers are used. It is also a thirst crop, using 233 billion cubic meters per year, equivalent to 238 bathtubs per capita per year. The other fibres are also no better: They require about 342 million barrels of oil each year to meet the demand for plastic fibres. The breakdown of synthetic fabrics such as polyester, nylon, and acrylic are responsible for between 20 and 35% of all microplastics in the marine environment. Amr Heikal says in his research that switching to organic cotton is an essential part of the solution. The annual saving of 96.2 million tons of carbon dioxide that this sustainable agriculture provides is the equivalent of driving an average car around the world 14,112 times. In addition to eliminating.

Author:
Amr Heikal CMgr FCMI, CChem FRSC, MSigmaXi, FIScT CSci, FIES, AFIChemE. Amr Heikal has more than 27 years of experience working in the Oil and Gas industry for such companies as Halliburton, Schlumberger and Baker Hughes. He has worked in most Middle East countries, the United Kingdom, all North Africa, and Azerbaijan. During his career he has focused on new technology developments that reduce pollution and optimize operation.

A scientific, cultural, and epidemiological history of facemasks and face coverings

Dr. Tim Sandle PhD FIScT

Introduction

The coronavirus pandemic of 2020 (caused by the SARS-CoV-2 virus) has put the wearing of facemasks and face coverings to the fore, taking masks outside the traditional arenas of surgical theatres and cleanrooms and into the public domain. Facemasks have an interesting history, and this article presents a potted overview of the development of facemasks, ending in current times.

Figure 1: *There are two common forms of facemasks. The image on the left is a respirator mask (an N95 mask, of a non-valve design) and the image on the right is a standard surgical facemask (source: Creative Commons repository)*

Even with our current knowledge, facemasks have limitations, and the article concludes with an assessment of the capabilities of modern facemasks as well as demonstrating the limitations of other forms of face coverings (1). Surgical masks have two functions: the first to protect the patient from a potential source of infection—the wearer; the second, to protect the wearer from another potential source of infection—the patient. The former remains more effective than the latter. Respiratory masks decrease in efficiency over time as the collection of particles hampers breathability. However, advanced technologies like artificial intelligence are being harnessed to improve mask design and materials.

Early history

Humanity has a relatively long history with face coverings, if not facemasks. One of the earliest recorded face mask-like objects dates to the 6th century BCE, where it was recorded that people adopted the wearing of cloth to cover their mouths (based on etchings made on Persian tombs dating back to this era). There is also a description of a Roman called Pliny the Elder (23-79 AD), a philosopher and naturalist, who made use of loose animal bladder skins to filter dust from being inhaled while crushing cinnabar, which is a toxic, mercuric sulphide mineral used at the time for pigmentation in decorations (2).

Later, in China, there are records of a form of scarf woven with silk and gold threads from the Yuan Dynasty (1279-1368), which was designed to pulled across the face (this is drawn from The Travels of Marco Polo, the 13th-century travelogue who is known to have visited China during Yuan Dynasty. It is thought that servants who served the emperor during mealtimes were required to pull the scarves across their face in order to prevent any unpleasant odours from their breath altering the smell and taste of the food. Much later, during the late Qing Dynasty (1644-1911), Chinese medical scientist Wu Liande invented a mask made of two layers of gauze called “Wu’s mask” in response to a plague in Northeast China (3).

To address disease specifically, at the time of the Black Death that spread across 14th century Europe (caused by the bacterium Yersinia pestis) (4), some in the population adopted face coverings in an attempt to ward of the disease. Later, in the 16th century the French medic Charles de Lorme (physician to Henri IV, Louis XIII and Louis XIV) invented the beak mask. This odd looking contraption included glass in the eye sockets to aid visibility together with a bag containing scented spices and mint leaves where it was reasoned the vegetative matter would help to filter out disease. This connected to the miasma theory, the obsolete medical theory that held that diseases like plague,

were caused by a miasma, a term for a noxious form of "bad air" (5). During the same century, Leonardo da Vinci proposed soaking cloth in water and placing it on his face in order to filter out toxic chemicals coming from people's respiratory systems (6). While also based on miasma theory, the concept is still used with modern masks worn by fire officers where toxic fumes are present.

Vestidura de médico (1656). En el pico de pájaro llevaba un algodón empapado en perfume para evitar el contagio.

Figure 2: *Display in the Museo de Sanidad with the reproduction of the engraving DerDoctor Schnabel von Rom and accompanying text (source: Museo de Sanidad Plague doctor at: https://www.isciii.es/QuienesSomos/CentrosPropios/MuseoISCIII/PublishingImages/Paginas/Visitas_acceso/June2016_Plague_doctor.pdf).*

Nineteenth century innovations

In 1848, Lewis Hasslett developed a mask to be worn by miners. This was based on principles established by Robert Brown, who in 1827 proposed what would come to be known as "Brownian motion" (the random motion of particles suspended in a gas or liquid medium) (7). The principles behind this could be used to theoretically prove the protective effect of masks on dust. Hasslett went on to obtain the first patent for a protective mask (US Patent Office 6529, registered I 1849), which was something akin to the World War I gas mask. The mask was designed to protect miners from hazardous dust and gases; later the design was used to protect soldiers from chemical warfare agents and firefighters from smoke and carbon monoxide. This led to the development of respirators during the 1920s (W. E. Gibbs developed the first respirator to be approved for industrial use) (8). Today there are two types of respirators: the air-purifying and the air-supplying respirator.

There is documentary evidence indicating that surgeons in the American Civil War (1860-1865) acknowledged the environmental risks from field surgery. For instance, army physicians speculated that the spread of pus-formation from one patient to another was probably airborne, which led to rudimentary face coverings being worn as well as the use of tent cloth to create divisions between infected patients who were believed to be contagious from others (9). Further with the biological aspect, in 1861, Louis Pasteur proved the presence of bacteria in the air, a finding that made a growing body of scientists pay attention to the design of modern masks.

The clearest signal that masks were being considered for medical use came in 1878, when A.J. Jessup, a physician from New York, observed that cotton gauze stoppers prevented bacteria from entering a test tube. From this observation, he proposed to extrapolate this concept to human beings in terms of facemask protection (10):

"Thus we see that as quarantine and disinfection will certainly spread of contagion from patient to patient, may we not confidently hope, by preventing the entrance of germs into the lungs and blood, by a properly constructed filtering mask to yet witness the spectacle of a population walking about the streets of a cholera infested city, without fear of its infection however deadly. As a properly made cotton filter worn over the mouth and nose must shut out all atmospheric gems of the ordinary putrefactive kind. We may confidently assured that those of disease will be equally excluded."

In 1879, one of the first domestically produced masks in Japan is advertised in newspapers. Initially these were aimed at mine, factory, and construction workers. These facial masks featured outer shells made from cloth fitted with brass wire mesh filters. Mask wearing outdoors is common in Japanese culture, irrespective of any epidemics or pandemics (in 1934 the Japanese government began to encourage citizens to wear masks on public transportation, in theatres, and any other place people gather). The rate of facemask wearing by Japan's population is anywhere between 22.8 and 48.75 of the population (11).

Figure 3: *Late nineteenth century Japanese woodblock, featuring a person wearing a facemask (source: History of Woodblock Printing in Japan, Creative Commons Licence).*

Building upon this, Carl Flugge, a German bacteriologist theorized in 1897 that droplet transmission was a route for the spread of respiratory diseases. He outlined his concern that when a surgeon coughs, sneezes or talks during an operation then expiratory droplets will be generated, which if contaminated with bacteria, may cause sepsis of the surgical wound. Flugge also suggested that surgeons should cover their mouths while performing an operation. This was supported in 1905 by Alice Hamilton who identified different staphylococci and streptococci from droplets produced by surgeons in operating theatres. These findings later led to the use of roller gauge strip placed over the mouth, as a way of fashioning rudimentary masks (12). Around the same time, in 1897, Polish medic Jan Mikulicz-Radecki publishes the first study supporting the use of a mask in surgery (a surgical mask composed on one layer of gauze) (13). However, it was not until the 1920s that the surgical mask is used first in the operating rooms of Germany and the United States (14).

On the industrial front, to address issues relating to toxic fumes, in the U.K. the Nealy Smoke Mask was devised. This contraption used a series of water-saturated sponges and a bag of water attached to a neck strap. The wearer could squeeze the bag of water to re-saturate the sponges to filter out some of the smoke (15).

Twentieth century

Early into the twentieth century the association with wearing masks to avoid infectious diseases began to emerge. The first widescale advocate was Wu Lien-teh, a Chinese physician, who advocated the use of masks during the Manchurian Plague of 1910-11 (a pneumonic plague) (16). These masks were multi-layered and it was recommended that masks be tied tightly to minimise particles from moving out from the edges of the masks, Wu also convened the International Plague Conference in Mukden in April 1911, the first major event of its kind that brought together an international team of scientists concerned with disease control (17).

The most notable requirement to wear facemasks in relation to mass infection was during the Spanish flu epidemic of 1918, which became a global pandemic as World War I ended. In many countries the wearing of masks became mandatory. For example, in many U.S. cities, failing to wear a mask led to a person having to pay a penalty (with failure to pay leading to the risk of imprisonment - penalty for violators was $5 to $10, or 10 days' imprisonment) (18). Fear of penalties did not prevent the Anti-Mask League of San Francisco being formed, which became a national anti-mask movement with the purpose to fight for the mask-wearing mandate to be repealed.

Figure 4: *An advertisement for a protest by the Anti-Mask League in The San Francisco Chronicle, on Jan. 25, 1919*

In other parts of the world, there was greater acceptance of mask wearing without the need for penalties (as with the U.K.); whereas in France there was great hostility, as the following quotation from the newspaper L'Heure infers (19):

"The Faculty adopted it, but not the public – a small section of public if truth be told, who, fearful of being ridiculed, prefer killing themselves by pneumococci and all the microbial agents projected by infected individuals when they cough or sneeze repeatedly in the tramways, buses and metros! In London, it is worn no questions asked, and in the busiest neighbourhoods, ladies, soldiers and solemn civilians can be seen protected by the mask – which does not prevent conversation – against the unfortunate and mysterious microbe."

Figure 5: *A streetcar conductor and passenger in Seattle wearing masks during the 1918 pandemic (source: Wiki Commons at: https://en.wikipedia.org/wiki/File:165-WW-269B-11-trolley-l.jpg).*

With the development of the form of the mask, in January 1918, Dr. George H. Weaver (working at Durland Hospital in Chicago) proposed the use of a mask made of double thickness gauze. Examining data across a two year period, Weaver showed a drop in infection rates of attendants of patients with diphtheria. Weaver also paved the way for proper use of the facemask. Weaver recommended that a mask should not be worn a second time until it had been sterilised, that the mask should be not be used after it became moist and that hands should not be placed onto the mask, in order to reduce the risk of cross-contamination (20).

For U.S. military hospitals in World War I, Joseph A. Capps required any person (patient or orderly) entering an ambulance to wear a facemask. The mask used was a gauze mask of three to four layers, 5 x 7 inches in size. The mask reportedly led to a drop in cross-infection rates when data was published in 1918 (21). While World War I presented a new kind of threats to personnel, including chemical warfare gases like chlorine, phosgene, and mustard gas, military equipment at the time did not account for protective masks or respirators. Combat equipment did not include respirators until World War II (22).

In 1918 the first study producing a specification for surgical masks is published. This study finds extreme variations in the numbers of layers and quality of gauze of which masks are made, with researchers undertaking a series of tests to determine how many layers were needed to provide complete filtration. The concern here was with the large numbers of bacteria that are liberated into the air from desquamated skin and clothing as a result of normal body activity (23).

Mask wearing became more commonplace in healthcare settings between 1910 and 1920, albeit with many of the masks substandard and with the manufacturing quality variable (24). For example, in 1918 the U.S. Academy of Medicine recommends that masks be worn to avoid the spread of influenza among health staff. The wearing of facemasks when undertaking surgical procedures began to become commonplace following the publication of research, published in 1927, by Frank Lamont Meleney, a medical doctor from New York. Meleney's research unearthed the finding that 33% of the surgical staff tested in a study were asymptomatic carriers of haemolytic streptococcus, isolated from the throat and nose (25). Trials using facemasks that followed on from these observations significantly reduced the rate of surgical infections deriving from surgeon-originating infections (26). These masks began to be formed from two layers of gauze. While many in the medical profession acknowledge that masks are effective in reducing infections, they are not always well received. For example, a medic called Edwin Jordan writes in 1927 that "masks are uncomfortable and inconvenient, as anyone who has worn them can testify" and require a great deal of "discipline, self-imposed or other" (27).

Research into the most suitable material for the facemask began to develop, with one of the first material studies concluding how coarse gauze was inefficient, regardless of the thickness, and that finer gauze was necessary in order prevent the spread of droplets efficiently (28). For example, Weaver found that fine-mesh gauze, with 44 x 40 threads to the inch, was more efficient than butter cloth (a soft form of cotton) which has 28 x 30 threads to the inch (29). In 1923, the Kotobuki Mask developed by Uchiyama Takeshoten, in Japan, becomes the first registered trademark facemask product.

As surgical masks eased into acceptance in the medical field, respiratory masks were adopted earlier. The United States Bureau of Mines initiates the first respirator certification programme and certifies the first respirator. While these earlier respirators were fairly heavy and crude, there is an interesting story around the shape of the modern, lighter and more effective respiratory facemask.

During the 1950s, a former décor editor for a U.S. publication called House Beautiful magazine, Sara Little Turnbull, began working with the company 3M to make better quality ribbons. 3M had developed a technology to take melted polymer and air-blast it

into a fabric of tiny fibres. Inspired by the technology, Turnbull began experimenting with the material to fashion shoulder pads. This led to a design for the moulded bra, launched in 1961. A few years later, on visiting sick family members in hospitals Turnbull proposed that the technology be used to form the "bubble" surgical mask, essentially an inversion of the brassiere cup that 3M released in 1961, that yes, takes its inspiration from the cup of a bra. While the design was less effective at bocking pathogens, it proved to be of a suitable design as a "dust" mask. This led to 3M introducing the first, single-use N95 mask in 1972. Instead of fiberglass, this mask was made up of very thin layers of fibres by air-blasting melted polymer. This created a filter-network which enabled most types of particles, be they silica or viruses, to become captured into the maze-like structure. 3M later added an electrostatic charge to the material, ensuring that smaller particles are pulled toward the fibres. Key to the design was the use of relatively large holes, which made breathing easy for the wearer, although at the same time the repeating pattern provided multiple opportunities for particle capture. However, breathing becomes more difficult over time as the spaces between fibres become clogged up with particles, which is why masks generally should not be worn for more than four to eight hours. Contrary to fake news posted on social media during 2020 in the context of COVID-19, wearing masks for a prolonged time does not lead to hypercapnia.

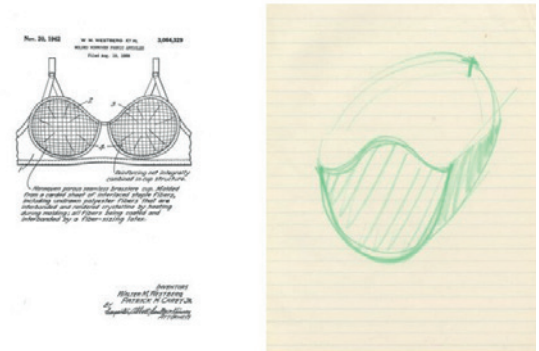

Figure 6: *How the 3M mask design developed from the shape of a bra, by Sarah Turnbull (source: on display in the Design Museum, London)*

The adoption of the respirator mask in the medical field grew in importance into the 1990s, when healthcare workers began wearing respirators to protect themselves from the airborne spread of drug-resistant tuberculosis from HIV patients (30).

Another important study showing the importance of good quality masks for surgical use came from Hare and Thomas in 1956. This concerned the pathogenic bacterium Staphylococcus aureus. Hare established that the organism is carried in the anterior nares in 50% of the population. He also discovered that it was only expelled from the nose during sneezing and snorting; hence, the need for suitable masks to minimise the release of the bacterium (31). It was at this time that masks started to be manufactured in colours like white or pale blue; early masks were black, brown or green, in order to disguise dirt or stains from repeated use. The design of the medical mask also became more robust, drawing on physics to consider deflection and filtration principles. New forms of plastic surgical mask that divert the flow of breath backward on either side together with filter material near the side outlets, designed to trap the deflected organisms, are produced from the late 1950s.

Facemasks today

The 'surgical' or 'medical' mask in 2020 is normally formed of three-layers of folded (ply) material and formed from a melt-blown polymer (typically polypropylene, or polyethylene or cellulose) placed between non-woven fabric. The finished form is pleated, to enable the mask to expand so that it fits the wearer more securely and equipped with either elastic straps to allow the mask to be tied or pulled around the head or with ear loops. The design aim is to balance high filtration, adequate breathability and optionally, fluid penetration resistance.

There are different standards for face masks which, subject to periodic update, date back to a study from 1980 which lay down the foundations for assessing mask efficiency (32). For the 'surgical style' mask (and most common cleanroom mask) the European standard is Europe EN 14683: 2019 (33). Within this norm there are three classes of mask (Types 1 to 3) based on particle filter efficiency ratings, where masks range between 95% and 98% in relation to the ability to filter particles of 3.0 µm (stated as the 'Bacteria Filtration Efficiency standard'). The U.S. equivalent standard is ASTM F2100 (34). The U.S. standard has an identical particulate filter requirement, although it has an additional 0.1 µm filter efficiency rating (for the 'Particle Filtration Efficiency standard'). With both types of filtration this relates to particle capture efficiency.

Figure 7: *A modern respirator headset (source: Tim Sandle)*

For respiratory masks, the European standard is EN 149:2001 (35) (and the masks are classed as 'filtering face pieces' (FFP) in the range FFP1 – FFP3). The U.S. standard is developed by the U.S. National Institute for Occupational Safety and Health (NOSH) as 42 CFR 84 (36), where the masks are classed N95, N99 and N100. There are some variants with the standard:

- N95 – Filters at least 95% of airborne particles.
- Surgical N95 – A variant of the N95 respirator that is suitable as a surgical mask.
- N99 – Filters at least 99% of airborne particles. Not resistant to oil.
- N100 – Filters at least 99.97% of airborne particles. Not resistant to oil.
- R95 – Filters at least 95% of airborne particles. Somewhat resistant to oil.
- P95 – Filters at least 95% of airborne particles. Strongly resistant to oil.
- P99 – Filters at least 99% of airborne particles. Strongly resistant to oil.
- P100 – Filters at least 99.97% of airborne particles. Strongly resistant to oil.

The reason why N95 and its European equivalent are more commonly spoken of is because it becomes harder to wear higher specified filtration masks for the 4-8 hours target without feeling suffocated. In 1995, the N95 respirator became a healthcare standard in epidemics in the U.S., as prescribed by the US National Institute for Occupational Safety and Health (NIOSH).

The respirator masks are assessed by their ability to filter 0.3 µm (which is used to represent the most-penetrating particle size). The requirements for the U.S. masks is tighter. For example, the N95 has a >95% efficiency rating and the N100 a >99.97% rating, whereas the European FFP1 is rated >80% (total inward leakage <22%) and the FFP3 >95% (total inward leakage <2%). Readers with an interest in COVID-19 matters will note that the N95 and FFP3 ratings are equivalent. China has a different norm to both the U.S. and Europe. In addition to the performance ratings, masks used for some cleanroom operations are required to be sterile (with sterilisation achieved either through gamma radiation or ethylene oxide gas, with both processes required to achieve a Sterility Assurance Level of 10-6).

The bacteria filtration efficiency test is of importance to cleanrooms. This test typically uses Staphylococcus aureus as the challenge organism (an organism of clinical relevance); an alternative involves the application of 0.1 µm latex spheres. The bacterium is challenged against a test mask in an aerosolised form at a flow rate of 28.3 L/mm (which simulates the range of normal respiration). The test takes place with the inside of the face mask in contact with the bacterial challenge (to simulate what the wearer may be exhaling). A suitable number of masks should be tested in order to establish confidence limits concerning product performance (the numbers of masks to be tested vary according to different standards). For the particle efficiency of respiratory masks, this is assessed using a mildly degrading aerosol of sodium chloride (NaCl) with a maximum test challenge loading of 200 mg.

During the 1970s and 1980s, the pleated design made of non-woven fabric was introduced and there was a greater understanding of the importance of a correctly fitting mask. For instance, even when masks are worn correctly, the airflow during inhalation could bypass the mask material, resulting in reduced filtering efficacy and an increased health risk for healthcare workers (37).

With modern masks, these are designed to meet the major mechanisms involved in particle removal. These mechanisms are by fibrous media including gravity settling, inertial impaction, diffusion, and electrostatic attraction. It has been reported that particles larger than 0.3 µm are mainly retained by inertial impaction, whereas particles below 0.2 µm are captured by filtration and electrostatic attraction (38).

Facemasks, face coverings and the 2020 coronavirus pandemic

In considering the risks presented by the novel coronavirus and the global pandemic that began in 2020 it is necessary to point out that masks, depending on the material and design, filter out a majority of viral particles, but not all (39). Another factor is the type of mask, especially given that masks differ in their maximum internal leakage rate limit. The common surgical masks, and the type easiest to get hold of, are designed to protect against larger droplets or particles. Given that the SARS-CoV-2 virus is small, with a diameter of 60–140 nm, then the standard masks cannot provide a complete barrier.

Figure 7: *Sign of the times – an abandoned surgical facemask (source: Tim Sandle)*

A further factor with masks is that they work best protecting a non-infected person from an infected person when the infected person is wearing a mask of appropriate design. However, masks can confer a level of protection to the non-infected person, but not to the same extent. Data suggests surgical masks are 67 percent effective in protecting the wearer (40). Hence, where there is a shortage of masks, then the focus should be foremost with mask-wearing by infectious people (so-termed "source control"), rather than mask-wearing by susceptible people.

In terms of face coverings, a 2020 study showed that hand-made masks have some effect, provided they were made from cotton materials. The use of cotton is effective in reducing the level of spray generated through everyday speech. However, other self-made face coverings, like bandanas, neck fleeces and balaclavas are quite ineffective. The study, which was developed to provide useful data during the coronavirus pandemic, took place at the Duke University Medical Center and it set out to assess the relative effectivity of different face coverings. According to one of the researchers: "The notion that 'anything is better than nothing' didn't hold true." Aerosol visualization technology can be used to further show how loosely folded facemasks and bandanna-style coverings provide minimal stopping-capability for the smallest aerosolized respiratory droplets.

To reach their conclusions physicists designed a simple test method for mask and face covering effectiveness, based on a box, a laser, a lens, and a cell phone camera. The device detects the scattering of water particles, which are generated as a person speaks. With the relative, mean droplet efficiency, the N95 mask had a droplet count below 0.001; a surgical mask around 0.01; a self-made cotton mask of around 0.1; and many other materials close to 1.0 (which was almost identical to wearing no face covering at all). While some masks were evidently better than others, given that around half of COVID-19 infections come from people who do not show symptoms, the wearing of some form of mask does help to avoid viral transmission (41). Supporting evidence from mathematical models shows that routine facemask use by 50 percent or more of the population reduces COVID-19 spread to an R-number less than 1.0, flattening future disease waves and allowing less-stringent lockdowns. The reproduction or 'R' number relates to the number of people an infected individual passes the virus onto. This needs to stay below 1.0 for a pandemic to slow (42).

Figure 9: *Tim Sandle wearing a facemask in 2020*

The table below, from the World Health Organisation, shows the relative efficiency of materials used to make facemasks, where the higher the 'filter quality factor', the better the facemask is at filtering particles (43).

Table 1: Comparison of materials for fabric masks

Material (source)	Structure	Initial Filtration Efficiency (%)	Initial Pressure drop (Pa)	Filter quality factor, Q (kPa−1)
Polypropylene (interfacing material)	spunbonded	6	1.6	16.9
Cotton (sweater)	knit	26	17	7.6
Cotton (T-shirt)	knit	21	14.5	7.4
Polyester (toddler wrap)	knit	17	12.3	6.8
Cotton (T-shirt)	woven	5	4.5	5.4
Cellulose (tissue paper)	bonded	20	19	5.1
Cellulose (paper towel)	bonded	10	11	4.3
Silk (napkin)	woven	4	7.3	2.8
Cotton (handkerchief)	woven	1.1	9.8	0.48
Cotton, gauze	woven	0.7	6.5	0.47
Nylon (exercise pants)	woven	23	244	0.4

Caveats with Table 1 are that each mask fashioned from the material is formed of a minimum of three layers: an inner layer touching the mouth and an outer layer that is exposed to the environment. Material should be water-absorbing (hydrophilic) materials combined with an external synthetic material that does not easily absorb liquid (hydrophobic).

While the data displayed in Table 1 is of contemporary interest, it was established back in 1971 by Micik and colleagues that when materials for facemasks and face coverings were exposed to aerosols only those made of glass or synthetic fibre displayed relatively high filtering efficiency (44).

How long a mask is worn for is an important consideration (masks tend to become less effective after four hours of wear). It also follows that the more time a person spends in an environment where the virus is present, the less effective a mask becomes. The surrounding humidity is also a factor, as aerosol size can be affected by humidity, in that if the air is drier, then aerosols become smaller faster. If humidity is higher, then aerosols will stay larger for a longer period of time, dropping out faster onto surfaces, leading to high level of viral contamination (45).

In concluding this final section, it is useful to note:

- Face masks must be of the right size for the user. Having to readjust a face mask is poor practice and is one indication that the face mask is unsuitable.
- Once a face mask has been fitted, a test to see if the face mask fits is to breathe in (and check that the fabric of the mask moves in towards the mouth) and to breathe out (to check that the mask blows slightly outward).
- Furthermore, there are clear risks with handling face masks. Coronavirus RNA has been shown to be recoverable from the material used to manufacture surgical masks for several days and a mask that been worn must be regarded as hazardous (or infectious) waste.
- The act of putting on or removing a mask carries a risk, including viral transmission to the hands and the way the mask is handled, particularly any potential contamination from the inside of the mask.
- Face mask efficiency decreases over time. It is recommended that face masks are only worn for the work session or for a maximum of six hours. The six hours is one continuous time period rather than cumulative (that is the masks should not be removed and then put back on again).

The evolution of facemasks has not stopped, and new innovations are being driven in response to the coronavirus pandemic. Industry 4.0 technologies like artificial intelligence, 3D printing, holography, and virtual reality are being used to improve design and to propose new materials, such as graphene oxide for the fabrication of antimicrobial surfaces (46).

Summary

This article has shown that facemasks are more complex than perhaps their simple-appearing form suggests. The article also charts the gradual development of the mask and what now seems, with the benefit of hindsight, a slow adoption. The rate of adoption was seemingly slower with the surgical mask in the medical and healthcare setting than it was for the respiratory mask (which was primarily development for emergency services and the military).

As well as charting the development of the mask, this article has also reviewed the use of masks alongside their role in pandemics, drawing some parallels with the 2020 coronavirus pandemic, together with an overview of the effectiveness of face coverings,

Facemask development is not at a standstill. Current materials used in production including non-woven fibrous substances have been in use since the beginning of the 20th century and have been shown to be still sufficiently viable in their use. However, advances in materials is leading to experiments involving alternative coatings that are antimicrobial and new production methods. The history of the facemask is not yet over.

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Inductive & Deductive Approaches to Teaching & Learning in Science and Technology

Kevin Fletcher

Introduction

I have already given a brief consideration in a previous article (Fletcher 2019) to the extent to which a model of Cognitivist Theories of Learning can be applied to Science and Technology teaching. This was then followed by a similar consideration of Humanist Theories of Learning and mapping the extent to which they can be applied to, and used in, Science & Technology teaching (Fletcher 2020).

In this brief discussion I hope to consider the differences and similarities of inductive and deductive approaches to teaching and learning in Science and Technology.

Inductive and deductive approaches

The differences and similarities of inductive and deductive approaches to teaching and learning in Science and Technology are, perhaps, best seen through simple examples:

Suppose we wished our students to gain an understanding of magnetic forces. We could give students a magnet and a number of items made from a range of different materials. The students are then allowed to explore the use of the magnet and the various items made from the different materials. The students may then list items attracted to magnets and those not attracted. You may have to prompt at this stage. The list may be as follows:

Attracted by magnet	Not attracted by magnet
pen	plastic pen
chair leg	paper
watch	cup
paper clip	wood
hair clip	clothes
spoon	
zip	

You can then ask the students to make a statement which summarizes their observations. It may be that they say metals are attracted by the magnet. A more sophisticated test would indicate only some metals

are attracted by the magnet. The students can then be given more objects and asked to predict which items would be attracted.

An alternative approach could be to give out magnets, telling the students that magnets attract (some) metals but not objects made from other materials. Question and answer could then be used to ask the students to predict, then test, whether the magnets will attract various materials.

The two methods have some commonality. Essentially the content and equipment are the same. Both methods depend upon the generalisation that magnets attract (some) metals.

There are, however, significant differences. In the first case the students make observations about specific examples and then make and test a general statement. This process of moving from specific examples to generalised statement or law is called **an inductive approach**. In the second case the generalization was stated and then tested using specific examples. This process of working from a general statement and using specific examples is known as **a deductive approach**.

Example	Deductive	Inductive
Mixing Colours	• Teacher states "Yellow and Blue mixed make Green".	• Teacher "How can we make green?", Students experiment.
Interview Skills	• Lists process of do's and don'ts • Practice role play interview • Playback video and discuss in relation to do's and don'ts.	• Students interview each other. • Design guidelines • Apply guidelines in new • practice interviews • Playback.
Needs of a Stroke Patient	• Teacher states needs of Stroke Patient.	• Students visit Stroke Patients and their relatives. • Students meet in a group and generate the list of needs.

Both approaches have their benefits, and choice of approach may depend upon the topic under consideration. Also, some students in your class will prefer an inductive approach whilst the other students may learn better with the deductive one. It could well be that the best approach is to use a mix of the two throughout the course.

Summary

In this article, I have outlined some of the basic considerations of the differences and similarities of inductive and deductive approaches to teaching and learning in Science and Technology.

In a future article, I intend to discuss the concept of Androgogy in Science and Technology. That is; the teaching of adults and how they learn, in contrast to how children learn in the fields of Science and Technology.

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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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.

Development of improved machine learning techniques for plant disease detection and classification

Adekunle M. Ibrahim and Abdulwahab Funsho

Abstract

Agricultural production plays a big role in economic growth especially in developing countries; one of the biggest problems that a farmer can face is the different type of diseases that can affect crops on their farm. This problem has destroyed crops and eventually led to shortage in annual agricultural production across the world. Quality and high production of crops could be determined by early detection of diseases. Disease detection through manual observation can be somewhat tedious, complex, expensive, and difficult, and subject to rigorous analysis. Although some researchers have worked in this field most of the existing methods for solving problems in disease detection have not been effective in terms of real time application. This paper therefore proposes to apply modified histogram equalization to extract useful features from maize crops by first and foremost transforming the RGB image in the form of 3D dimensional features into grayscale images equivalent in 2D features. The resulted images were processed further to generate a binary image in order to expose those areas with disease. Gaussian and median filters were applied to eliminate unwanted materials that could introduce errors into research computational calculations. Machine learning classifiers were used to classify the extracted features to separate diseased plant leaf from healthy ones. The developed model was tested with three different classifiers and results showed that Random forest performed best with an overall classification accuracy of 96.7%. These results have shown that applications of histogram equalization with appropriate classifier algorithms could be effectively used for the classification of plant leaf diseases. This early detection of plant disease could help to reduce crop damages and hence increase food production in our society.

Keywords–Maize Leaf, Feature Extraction, Histogram Equalization and Machine Learning

Introduction

The knowledge of pest management and diseases is still lacking in different developing countries. Poor disease control and climate changes are some of the key factors in food production. When we talk of plant disease, this could also involve important plants such as crops, tomatoes, cassava, vegetables and other valuable plant that could lead to food production (Usha et al., 2019). It is therefore very important to monitor and take proper care of our agricultural products as this would increase our harvest in farming at the end of each year. Disease is one of the factors that can affect a large amount of food production annually; how do we control these effects of pest and diseases on our crops? Disease identification in plants has been identified to be a very important technique for preventing the loss in the production of agricultural products. Of course, it could be very difficult to monitor plant diseases manually at all times as this would require more energy and time in the process. Early detection and classification of plant diseases can help in no small way to manage the agricultural products of crops in different farms. Many modern approaches have been implemented to minimize the effects of diseases in plants and also maximize the agricultural productivity but unfortunately the expected success has not been achieved in this area (Sullca et al., 2019). In spite of various technological approaches, expected production of local foods has not been met in various countries across the world today. Of course, governments are trying their best to ensure there is enough food for their people at all times. To achieve this some developing countries are using their natural resources to buy imported foods from neighbouring countries in order to meet people's demand on food and other agricultural products.

Diseases in plant can cause economic and production losses in agriculture and forestry. For example, (Aziz et al., 2019) economic loss caused by a fungal disease in soybeans has led to a profit loss of about 11 million dollars due to plant infection. Early detection of infection in plants can play a very big role in the field of agriculture and the use of automatic disease

identification system can be extremely important in this case. For these reasons, this research therefore proposes to develop and apply modified histogram equalization for automatic detection of leaf diseases in maize crops. The rest of this paper is structured as follows. Section II presents the proposed framework for maize crop disease identification. Section III reports the experimental results and in Section IV, concluding remarks of this work are presented.

Materials and methods

The online database used for this research consists of four different classes of corn leaves from plant village website. The images were not directly collected from the plant village website but through the Mendeley website (Mendeley, 2020). The corn diseases symptoms can be categorized based on diseases severity of the affected areas in the crop. The four major classes of maize leaf crop are rust-leaf, spot leaf, blight leaf and healthy leaf. Each symptom can be physically sighted for proper identification of plant diseases on the affected parts. The database has a total image of 3852 ROIs of size 256x256 pixel patches from four different classes: normal healthy leaf (1162 images), corn leaf blight (985 images), corn leaf rust (1192 images) and corn leaf spot (513 images) (Mendeley,2020).

The proposed study design for early detection of fungal disease from physical appearance and other symptoms of maize crops comprises of the tasks such as image acquisition, pre-processing of images, feature extraction and so on. The summary of this design for efficient detection of maize diseases is shown in Figure 1. The system overview of crop disease detection and analysis involves several algorithmic steps as we have mentioned earlier. Each step of the algorithmic approach would be thoroughly discussed and analysed using the data from the online database with the help of image processing techniques and machine learning methods.

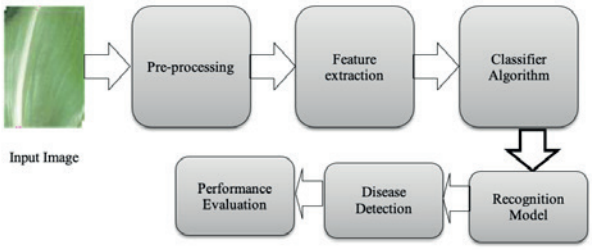

Figure 1: System models for disease identification in Maize crop leaves

Acquisition of maize crop

This method uses some characteristic features extracted from the input images to identify different symptoms on the crop plant. These diseases can affect different parts of crop plant ranging from leaf, stem and other parts of plant. The developed methodology as shown in Figure 1 consists of different stages; the first stage of the algorithmic steps is the acquisition of maize crop leaves from online database. The samples of the image leaves for different classes are shown in Figure 2 after cropping into smaller size with pixel dimension of 256 x 256. The images are stored in JPEG format and all in RGB colour, the prototype uses MATLAB image processing library for this process.

Reduction of noise level in image leaf

After we have acquired the images and cropped to appropriate pixel size to increase the speed of experimental computation, the next stage of the

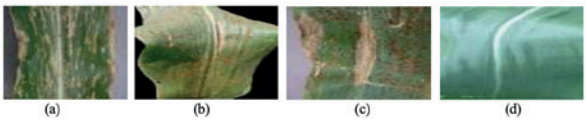

Figure 2: (a) Leaf with spot disease (b) Leaf with rust disease (c) Leaf with blight disease (d) Healthy leaf

implementation process is pre-processing stage. Pre-processing of the input image is one of the important stages in the process of identifying diseases in maize crop leaf; this process has been applied to improve the quality of image and also remove the unwanted materials such as noise from the images. At this stage, the input image was processed to obtain the equivalent binary image with little or no noise in order to improve the classification accuracy of disease detection. The RGB image in Figure 3a was converted to a grey scale image as shown in Figure 3b, the resulted image after this conversion was processed further to generate a binary image with noise as presented in Figure 3c. Gaussian and median filters were used to get rid of unwanted features that could introduce errors into our calculation, which results into the image generated in Figure3d.

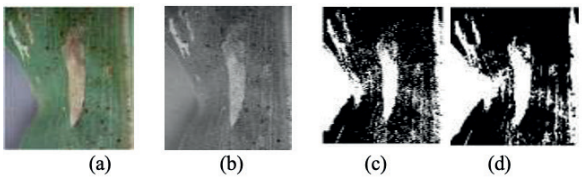

Figure 3: Illustrating Pre-processing stage of Maize leaf; (a) RGB image with blight disease; (b) Grey Scale Image; (c) Binary Image with Noise; (d) Binary Image with Noise free

As can be seen in Figure 3, several stages were involved in reducing the noise level of the input image and improving the quality of image enhancement for efficient detection and analysis of crop leaf. The process has really helped us to identify the affected parts of the leaf as presented in Figure 3. During this

process, a 3D dimensional image has been converted to the corresponding 2D by applying some programming skills to normalize the intensity values of the image by transforming the RGB image to grey scale (Figure 3b). The image in Figure 3b exposes some of the blight diseases caused by bacteria in the affected areas, even the brown spot becomes more darken than other areas with grey colour while the brown blight at the middle of the image becomes lighter. This process has converted the true colour of RGB image (Figure 3a) to grey scale intensity image (Figure 3b) by eliminating the hue and saturation information while retaining the luminance. In RGB, visualization of colour spaces is much harder since there are additional dimensions that the standard brain cannot visualize easily. Working around the image by thinking of each colour variable as an intensity image could lead to grey scale image processing.

Additionally, colour information does not help us to identify important edges or other features that could enhance the image and result to efficient diseases detection and classification of crop leaf. Even the complexity of images and codes are other reasons why one should think of converting to grey scale since this process would drastically reduce the time and space complexity of processing and detecting disease in plant leaf. It is a very excellent approach of solving problems since most previous and existing methods encountered this problem of high time consumption of algorithms. Starting with grey scale processing rather than colour and understanding how it can be applied to multichannel processing would go a long way in improving the speed, accuracy and overall efficiency of our approach.

Intensity normalization using histogram equalization in maize crop

The segmentation and pre-processing task are the initial stage; the next stage of this process is to obtain binary images by selecting the lowest points between two classes of histogram by considering the class variance within the image. Figure 3c shows a binary image of maize leaf with some noise level as we can see, however in this Figure 3c, visualization of diseased part becomes easier compared to the previous stage. With this binary image (Figure 3c), one can identify and analyse some set of pixels with different information. For instance, in Figure 3c, the process separates the background level that is zero from the diseased parts that is in the form of white level (1) since a binary image usually consists of pixels of exactly two colours (black and white). This means each pixel is stored as a single bit- 0 or 1. This process has normalized the intensity values of the grey scale images from 0-255 to 0-1. The problem with this stage is that it contains some noise or unwanted materials that can introduce errors into our experimental computation.

For this reason, a median filter was implemented. The average filter computes the mean (average) of the grey-scale values within a rectangular filter window surrounding each pixel. This has the effect of smoothing the image (eliminating noise) as presented by the following equation:

$$r = (a1 + a2 + \ldots + an) / n \quad (1)$$

The outcome of this implementation has been fantastic, Figure 3d now becomes more clearer compared to Figure 3c as the diseased parts indicated with white colour are more prominent than the previous image.

Results and discussion

In this work, histogram equalization techniques were modified and used to extract useful features from segmenting images by improving the contrast image enhancement of the input image. In diagnosing and analysing diseases patterns in crops, it requires good contrast images for better detection and accuracy since this process contains maximum information of diseases affecting plants. Most crop and plant images are of low contrast and this makes detection or visualization very difficult; therefore, better contrast or localization of images is required. This approach would improve the image brightness and preserve the necessary information for further processing such as classification and so on.

The extracted features were trained with random forests, neural networks and support vector machine classifiers for comparative analysis. The three classifiers selected are very flexible in nature and can be used for classification and analysis of crop plants. The extracted features from the processed images were divided into training and testing data, such that the feature vector can be generated for training the dataset. The generated feature vector was trained with all classifiers to construct robust classification models for efficient classification of crop diseases. The feature vectors were extracted for testing images to validate the performance of the classification models in order to evaluate and determine the accuracy of diseases detection in maize leaf. About 80% of the datasets prepared were allocated for training the classification models while the remaining 20% were used for testing the algorithms. These vectors were processed with three different learning algorithms: Support Vector Machine (Bashir and Sharma,2012; Maniyathh and Ram,2018), Random Forests (Chen et al., 2016; Ibrahim et al., 2017; Polder et al.,2019) and Neural Networks (Sannakki and Kaajpurohit,2015; Venkatesan and Li,2017). The classification results after the experiments are presented in Table 1.

Table 1: Classification for Maize Leaf Diseases

Machine Learning Models	Accuracy
Support Vector Machine	93.6%
Random Forests	96.7%
Neural Networks	95.3%

In Table 1, when SVM and characteristic features with histogram equalization were used, the algorithms recorded a classification accuracy of 93.6%, with random forest, we obtained a classification accuracy of 96.7% and lastly neural network classifier gave an accuracy of 95.3%. Overall classification accuracy of over 90% for maize leaf diseases recorded with three different classifiers is an excellent result. The results show the effectiveness of pre-processing approaches with the feature extraction methods in developing robust models and very powerful features for automatic detection and classification of plant leaf diseases. Random Forests performed best with an accuracy of 96.7% compared to support vector machine and neural networks. Of course, support vector machine can sometimes perform better than Random Forests classifier but in this case, Random Forest seems to be better in terms of accuracy. This is probably because Random forest is well suitable for multiclass problems as in our datasets while SVM is more suitable for two-class problems and the use of binary techniques during pre-processing has really helped especially in the performance of Random forests classifier. With Neural Networks, it does not require big data to train the classification models unlike SVM that always work or train well with big data. The size of our data in conducting experiments in this research work could be one of the reasons why we have got better results with random forest compared to neural networks and SVM.

Conclusion and future work

Accurate detection of symptoms of plant diseases with the help of image processing techniques and machine learning can help in supporting farmers during their struggle against disease outbreaks. In this work, images of plant leaf that can visually display different symptoms of plant diseases have been used for different experiments to develop different recognition models for detecting diseases. The maize leaf used for the experiments has four categories of diseases; leaf rust disease, leaf spot disease, leaf blight disease and healthy leaf. The images from the database have been prepared with appropriate pre-processing techniques and improved learning methods for extracting powerful features that could yield good results. The experimental results indicate that the developed models can significantly support accurate and automatic detection of leaf diseases. The results have significantly demonstrated effectiveness of modified histogram equalization in terms of contrast adjustment and enhancement of image quality in detection of maize leaf diseases with a classification accuracy of 96.7% using random forest classifier. Also, the extracted features after series of algorithmic stages have been tested with three different classifiers to determine the performance of developed model in detection and classification of plant diseases. It was discovered that all classifiers have more than 90% classification accuracy in detection of maize leaf diseases. However, in future this research work can be improved by combining neural network classifier with deep learning techniques using other plant leaf to capture more information that could be useful for better classification accuracy. Additionally, a comprehensive study is required to understand the factors affecting the detection of plant diseases, such as the classes and size of datasets, learning rate, illumination and so on.

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Reverse mentoring

Lucy Hudson and Simon Breeden

Jack Welch, CEO of General Electric devised the model of reverse mentoring with a specific goal in mind. Many senior managers at General Electric in the 1980s lacked computer know-how, so younger staff were teamed up with senior managers to educate and train them in the use of computers and digital systems.

"Amazed to hear and see the complexity of the work that we (technicians) do and the vast variety of projects and repairs that we undertake and was intrigued to hear more"

At the University of York, we decided to adopt the concept of reverse mentoring to help us fulfil one of the Technician Commitment pledges, for our technicians to have a voice. In large organisations with established hierarchical structures, it can be difficult for all staff to be heard and their views considered; most employers host a form of annual review, but these conversations are formal and usually with line managers. We have established a pathway for our early career technicians to meet up with senior managers, a pathway that allows the flow of information from the bottom to the top of the institution and vice versa.

Reverse mentoring can myth bust any possible assumptions and stereotypes that can clutter our thinking and are often, simply untrue. For example, millennials and Generation Z seem to get a bad press about their work ethic and attitude: similarly, they may think Generation X and the Boomers are resistant to change. When really all we need is an opportunity, a platform for these staff groups to meet and talk freely, with benefits for both parties, not least to create a useful and informative network that cuts diagonally through the institution.

Through the Technician Commitment at York, we are on the pathway to delivering a respected and valued career pathway for technicians, Senior management need to know the current thoughts, aspirations, and the reality for career progression at York to be in an informed position to discuss, approve and drive change. Technician Commitment at York need to know the answers to questions such as: What do our technicians expect from their employer to support their career development? What do our senior managers and leaders know about the role of a technician? And what do both groups know about career prospects for technicians at York?

"I mentioned that, for those who are on fixed term contracts, such as myself, we worry about what happens next.

The redeployment scheme appears to be very beneficial, but we talked about the possibility of adding in opportunities to meet and shadow other labs."

We chose to engage with our early (to York) career technicians and apprentices who are free thinking, optimistic and enthusiastic about their future; to let them know they, and the work they do is valued and that we are committed to providing a pathway to a rewarding career. For our senior managers and leaders, the benefits are, an opportunity to talk directly with technicians at the coal face, with no agenda and; not from a podium, to learn about technician's career aspirations and how the institution and the Technician Commitment can support our technicians further.

The Benefits of Reverse Mentoring

For the Mentors	For the Mentees	For the University
Respect and empowerment from senior colleagues	Understanding roles within the University	Ideas and solutions
Career development	Respect from younger colleagues	Keeping staff engaged and committed
Feeling that the University values their uniqueness	Learn about the needs of younger colleagues	Encourage sharing and innovation across the University
Professional and personal development	Appreciation of changing technology and how it affects roles	Improving interpersonal skills of younger staff
Career development	Gain support from employees	Possibility to capitalise on generational differences
Self-confidence		

A benefit from the recent pandemic is that video conferencing has become an acceptable tool for all. Our technicians are often on video conference calls, and

this familiarity made it easy to set up one to ones. For our senior managers and leaders, an hour to meet and talk with technicians was a welcome change to their busy diaries. We were delighted that our early career technicians and senior management were all extremely keen to be part of the pilot scheme, with a technician from Biology, Physics and Theatre, Film, Television, and Interactive Media Departments and three members of our University Executive Board: Charlie Jeffery (Vice Chancellor and President), Joss Ivory (Chief Operating Officer) and Brian Fulton (Dean of the Science Faculty and Technician Commitment lead) taking part.

"I am really a big supporter of reverse mentoring and think we should adopt this as a construct that everyone expects to do. And I'm happy to do more!"
Joss Ivory (Chief Operating Officer)

It was stressed to participants that there was no agenda, and they should speak freely about their role, career, and work experience. We asked for feedback from all parties noting that interesting points and ideas were to be shared with the Technician Commitment Delivery Group. Most importantly, as this was a pilot, we wanted to know whether the experience was enjoyable and any adaptations to the process for future mentoring.

The feedback from technicians and senior management was reassuringly similar, for example all participants mentioned how technicians like working at the University of York and would like to progress at York, not necessarily in the same role or department. Personal roles were discussed, elaborating on what it takes to keep research space operational, with an emphasis on the teamwork required.

Technician feedback included several careers related requests.

- Technicians said much could be learned from shadowing other technicians, either in their own area of expertise or more broadly across the institution, to increase their employability through widening of their skills set.
- We all learn new stuff every day, but technicians would like time allocated to use for training and development; also, for on-the-job training to count as personal development with CPD points.
- It is vital for early career technicians to build networks for support and knowledge/skills exchange, but this has been limited during the pandemic. A social space for technicians to meet informally was also suggested.
- Career planning is limited when employed on, sometimes repeated, fixed term contracts, technicians currently need to go where the work is for job security rather than take their preferred career pathway.
- Technicians would like to know more about the research themes and activities across the whole of the campus, technicians can work across many disciplines but need to know where their skills could be useful.

Technicians raised a common issue that each department has its own processes hindering a collegiate culture, for example the ability to share or borrow equipment. Apprentices were mentioned by both senior management and the technicians, with technicians saying they like to train and share their skills and expertise, more apprentices please!

The career pathway at York limits those technicians who do not manage staff. Our Chief Operating Officer shared her own experience in a previous role of technical specialists being at higher grades than their managers. York has technical specialists up to grade 7, does this limit the career and retention of talented staff?

"I talked about what it takes to run a lab and how many people are needed to help – a real team effort is required."

"I felt as though this conversation was important."

Senior management agreed; they were amazed at the complexity and specificity of some technical roles to keep equipment and services in a well-founded research area operational and in technician's commitment to deliver an evolving teaching curriculum and support world class research at the same time. They were extremely keen to be involved in any future sessions, saying they found the meetings informative as well as enjoyable, with an opportunity to encourage and motivate.

It has been previously documented in a Gatsby report that technicians in HE are an ageing workforce with declining numbers of school leavers considering a technical career. However, the UK government industrial strategy aims to increase UK R&D investment.

Technicians are a valued workforce. By their own admission, many will say they do not speak up, promote, and celebrate their successes, impacts and contribution to research and teaching activities. Reverse mentoring is a way of placing our technicians and their contribution to the University into the minds of those who make decisions about policies, finance, and resources.

Reverse mentoring at York will be an annual scheme for technicians and will be widened to all staff groups in the future.

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Are you ready for T Levels?

Suzanna Butler, Harrow College

'It wasn't just an extra pair of hands, it was a really good pair of hands. We didn't feel like they were students, we felt like they were our employees.' Kanika Mehan, Medical Device Training and Library Officer, Imperial College Healthcare NHS Trust

Technicians are the backbone of the STEM industry, but every year 50,000 experienced technicians retire and take years of knowledge with them. In the next decade, 700,000 new technicians will be needed to fill these gaps. Have you thought about how to engage with the local workforce and build a talent pipeline, finding the best young people to join your workforce?

T Levels are a new qualification, first introduced in September 2020 to develop employability and technical skills for the next generation. 2021 introduces a Science T Level with an occupational specialism in Laboratory Sciences. Students spend 80% of their time in the classroom, learning practical skills such as good scientific practice, data handling, and health and safety within the workplace. The rest of the time is in the workplace, completing a 315 hour unpaid placement in industry. T Levels have been created by employers, for employers, with an employer panel including GlaxoSmithKline, AstraZeneca Group, Royal Society of Chemistry and The Royal Marsden NHS Foundation Trust.

One of the trusts that has led the way working with T Level students is Imperial College Healthcare NHS Trust. After an induction and training programme, and some time shadowing experienced staff, students worked across three hospitals in a number of departments including the Medical Equipment Library.

"I definitely recommend taking a T Level student on. They give you an added workforce for limited cost, they are an extra pair of hands. Invariably they are keen, conscientious and they want to understand what we do and by doing that they help us deliver a better service."
Max McClements, Head of Clinical Technical Services, Imperial College Healthcare NHS Trust

Your local College can support you in setting up an Industry Placement Scheme within your workplace. The first step is to think about projects and tasks that a young person could help your employees with. Do you have tasks that with some training and supervision, could be completed by a motivated and talented young person?

"One of the misconceptions is that there won't be anything for students to do. We treated them like our own employees and the same way you find tasks that are suitable for your own employees to do, you soon find tasks for the students." Kanika Mehan, Medical Device Training and Library Officer, Imperial College Healthcare NHS Trust

Imperial College Healthcare NHS Trust has taken 4 T level students this year and will be taking a further 9 next academic year.

One of the most common tasks our employers have found that students can excel in is the cleaning & calibration of laboratory equipment. With training, a student can learn how to safely clean a range of equipment, including those which may have fluids or other hazards on them. In their course students will be taught how to calibrate basic lab equipment such as pH meters, balances and mechanical pipettes. You can teach them how to check functionality of equipment specific to your lab and to inform the correct member of staff if equipment is not working correctly.

Students can also carry out some practical scientific techniques – by the end of their course students will have experience in the following areas: paper and thin layer chromatography, distillation, acid-base and redox titration, refluxing, filtration, differential staining (microorganisms), aseptic

culture of microorganisms, preparation of serial dilution, preparing a solution of defined molar concentration and colorimetry. They do not need to do all of these on placement, but if you have any way that they can experience any of the above, it would be extremely useful for them. They can be taught other techniques and can carry them out with supervision if you are happy with their competency level.There may also be other more complex activities that you would not allow students to partake in, but they can observe safely. Based on your experience with the student, you can make this decision.

"They came at a perfect time, there were lots of staff taking annual leave and we were very busy supporting the Trust during the COVID surge. It was the perfect opportunity to have an extra pair of hands. The students we selected were really helpful, eager and quick to learn. They were proactive which we really liked. I hope the students found it fulfilling as well to be part of the NHS when we really needed them."
Kanika Mehan, Medical Device Training and Library Officer, Imperial College Healthcare NHS Trust

The T Level is the first step in a student's career, they can then go onto work, or an apprenticeship, depending on your business needs. It is a great way to help the community, to build your talent pipeline, to help your staff build their management and supervisory skills and of course, to get extra assistance for any specific projects or your everyday tasks.

If this sounds like something that you would like to hear more about, contact Suzanna Butler **subutler@uxbridgecollege.ac.uk** to arrange a short meeting to help get you started.

Author:
Suzanna Butler, T-Level Development Manager at Harrow College. Developing T Level qualifications in Digital, Science, Business Management, Engineering and Childcare at HCUC.

Applying for IST Fellowship

Fellowship of the Institute is the most senior grade available and is an indicator of the highest level of achievement within the profession. Individuals may apply, or be nominated, according to the guidance laid down by the Executive and, if suitable, will be elected by the Fellowship Committee. Applicants for Fellowship would be expected to have at least one year's membership at MIScT level prior to a Fellowship application/nomination, but in exceptional circumstances the Executive may elect Fellows who have not previously been members.

The Fellowship Committee will take into consideration your qualifications, professional work experience, length of service, supervisory ability, and any contribution to the advancement of science, technology, education and training.

Fellows are expected to contribute to the activities and/or development of the IST and the nature and extent of that potential contribution will be taken into account when Fellowship applications are considered. Contributions could include the submission of articles to The Journal, support for professional registration, enhancement of the IST profile in the workplace – to name just a few examples. We would be happy to discuss options with potential applicants.

Fellows may be nominated (by two or more Executive members) and/or applications made on the designated form, which is available for download. Nominated candidates would be subject to the same review/ assessment channels as per individual personal applications.

Application forms and guidance documents can be downloaded at:
istonline.org.uk/membership/fellow
E: office@istonline.org.uk

Fred Consterdine and Ralph Gilson: A Chapter in the History of the IST

Alan Gall, IST Archivist

Introduction

Biographers occasionally refer to their subject as "a scientist of the first rank". If a similar measure of achievement is accorded to laboratory technicians of the past then Frederick George Consterdine and Albert Ralph Gilson deserve the accolade. Amongst other notable events in their long careers, they were founder members of the Science Technologists Association, renamed as the Institute of Science Technology in 1954.[1]

It needs to be said that while Consterdine played a significant role in the very early history of the Institute, Gilson gave his support in a much less prominent way. However, for the purpose of this article the IST connection provides a convenient backdrop to their intertwined lives.

Consterdine at Manchester

At the time of Frederick Consterdine's birth on 11 May 1903, job opportunities for science technicians were limited. G. F. Daniell, a science master at Mercers' School, London, wrote in 1906:

Although one finds frequent reference to the "laboratory assistant" or "laboratory steward" in recent school text-books, it is a matter of common knowledge that in many schools the necessity for such a person is not recognised.[2]

The same applied further up the ladder, in colleges and universities. Positions available at industrial laboratories were also scarce. Little had changed when Consterdine later secured a post at the University of Manchester.

Leading up to this event, we know from genealogical records that Consterdine lived in the Beswick area of Manchester while attending Birley Street School from the age of ten. The Consterdine family lived at 41 Beaumont Road where his father (also called Frederick) ran a shop.

Ian Morris Heilbron FRS (1886-1959) joined the University of Manchester as professor of organic chemistry in 1933 and developed a close working relationship with Consterdine. This would result in both moving to take up positions at the Imperial College of Science and Technology, and later with the Brewing Industry Research Foundation. Alexander Todd, who succeeded Heilbron in 1938, says:

Fred Consterdine was a very efficient person, and was generally regarded in chemical circles as the country's outstanding laboratory manager; he had built up a smooth-running organisation in Manchester, but it was clear that unless someone equally talented and efficient could be found to replace him, that organisation would be unlikely to survive for long.[3]

That "equally talented and efficient" person was Ralph Gilson.

Gilson at Manchester

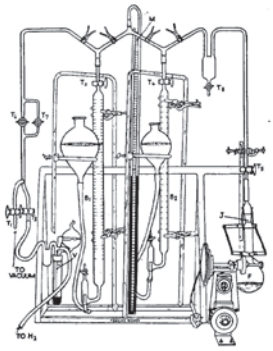
Younger than Consterdine by eleven years, Albert Ralph Gilson generally went by his middle name.

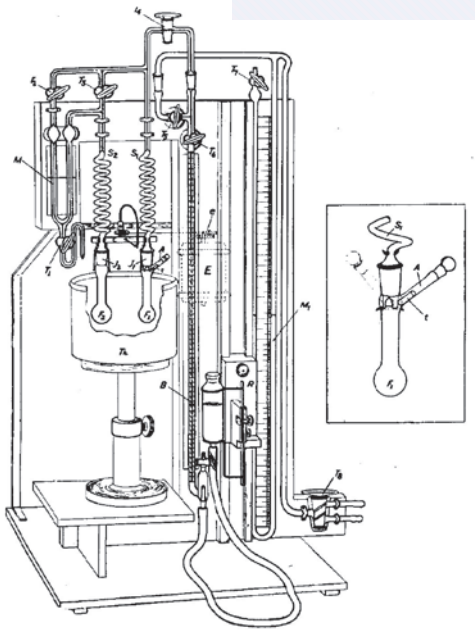
As a junior assistant he showed great promise under the direction of Consterdine. So when Heilbron moved on to Imperial College with Consterdine in tow, Gilson and Todd formed a partnership not unlike the relationship between Ernest Rutherford and William Alexander Kay at Manchester thirty years before. At the age of twenty-four, Ralph Gilson succeeded Consterdine as steward of the laboratories with full control of the non-academic administration. The arrangement led to a collaboration over many years and Todd later commented on the appointment, "... I never did a better day's work."

Professor Alexander Robertus Todd FRS (1907-1997), later Baron Todd of Trumpington, is credited as being one of the leading chemists of the 20th century.[4] Todd's Nobel prize in 1957 resulted from work on coenzymes and nucleotides but at the time of arrival at Manchester his studies of vitamin E were ongoing. Another line of research focused on separating the constituents of cannabis using column chromatography in order to identify the active components (later work by others found delta-9-tetrahydrocannabinol to be the main psychoactive compound). However, the beginning of WWII started the process of diverting Todd's energies elsewhere. In 1939 he received a request to join Robert

Robinson[5] and Heilbron on the Dyestuffs Group Research Committee hosted by Imperial Chemical Industries Ltd (ICI). Additionally, there was involvement with chemical defence research under the auspices of the Ministry of Supply. Basic research on natural products continued with a reduced timetable, but ably supported by Gilson and his talent for conjuring up suitable apparatus.

As war progressed not only were the daylight hours fully occupied but also some nights. On a rotor basis Todd and Gilson (with chemistry lecturer F. S. Spring) spent time on fire watching. As a preliminary to these activities a full evaluation was made of possible fire hazards in the chemistry department. This turned up mustard gas bottles and cordite in the basement and spontaneously inflammable metal alkyls in the attic!





Above: Figure 1. The Towers-Gilson Vibro Shaker. J W Towers & Co Ltd catalogue No. 53

Left: Figure 2. Towers general purpose hydrogenation apparatus. J W Towers & Co Ltd catalogue No. 53

Below: Figure 3. Micro hydrogenation apparatus. J W Towers & Co Ltd catalogue No. 53

Gilson's flair for innovation had a useful spin-off through an arrangement with Widnes laboratory supplier J. W. Towers & Co Ltd. Gilson produced novel prototype equipment and the designs were handed over to Towers for production and sale. In return, the University received the Towers-made apparatus when needed, and secured priority treatment at a time when war-time conditions restricted supplies. Figure 1 shows the Towers-Gilson high frequency shaker. Consterdine evidently had some involvement in these endeavours because Towers marketed hydrogenation apparatus "designed by A. R. Gilson and F. G. Consterdine" (figures 2 and 3). The glassblowing department at Towers shown in figure 4 illustrates how the employment of female labour dominated many areas of production during the war.

Figure 4. Glassblowing department at Towers. J W Towers & Co Ltd catalogue No. 53

The University of Manchester enjoyed an outstanding reputation for its science departments but more prestigious posts often lured the leading talents away. Cambridge had bagged Ernest Rutherford in 1919 and now Todd followed, taking with him a large group of research students and his administrator, Ralph Gilson.

The Science Technologists Association

On Friday 8 November 1946, six technicians held a meeting on Albemarle Street, London[6] and afterwards at Schmidt's Restaurant on Charlotte Street. During the course of the meal, the Science Technologists Association (STA) came into being. How and why the original founder members reached this point is better left to a more in-depth treatment of the IST's history. Present at this event, when each contributed a £1 membership fee, were:

- Frederick George Consterdine (elected as honorary treasurer), Imperial College of Science & Technology
- David Henry Edgar Gadd, Guy's Hospital, London
- Reginald Ernest Gardner[7], Royal Holloway College, Englefield Green

- Albert Norman (elected as chairman), Research Institute, New Haw, Weybridge
- Arthur Harold Randle, University College Cardiff
- Arthur Harry Walters (elected as honorary secretary), Irrigation Envelopes Ltd, London.

A seventh member (of what was known as the nucleus committee), Robert John Fisher of University College, London sent his apologies for absence. Albert Norman, as chairman of the Institute of Medical Laboratory Technology, brought more than just experience to the committee; an unconditional donation of £50 from the IMLT.[8]


THE SCIENCE TECHNOLOGISTS ASSOCIATION

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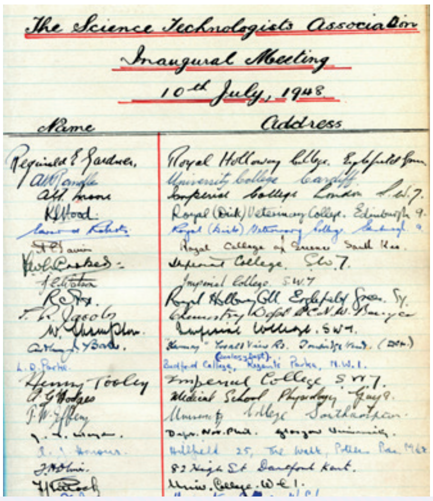
Figure 5. STA's temporary accommodation in 1948

Consterdine wrote the first draft of a circular to be sent out to known technicians, inviting suitably qualified persons to form a cohort of founder members. As a result of this, and other efforts, 154 technicians responded favourably and arrangements were made for an inaugural meeting. This took place at the Imperial College of Science and Technology, South Kensington, London on 10 July 1948. There were delays in contacting prospective candidates, one being the lack of an office for a base of operations. The IMLT had declined to offer shared space but Imperial came to the rescue with room 73 in the chemistry department as a temporary measure (figure 5). Secretarial duties were provided by a Mrs Howard under the direction of Consterdine.


The Science Technologists Association
Inaugural Meeting
10th July, 1948

Name	Address

Figure 6. The first page of a ledger containing 69 signatures of founder members

The STA minutes of the inaugural meeting records that 75 founder members attended, although the register contains the signatures of only 69 people (figure 6). Gilson's signature is not there but he was certainly one of the 154 respondents to the original circular. He duly enrolled with membership number 50. It is also recorded that he obtained the STA's diploma on 1 December 1950. Consterdine had been awarded his diploma the month before.

At the first meeting of the STA's Council on 23 July 1948, Vice-President Robert Fisher took the chair and Reginald Gardner proposed that Consterdine act as honorary secretary. The minutes report: "Mr Consterdine said that whilst he was not exactly looking for the job, he was willing to to do his best at least during the transition of the Association from a non-operative to an operative body."

This meeting also discussed possible candidates for the role of president. No doubt Consterdine had been behind an invitation for Sir Ian Heilbron to accept the post. Heilbron expressed willingness initially (later to decline), but suggested that Sir Harry Jephcott of Glaxo, as a leading industrialist, would better further the interests of the Association. However, moves had already been made to contact zoologist Professor Charles Henry O'Donoghue, someone with a known interest in the affairs of technicians. He became the first president and joined the fourth Council meeting on 4 June 1949. The STA Bulletin enthused:

Of Professor O'Donoghue himself, it can be said that he is by no means the orthodox professor. He bubbles over with wit and good humour, is friendly and approachable, giving advice and sympathy whenever needed.[9]

The new president's attendance coincided with Consterdine's first absence from the meetings. Robert Fisher read out a letter in which Consterdine expressed his regret that due to overwork, and on doctor's advice, he must resign as honorary secretary. In addition, "Other private matters were involved".[10] This seems to have taken the other members by surprise, who agreed to postpone discussion until after lunch. Luncheon over, Council recorded its corporate regret and appointed F. W. L. Croker as acting honorary secretary.

Consterdine continued as a member of Council, attending a few meetings, until the first AGM (5 November 1949) when he failed to be re-elected. He wrote on 2 January 1950 expressing his displeasure that he had not been informed of the election outcome and had not received his membership card. So, it would appear, his active involvement ended on a sour note.

It is interesting to see the distribution of STA members under location and scientific discipline as it stood at the beginning of 1950 (see Appendix).

Imperial College of Science and Technology, South Kensington

Arriving at Imperial in 1938, Heilbron replaced Jocelyn Thorpe (1872-1940) as professor of organic chemistry, installing Consterdine as senior laboratory steward.[11] Other ex-Manchester colleagues with the new influx were William Fairclough (Bill) Boston (1907-1944), Donald Holroyde Hey (1904-1987) and Ewart Ray Herbert Jones (1911-2002). Boston came as a laboratory technician and set up a microanalytical laboratory. He had a fatal heart attack at the age of thirty-seven while in the Royal College of Science building on Imperial Institute Road, London (now called Imperial College Road). Heilbron found the laboratories at Imperial lacking modern equipment and facilities, but perhaps not as outdated as Alexander Todd would find the Cambridge labs some years later.

We have already met F. W. L. Croker, who replaced Consterdine as honorary secretary of the STA.

Francis Walter Leslie (Les) Croker started as lab boy to Henry Harwood in the analytical laboratory at Imperial in 1926 and retired as laboratory superintendent fifty-one years later. He was one of a number of the STA founder members based at Imperial, these being George Barrett, George Chilton, Arthur Davis, Richard Martin, Frank Oliver, Henry Tooley and J. C. Watson. Les Croker is one of the major figures in the early history of the IST and first editor of the STA Bulletin.

The department did not have an overall head of the three separate branches of physical, organic and inorganic chemistry. A new college rector appointed in 1948 decided to nominate someone for the job and picked the director of the physical chemistry laboratories, Henry Vincent Briscoe (1888-1961). This did not go down well with Heilbron who felt that his own status would be reduced. So, with Consterdine and Arthur Cook[12] he jumped ship to direct a new institution – The Brewing Industry Research Foundation.

It was due to the backing of Professor Briscoe that Imperial hosted the inaugural meeting of the STA and provided the use of room 73 for a (no so) temporary office with telephone. He became a vice-president of the IST and for a time the IST awarded the Briscoe prize to authors of Journal articles considered worthy of recognition.

The 150th meeting of the Executive Committee of the IST on 14 January 1964 was the last to be held in the chemistry department at Imperial College. As of 1 January 1965, the Institute took possession of rented offices at 106 Hampsted Road, London NW1. Further meetings were held there until the 179th on the 13 November 1967, at which time a lease had been taken out on premises at 345 Gray's Inn Road, London WC1. The minutes for the previous meeting record:

It has been necessary to employ a cleaning firm to wash down the walls of the present office [Hampsted Road] at a cost of £22. Three of the five rooms in Gray's Inn Road had been decorated at a cost of £148, the cost of removal was 38 guineas and the solicitor's fees £27.13.0.

Gilson after Manchester

With seven months of the war in Europe still to run, Alexander Todd and his entourage arrived at the University of Cambridge where Gilson had the task of refurbishing the laboratories. This turned out to be quite a task, Todd describing the labs as "a disgrace to any university".

Even in this newest block [a section added after WWI] the laboratories were lit by gas although obviously gas brackets on the laboratory benches represented an appalling fire hazard … I was given a fantastical explanation the gist of which was that determination of the end-point in volumetric analysis by titration was more accurate by gaslight than electric light!

By the time that Todd returned from a trip to America in 1948, Gilson had completed the modernisation. The gas lighting fixtures were gone, the labs properly equipped. Todd's growing reputation and the transformed facilities resulted in a flood of applications for doctoral and postdoctoral positions.

Snippets of information have appeared in *Chem@Cam: Chemistry at Cambridge Newsletter.* Alexander Todd's daughter Sandy recalls Ralph Gilson making glass animals for her.[13] Bernard Steele remembers how cost dominated the availability of apparatus. Soda glass was used in preference to the more expensive Pyrex and interchangeable (jointed) glassware could only be drawn from stores with Gilson's approval.[14] Don Flory left school in 1947 with little knowledge of chemistry but was employed by Gilson in the chemistry department and stayed for the next forty-nine years.[15]

With Jack Richard Cannon, Gilson developed a separation technique by electrophoresis on Whatman seed testing paper, details of which were published in *Chemistry and Industry*.[16]

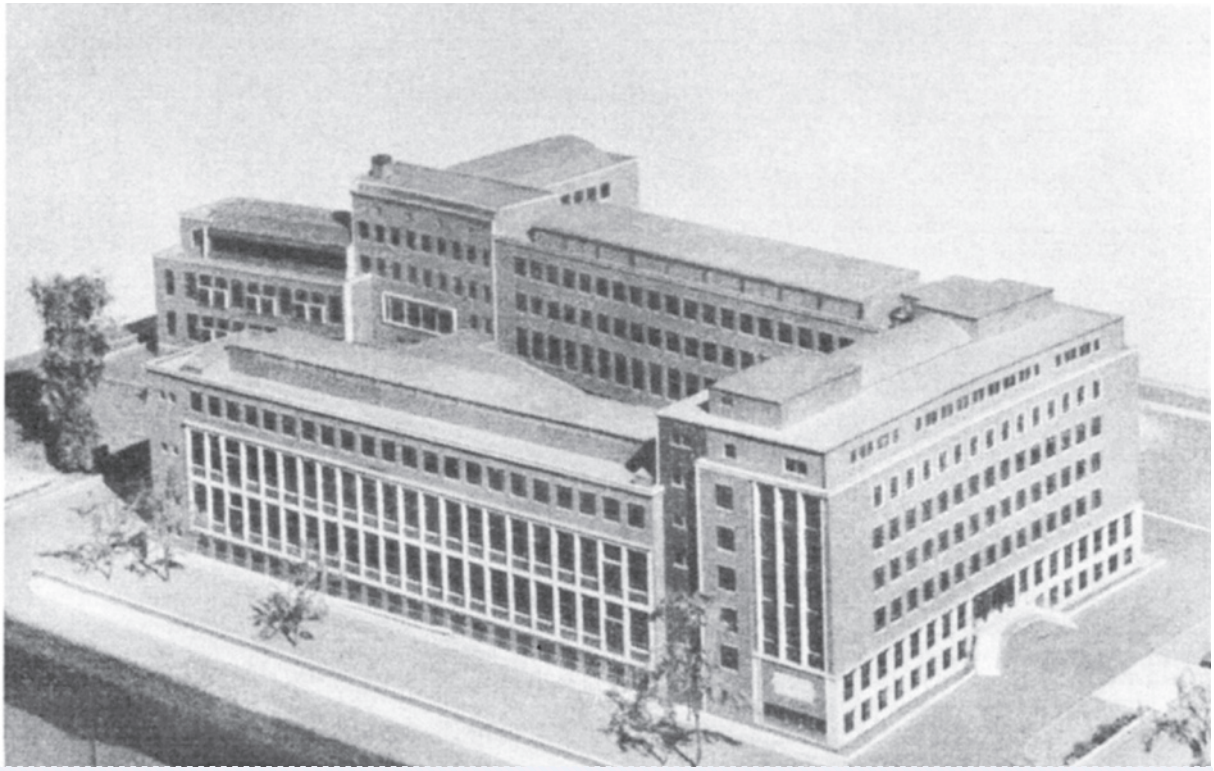


Figure 7. A model of the new chemical laboratories on Lensfield Road, Cambridge, as shown in Nature 8 November 1958

Princess Margaret opened new chemical laboratories at the University of Cambridge on 6 November 1958. Amongst the agreements made between Todd and the University in 1944 was an undertaking that priority be given to the erection of new laboratories. This represented a major project, as can be seen from figure 7, the structure and contents often presenting novel problems to be overcome. Undertaking the design were architects John Murray Easton and Sidney Edward Thomas Cusdin.

Figure 8. Ralph Gilson. Credit: Anthony Barrington Brown

Todd says: "Easton and Cusdin, aided considerably by Ralph Gilson whose knowledge of the operation of laboratories was unequalled, rose to the occasion". Indeed, Gilson received an MBE in 1958 for his contributions, being described in the citation as a "Building Consultant". By this time Todd and Gilson had parted company. Todd again: "It was abundantly clear that he was a man of such remarkable ability that to remain in Cambridge in the position he held there would be a serious waste of talent".

With the new labs partially completed, Gilson (figure 8) left in 1956 to take up an appointment at the firm Perkin-Elmer.

Consterdine after Imperial College

Figure 9. Ian Heilbron. Biographical Memoirs of Fellows of the Royal Society, 1960

1949, the time of Consterdine's resignation as STA honorary secretary, is the year when Heilbron installed him as technical superintendent of the newly-formed Brewing Industry Research Foundation (BIRF). John Masson Gulland had been nominated as the first director of the BIRF but died before taking up the appointment when the Flying Scotsman train derailed near Goswick, Northumberland, on 26 October 1947. Sir Ian Heilbron (figure 9) replaced him and together with Consterdine faced the inevitable mountain of work required in establishing laboratories, bringing in equipment for an experimental brewery, supplying a library and housing the National Yeast Culture Collection. These facilities were based at Lyttel Hall, Nutfield, Surrey, acquired in 1948. Given Heilbron's reputation as a striver for perfection, it is not surprising that Consterdine soon found himself overworked. Both continued their roles until

Figure 10. Alexander Todd

1958. The resignation of Heilbron in that year (he died the next) precipitated the departure of Consterdine.

Meanwhile, Todd (figure 10) had found a replacement for Gilson in the person of Ron Purchase, an ex-RAF flight engineer. Ron Purchase, being of a restless nature, left after only two years in the job. Word went out about the vacancy and arrived at the ears of Fred Consterdine. Thus, Consterdine, who had trained Gilson and whose virtues were well known to Todd, became laboratory steward at Cambridge.

After early enthusiasm, Fred Consterdine allowed his membership of the STA to lapse. His time at Cambridge probably seemed like a holiday compared to the decade spend under Heilbron at the BIRF. Yet he remained loyal to Heilbron and only left for Cambridge after Heilbron's retirement. As far as is known, Consterdine continued at Cambridge until his own retirement. He died in 1986 aged eighty-two.

Gilson at Perkin-Elmer

The connection with The Perkin-Elmer Corporation came about through a friendship between Ralph Gilson and Richard Scott Perkin. Perkin-Elmer had been incorporated in 1939 to design and manufacture optical products. They quickly diversified to encompass the use of advanced electronics in analytical instruments. Richard Perkin invited Gilson to head a UK branch of the American company, based at Beaconsfield, Buckinghamshire. Perkin-Elmer Ltd received its certificate of incorporation dated 21 June 1957.

Early employees were scientists drawn from the University of Oxford: Harold Thomson, of St. Johns College, and Rex Richards of Lincoln College. Dr Michael Ford also joined at the beginning and became technical director in 1961. An interesting addition to the board of directors came in 1969 on the death of Richard Perkin in May of that year. Already president of the parent corporation in the US, Chester William Nimitz junior became chairman. His more famous father gave his name to the largest warship of the time, a nuclear-powered aircraft carrier, the USS Nimitz.

Figure 11. Perkin-Elmer model 137UV ultraviolet and visible spectrophotometer

Gilson started with a contract that guaranteed employment until 1971. In the event, he remained as a director until 1984, having retired from full-time work in November 1979. He oversaw rapid commercial progress: sales for the financial year ended 31 May 1959 amounted to £138,844, which by 1968 had climbed to a reported £3,113,195. Also by 1968, there were three factories at Beaconsfield and one at Llantrisant, South Wales. Most of the 630 personnel were employed at Beaconsfield.

Figure 11 shows a spectrophotometer exhibited by Perkin-Elmer at the Manchester College of Science and Technology in April 1963. The advanced nature of Perkin-Elmer Corporation's instrumentation is illustrated by some of the aerospace projects running in the 1960s: the Hydrogen-Alpha Telescope for monitoring solar flares, sensing devices for the US Army's missile re-entry program and work for NASA on the Saturn rocket's guidance system.

Gilson retired fully after nearly thirty years with the firm. He had been managing director, then chairman, and for the last five years a non-executive director. During this period he also received an MBE for his previous laboratory design work at Cambridge, and an MA degree. Albert Ralph Gilson died on 19 November 2001, three days after his 87th birthday. He survived Frederick Consterdine by fifteen years.

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Other references are given in the notes.

Appendix

Registrar's figures reported at a meeting of the General Purpose Committee 24 February 1950

(a) Membership by area

Aberdeen	10	Oxford	7
Birmingham	2	Worcester	1
Belfast	1	Wolverhampton	1
Edinburgh	18	Cardiff	9
Glasgow	21	Bangor	2
Leeds	3	Swansea	1
London	120	Cambridge	4
Leicester	4	Newcastle	2
Manchester	10	Reading	9
Nottingham	3	[not specified]	8
		Total	236

(b) Membership by subject

Chemistry	54	Pharmacy	5
Anatomy	15	Pathology	2
Botany	6	Zoology	12
Biology	8	Biochemistry	9
Histology	8	Geology	7
Instrument Makers	15	Animal House	2
Physiology	28	Bacteriology	18
Physics	24	Entomology	2
Electrical	4	Other subjects	17
		Total	236

1 There were a number of suggestions for the name change. The membership voted on the issue and of the replies received, 287 votes supported the choice of "Institute of Science Technology". "Institute of Laboratory Techniques" attracted 132 votes, and the less popular "Institute of Laboratory Techniques" 32 votes.

2 G. F. Daniel, "The Laboratory Assistant", *The School World*, March 1906, p.84.

3 This and other quotes by Alexander Todd are from his autobiography *A Time to Remember*.

4 Roy Porter (ed.), The Hutchinson Dictionary of Scientific Biography (London: Helicon Publishing 1994) p.672.

5 Robert Robinson (1886-1975). Knighted 1939. Nobel prize for work on alkaloids in 1947.

6 A public house. The exact venue is not given in the typed-up notes of the meeting.

7 Gardner was expelled from the STA, 22 April 1950.

8 The Institute of Medical Laboratory Technology originated in 1912 as the Pathological and Bacteriological Laboratory Assistants' Association. The present name is the Institute of Biomedical Science.

9 *Science Technologists Association Bulletin*, No 3, March 1949.

10 Jeff Friend, a member of the STA technical sub-committee, reported that at one point Fred Consterdine, his wife and child were ill simultaneously.

11 Consterdine's job title changed to laboratory superintendent not long afterwards.

12 Heilbron and Cook had worked closely together. When Cook departed from Imperial he had just been promoted from senior lecturer to reader. At the BIRF he served as assistant director under Heilbron.

13 Chem@Cam Summer 2009, p.3.

14 Chem@Cam Summer 2008, p.15.

15 Chem@Cam Autumn 200, p.12.

16 Referenced in Cannon, J. R., Johnson, A. W. and Todd, A. R., "Structure of Vitamin B_{12}: A Crystalline Nucleaotide-Free Degredation Product of Vitamin B_{12}", Nature, 25 December 1954.

17 An exhibition attended by the author after persuading the science teacher to sanction a day off school.

Not working in science or science technology?

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MIScT(Reg) Registered Practitioner

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

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

Comparative Study on The Phytochemicals, Proximates, Vitamins and Mineral Elements Compositions of Unfermented and Fermented Seeds of Parkia Biglobosa

Felicia Uchechukwu Okwunodulua, Chisom Fridaya, Innocent Nwazulu Okwunodulub and Vintan Ifeanyi Chukwudia

Abstract

This study was undertaken to compare the phytochemical, proximate, vitamin and mineral elements compositions of unfermented and fermented seeds of *Parkia biglobosa* (African locust bean). The results revealed that the unfermented seeds had higher amounts of alkaloids, tannins and Phytate, compared to the fermented seeds with higher amounts of flavonoids and saponins. The proximate composition showed that the unfermented seeds contained higher amounts of dry matter, crude fibre and carbohydrate, compared to the fermented seeds having higher amounts of moisture, crude protein and lipids, while there was no significant difference in their amount of ash. The fermented seeds contained higher concentrations of retinol, ascorbic acid, thiamine riboflavin and niacin, compared to the unfermented seeds having a higher concentration of only tocopherol. The results of the mineral elements composition for the unfermented and fermented seeds showed that there was no significant difference in the concentrations of potassium, calcium, magnesium, phosphorus, iron, zinc, manganese and copper, while the unfermented seeds had significantly higher amount of sodium than the fermented seeds. These investigations revealed that the fermented seeds of *P. biglobosa* is more nutritionally rich than the unfermented seeds. The fermented seeds are also more suitable for consumption by hypertensive patients.

Keywords: *Parkia biglobosa*, phytochemicals, proximate, vitamins, minerals, Fermented, Unfermented.

Introduction

Legumes are plant seeds such as beans, peas and peanuts. They are edible plants which are used as staple food around the globe. Legumes are highly nutritious being rich in protein, amino acids, dietary fibre, vitamins and fatty acids (Bouchenak and Lamri-Senhadji 2013; Rebello et al., 2014). Despite the high nutritional values of legumes, certain legumes are still underutilized in South Eastern Nigeria. One of such legumes is *Parkia biglobosa*, commonly known as the African Locust Bean. *Parkia biglobosa* is a perennial leguminous tree belonging to the family, *Leguminosae* and sub family, Mimosideae (Femi-Ola *et al*., 2008). Its vernacular names include; Ogiri in Igbo, Irugba in Yoruba and Dorowa in Hausa (Ajaiyeoba, 2002). The seed is usually extracted from the yellow pulp. The seed can be roasted for the production of Soudan Coffee. The seed is eaten as meal when cooked and are used as condiments to enhance the flavour of foods when fermented (Oluwaniyi and Bazambo, 2014). The plant parts such as the leaves, stem bark, pulp and seed are used to relieve diarrhoea, dysentery and in the prevention of cardiovascular diseases (Koura et el., 2011). In Ghana, the leaves, stem bark, raw fruit and fermented seed are used for the treatment of malaria and stomach ache (Asase *et al*., 2015). In Nigeria, the leaves roots and stem bark are used for the treatment of hypertension, stomach ache, ulcer, fever and stroke (Erakhrumen *et al*., 2010; Adetutu *et al*., 2012). *Parkia biglobosa* is a wild legume and wild legumes have been reported as rich sources of protein, amino acids, essentially fatty acids, fibre and vitamins (Oluwamyi and Bazambo, 2014). The phytochemical, proximate and mineral elements compositions of both the seeds, fruit pulp and leaves have been reported (Afolayan *et al*., 2014; Soetan *et al*., 2014). Fermented foods have been found to be more nutritious than their unfermented counterparts (Hasan *et al*., 2014). Hence, the aim of the present study is to compare

the phytochemicals, proximate, vitamins and mineral elements composition of unfermented and fermented seeds of *Parkia biglobosa*.

Materials and methods

Sample Collection and Preparation

Matured locust bean pods were gotten from Gwagwa local market, Abuja. The fruit yellow pulp was separated from the seed by scraping it off with the aid of a knife. Dehulling of the seed was done using a mortar and pestle. The dehulled seeds were grounded into powder using a blender. Fine grounded powder of the seeds was obtained by sieving with 1 mm aperture and the sample stored for laboratory analysis. The powdered seeds were divided into two portions. One portion was fermented for four days before determining the chemical compositions, while the chemical compositions of the other portion was determined without fermentation.

Determination of Plant Chemicals

Alkaloids and saponins were determined according to the method of Harbone (1973). Tannins was determined as described by Kirk and Sawyer (1998). Flavonoids was determined as described by Bohma and Kocipal (1994), while phytate was determined by the method described by Ajayi (2011). Vitamins were determined by the method of the Association of vitamin chemist as described by Kirk and Saywer (1998) except for thiamine, riboflavin and niacin which were determined according to the method described by Okwu and Ndu (2006). The mineral elements composition was determined by the methods described by the Association of Official Analytical Chemists (AOAC, 2006). The proximate composition was determined by the method of James (1995).

Statistical Analysis

Data in Tables were mean ± standard deviation (SD) of triplicate determinations.

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Communications and the IST

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

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

Our main email addresses are:
office@istonline.org.uk – general enquiries
memberships@istonline.org.uk – enquiries regarding new memberships and renewals
registrations@istonline.org.uk – enquiries regarding CSci/RSci/RSciTech registrations and renewals.

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

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

Social Media – We use social media routes for quick communications, networking and hope to encourage both members and non-members alike to engage in online discussions and provide ideas and feedback. The platforms that we use are:
Twitter (@istonline) – we encourage ideas, feedback, and discussions using **#istforum**
Facebook (@istonline.org.uk) – feedback, ideas and comments welcome
LinkedIn and Google+ – join in group discussions, links through to these groups (and our Twitter account and Facebook page) are available on our **website**.

Forgotten people in the history of coronaviruses

Stephen J Gamble

Introduction

The story of the discovery of the structure of DNA is littered with many people whose contributions were forgotten, most famously Rosalind Franklin and to some extent Maurice Wilkins. But other branches of discovery also have their own forgotten names.

This paper looks at some of the forgotten people involved in the discovery and initial investigation of, particularly human, Coronaviruses.

Coronaviruses in animals

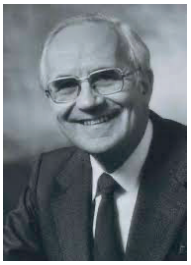
Apart from this brief mention, discussion of the whole range of Coronaviruses will be reserved for a separate paper.

Although human Coronaviruses are very important there are many diseases discovered in animals from the 1930s onward which we now know to be caused by Coronaviruses. In common with many viruses, animal Coronaviruses may jump both between different animal species and to humans.

McIntosh (1974) states the first separately identified disease was Infectious Bronchitis in chickens, discovered by Schalk and Hawn in 1931. It was not until 1937 that Beadette and Hudson were able to identify it as a virus, so now it is known as Infectious Bronchitis Virus (IBV). It was only much later that it was assigned to the newly created Coronavirus family in the 1960/70s. McIntosh (1974) provides a good summary table on page 87 of the paper showing many of the then known viruses in animals and humans that were reclassified into the new group.

Discoverers of human coronaviruses

David Tyrrell



David Arthur John Tyrrell was born in Ashford in 1925. After training in medicine followed by a couple of research posts he joined the Medical Research Council (MRC) Common Cold Unit (CCU) in Salisbury in 1957. In 1962 he succeeded Sir Christopher Andrews to become Director until the CCU closed on Tyrrell's retirement in 1990. In parallel with this he was also Head of the MRC Division of Communicable Diseases (1967 to 1986) and Deputy Director (1970 to 1986) both at the MRC Clinical Research Centre (CRC) in Harrow. In 1986 with the wind down of the CRC he returned full time to the Common Cold Unit. Tyrrell (1990) wrote a nice paper describing the origins of the CCU.

Jonathon Kerr and David Taylor-Robinson (Kerr and Taylor-Robinson, 2007) provide a very good biography of David Tyrrell. Although Rhinoviruses, the major cause of the common cold, had been discovered by others, this biography credits Tyrrell with developing the first method to grow them in culture.

In 1965 David and Malcolm Bynoe (Tyrrell and Bynoe, 1965) published the first description of a novel cold virus they had isolated and grown in organ cultures. This new virus appeared to be very different to Rhinoviruses (the cause of most colds) and influenza viruses. They called this virus B814, which was the number attached to the nasal washing and swab from which they first obtained it. They used some of this initial material to infect volunteers. In their paper they try to characterise the virus and initially wondered if it belonged to the group of myxoviruses. They dismissed this as it was ether labile, which suggested it had crucial lipid components. Other work would show that the infection was not stopped with DNA inhibitors which pointed to a RNA virus. In a couple of the infected volunteers they found slight rises in antibodies to Influenza C and Sendai virus, but these were not found consistently across the whole group.

From the 1950s onward it had been the objective of the World Health Organisation to eliminate Smallpox around the world. The last case in the wild was in 1977, but in 1978 there was a small outbreak at a laboratory in Birmingham where they were finishing up experimental work. An inquiry, the Shooter Committee, was set up to investigate. Members of the committee included David and the Director of the CRC, Sir Christopher Booth. I believe David was also for a time chairman of the government's Dangerous Pathogens Advisory Group and headed the government's first investigations into Bovine Spongiform Encephalopathy (BSE) and new variant Creutzfeld Jacob Disease (CJD).

In the late 1970s and early 1980s I worked on a project based at the CRC looking for viruses in neurological and psychiatry disease (Crow et al 1979, Tyrrell et al 1979). The principal investigators were David and Dr Tim Crow, Head of the MRC Division of Psychiatry. It was a good project for me as it introduced me to the basics of cell culture, electron microscopy and molecular biology (Taylor et al 1985a, 1985b). My recollection of David is as very friendly and cheerful. I think the last time I saw David was about 1989 when I went to visit somebody at the CCU and, although he was working from home that day, he came across to have lunch with us.

Although he officially retired in 1990 he continued working on a wide range of projects. This included a great deal of work for the Chronic Fatigue Syndrome Research Foundation where he was a member and later chairman of the research committee. He was involved in two major studies, both of which involved one of his biographers, Jonathon Kerr (Kerr and Taylor Robinson, 2007). The first study showed that the parvovirus B19 could cause Chronic Fatigue Syndrome (CFS) in some people. The second involved a pilot study which discovered 16 genes with different levels of expression in CFS people compared with controls. Work had started on a more in depth study in a larger group of patients when sadly David passed away in May 2005. This study went on to identify 89 genes in CFS with changed expression involved in a range of other functions including immunology and neurological disease. This CFS study in a way links back to David's earlier work with Tim Crow on viruses in psychiatric and neurological disease. Many of the symptoms of CFS are similar to those shown in Long COVID (Gamble 2021).

June Almeida

June Almeida was born in 1930 in Glasgow to bus driver Harry Hart and his wife Jane (Almeida 2008, Banatvala 2011). When she left school at age 16 she became a laboratory technician in histopathology, firstly at Glasgow Royal Infirmary then later at St Bartholomew's hospital London. In 1954 she married a Venezuelan artist Enriques Almeida. Shortly after they emigrated to Toronto, Canada. Here she found employment at the Ontario Cancer Institute as an electron microscopy technician where she became extremely skilled.

In 1964 she was encouraged back to England where she joined Professor A.P.Waterterson's department at St Thomas's Hospital medical school. She was a pioneer of negative contrast immuno-electron microscopy which brings out fine detail and is good for imaging viruses at low concentration.

There had been earlier attempts to image Infectious Bronchitis virus (IBV) in chickens but it had to await the discovery of negative staining electron microscopy in 1959 before clear images could be obtained. Almeida and Tyrrell (1967) attribute this discovery to Brenner and Horne. Almeida built a reputation for being an expert in this technique which she and Tyrrell used to get the first pictures of the newly discovered human Coronaviruses B814 and 229E which they found were morphologically similar to IBV.

During her career she was awarded a DSc and authored a large number of important publications. Almeida is a good example of how technicians really do make it happen. Sadly she passed away at a relatively young age at the end of 2007 (Almeida 2008, Banatvala 2011).

Dorothy Hamre

In 1966 Dorothy Hamre working with John Procknow at the University of Chicago discovered a similar respiratory virus which they named as 229E (Hamre and Procknow, 1966). They had collected a large number of samples from medical students at their university during a major cold epidemic in 1962. From these they had isolated five strains of virus one of which was

ether labile, stable at both 4 and 37 degrees Celsius and was not inactivated by DNA inhibitors. They were able to grow the 229E virus in a kidney cell culture. Hamre provided the sample of 229E used by Tyrrell and Almeida (1967) for their electron microscopy study. She also provided a sample of 229E to McIntosh et al (1967) for comparison with IBV and their novel human viruses.

Kenneth McIntosh

In 1967 McIntosh, working at the US National Institutes of Health (NIH) was able to isolate several respiratory tract viruses using a similar technique to Tyrrell and Bynoe (McIntosh et al 1967, Kahn and McIntosh 2005). These cold viruses were similar to those isolated by Tyrrell. McIntosh was able to grow these viruses initially in organ culture so he named them with OC followed by the culture number. Of these the OC43 virus strain has been widely used for research and has been found widely over the years in many localised outbreaks across the USA.

In their 1967 paper McIntosh et al were able to compare the six respiratory viruses they had isolated from NIH employees with Hamre's 229E virus and IBV. As well as organ culture they were also able do electron microscopy and obtained results similar to Almeida and Tyrrell. In tracheal organ cultures they describe the virus as producing a ciliary immobilizing effect (CIE) which occurred between four and ten days after inoculation. Thinking about the current COVID-19 pandemic, the virus seems to attack cilia (Li et al 2020) and people tend to be infectious from about the fourth day from becoming infected and can excrete virus to around day 10, so this could be consistent with McIntosh's original findings about coronaviruses.

Later his career has been in paediatric infectious diseases. Looking at his publishing record on PMC he has worked a lot on both respiratory diseases and HIV.

Over 50 years after the discovery of Coronaviruses, McIntosh still appears to be active and publishing work, as a Professor at Harvard Medical School. Like many people his recent work includes the study of COVID-19.

Discussion

On 16th November 1968 a News and Views item in the journal Nature (Nature 1968) reports how a group of eight virologists had recognised a new class of viruses they called Coronaviruses. The virologists (J D Almeida, D M Berry, C H Cunningham, D Hamre, M S Hofstad, L Mallucci, K McIntosh, and D A J Tyrrell) had submitted their evidence and suggested name to the International Committee for the Nomenclature of Viruses for consideration. Of these eight only Almeida, Hamre, McIntosh and Tyrrell were working on human Coronaviruses with the others working on animal viruses.

Whilst chronologically Tyrrell and Bynoe were first to publish with their 1965 paper this only appears to be part of the story to which Hamre and McIntosh add some of the missing pieces. The Almeida and Tyrrell paper in 1967 and the McIntosh et al 1967 paper pull a number of these threads together. As Almeida, Hamre, McIntosh and Tyrrell are first authors on the key papers and are the signatories working on human viruses to the request to create the new Coronavirus class of virus, it is reasonable to see them jointly as discoverers of human Coronaviruses.

Over the past few years the SARS-CoV-2 virus, and to a lesser extent SARS-CoV and MERS-CoV, have wreaked havoc worldwide with major impacts on health, social and financial wellbeing. Unfortunately Nobel Prizes can only be awarded to living scientists and Almeida, Hamre and Tyrrell are all deceased otherwise a case could be made for them to be considered jointly, along with McIntosh, for the Nobel Prize for their work on the discovery and characterisation of human Coronaviruses. Nobel Prizes have previously been awarded for the later discovery of other viruses, for example HIV and Hepatitis C.

Whilst this paper has concentrated on the forgotten original discoverers of human coronaviruses, we should also remember Dr Li Wenliang, an ophthalmologist in Wuhan, China, who tried to warn the world about the SARS-CoV-2 epidemic he saw forming in December 2019 and who died from it just a few weeks later (Zimmer 2021).

Author

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Semi Retired/Independent research at S.J.Gamble Research

Member of British Neuroscience Association. Member of the Cambridge Neuroscience Network. He is also a member of both the Institute of Biomedical Sciences and the Royal Society of Biology CPD schemes.

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IST Virtual Technical Conference 2021

September 2021

Once again we adopted a virtual approach to our Annual Technical Conference and we met on **September 15th 2021** via Zoom. We are delighted to say it was a great success with over 450 registrations overall, and most sessions averaging over 200 attendees.

The overall theme for the event was Looking to the Sustainable Future. Our programme was again opened by our President, Dr Helen Sharman CMG OBE FRSC FIScT. We then followed with an exciting programme which had a broad range of diverse topics within the overall theme.

Rather than summarising the various sessions we thought you might like to view some of the feedback that we received from attendees.

Keynote: Why Equity, Diversity, Inclusion and Belonging are important factors for sustainability within the technical community.

"Denise is an inspiring lady and gave a very motivating presentation"

Workshop: Green Impact and Plastic Recycling

"Excellent workshop with some great ideas and interactive - great discussions going on in the chat"

Workshop: NFT, Artificial Intelligence and the indigenous peoples

"Will Terminator ever be a reality :-) I am sure i am not the only one to ask this! Or will it be indigenous people fighting back for their rights."

Workshop: Fabric of the City

"By far the best presentation of the day. So interesting to see behind the scenes of how art is created not just by the artist but by a whole team of technicians."

Workshop: Carbon Literacy

"I enjoyed taking part in the virtual quiz and learnt a lot about how to cut down on emissions"

Briefing: Science Museum Technician Gallery

"Definitely would like a look around when it's up and running, excellent way of communicating the role of technicians to younger people"

Workshop: LEAF - What it is and the NTDC involvement

"I would love for this section to have been longer and more in depth on how LEAF works and how people use it. It is an amazing concept I would like to see more and more people get involved."

Workshop: Headline data from the NTDC Skills Survey

"Looking forward to seeing the reports when they are released."

Close of the Day

Terry offered his sincere thanks to all the speakers and presenters for their excellent contributions to the day, which had proved to be enlightening, enjoyable and thought provoking in equal measure.

He also thanks the attendees for their engagement with the sessions and their questions and interest.

There was also appreciation expressed to the IST's Conference Volunteer Team for all their hard work preparing and running the event, which attendees seemed to have enjoyed.

We are really looking forward to the 2022 Conference, which we hope may be a 'live' event, with some possible blended content, and we look forward to seeing everyone over at the University of York – so keep fingers crossed and note the date in your diary – 14th September 2022.

Let's hope we can all meet in York next Year

The IST One-day Technical Conference 2022

IST Conference 2022

Wednesday 14th September 2022
University of York

Save the date

Spring Lane Building
397 Harewood Way
Haslington
York YO10 5DS

Book and secure your place at:
W: istonline.org.uk E: office@istonline.org.uk T:0114 553 1401

New IST Networks Launch

Networks are at the heart of how we as a professional body functions. Professional networks are vital in ensuring the growth of any organisation and such networks bind together people to help us achieve our goals. Networks can help individuals and their organisations realise new opportunities with an existing part of a network, or forge new relationships through recommendations and professional references. This year we established 2 new network groups, each with specific goals in terms of providing support and routes via which members can get involved.

Women in Tech

The Women in Tech Group will aim to advance the knowledge and interests of Women in Tech, support and empower females and help to overcome barriers to, or within, technical careers.

We will do this through events, both professional and related, informative events. We will look to create sub committees to advance the Women in Tech impact and vision. We would like to put an emphasis on young women in tech and working on getting more women interested in STEAM.

WOMEN iST in TECH Group

We have exciting events planned for the year and we have plan to develop a supportive community. Some of the benefits you can expect are:

- Talk on subjects such as Overcoming barriers to analytical careers, Impostor Syndrome, Consultancy, Leadership and Negotiation
- A supportive community
- Women in STEAM Showcase
- Young Professionals in STEAM Showcase
- Career Talks
- Workplace Support
- Networking
- CPD Benefits

If you are interested in joining the Women in Tech network group please let us know via **office@istonline.org.uk**

Artificial Intelligence Special Interest Group

The IST has recently established a new Special Interest Group to consider issues associated with the very broad topic that is referred to as AI (Artificial Intelligence).

AI is employed in increasingly diverse areas of society, including criminal justice, financial services, health and social care, digital and social media, energy and utilities, and many others. At the same time, data modelling methods employed by AI providers are often poorly understood by both users of the supplied technology and those people affected by its application. This lack of knowledge, and by implication transparency and accountability, in AI can be worrying. More should be done to ensure that AI is understood, its benefits harvested more readily and any risks mitigated.

The IST SIG on Artificial Intelligence will set out to explain and where necessary challenge the development of new such technologies where they relate to human-computer interaction. We hope the group will provide a unique vehicle made up of industry professionals, government representatives and academics that will help to drive the debate on AI from societal and technological viewpoints. The intention of an IST AI Group is to provide a cross-disciplinary forum for discussing actual and potential uses of AI. We are also interested in exploring elements such as bias, transparency, explainability and policy in terms of AI development.

The SIG should appeal to IST members with a general interest in AI. The plan is to hold regular meetings and workshops on AI and AI-related topics of interest, and also aim to promote links with experts working in the field of AI. To date we have delivered 4 open seminars, and more will follow in the New Year.

AI has been termed the fourth industrial revolution taking what was started in the third, with the adoption of computers and automation, and enhancing it with smart and autonomous systems fuelled by data and machine learning.

If you are interested in joining the AI Special Interest group please contact **office@istonlne.org.uk**

AI in Brief

Can AI tell us when to repair our systems? – Murray McMonies

All engineering systems degrade. However, degradation is rarely predictable, linear or similar between systems. Often failure occurs without any perceptible warning. Condition Based Monitoring (CBM) in its most simplistic terms, aims to measure degradation to inform when a component or system needs changed, to avoid unexpected failure but also to avoid unnecessary replacement.

Logically, even if it was not labelled as such, engineers have always used CBM throughout history but the advances in modern technology to enhance sensor capability and data capture has developed CBM into a science and industry in its own right. How do we make sense of the inevitable mass of data available? The growth of advanced computer modelling and AI provides some promise, but can it really tell us when to replace that part?

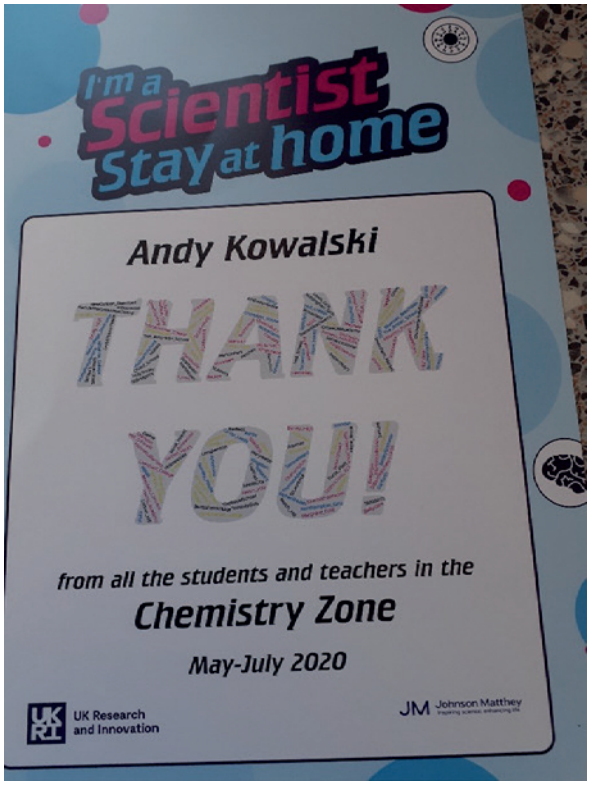
AI driven machines are bounded by their inability to correctly frame a problem due to the lack of context. They are purely driven to identify patterns from data rather than, in the case of an engineer, identifying reasoning and applying engineering logic to the observed data. An engineer can understand the wider context of the operating environment and will apply engineering logic to changes and variables and will apply unconscious assumptions but will also, sometimes more importantly, understand when these conditions are absent.

Degradation is dependent on many variables and can be affected beyond just usage, which makes it extremely difficult to ascertain remaining useful life. Endogenous factors, environmental factors, measurements errors and instantaneous shock events can significantly impact degradation rates, which can be extremely difficult to model and factor within AI predictions of remaining useful life. Whilst AI may play an important role in assisting CBM data collection and synthesis, context will remain key and the analysis and decision-making process is the engineer's. To that end, it remains imperative that any AI system remains explainable to the engineer.

Member news

Andy Kowalski MRSC MIScT FCMI

I thought it would be good to update colleagues within the IST with regard to my activities since my last article appeared in the Spring online edition of the Journal in 2020.



In the Spring of 2020, I was engaged in a programme of support for school children affected by the first lockdown, and this was called *Ask a Scientist*. This ran from May to July and my role was to offer advice and to answer questions posed by them in the area of chemistry. At the end of the programme, we were sent thank you letters and also certificates as shown below.

In November 2020 I contacted the STEM representative in Poland following a lead that evolved originally from the Polish Embassy in Warsaw from professionals working in that field.

I took the initiative and got involved and have been working with the Chairman of **STEM.org.pl** to get more resources for the after-school clubs they run for children aged 5-14.

On January 23rd, 2021 I was informed by them that I had been elected as UK Ambassador for their organization and I have been using more networks and contacts to assist them wherever I can.

In February of this year, I was approached by one of my contacts on LinkedIn from Tanzania who asked for advice on a project they are running on education for young people working in STEM areas. With special emphasis on reaching out to girls to advise them of the opportunities that exist in the long-term evolving from those subjects and also careers. I also gave them insights for using female role models and in particular ***Nobel Prize winners!***

Also, in that month I prepared a STEM presentation for the *Alumni Association of Loughborough University* on how I have applied chemistry into my working life, and this included voiceovers for each slide, and these can be seen on YouTube under *Alumni stories And Kowalski.*

lboro.ac.uk/study/school-college-liaison/inspiring-minds-stem/experience-subject/chemistry/

I also continue my engagement with the Royal Society of Chemistry and in particular with their Management Group with respect to finding new speakers for lectures and webinars, but also engaging in ongoing Zoom meetings throughout the year.

Science Council CPD Awards 2021

The Science Council's CPD Awards were back for 2021, as a vehicle to continue the celebration of outstanding CPD, achieved in previous years.

The CPD Awards are designed to celebrate outstanding professional development in science and technology, showcasing examples of good practice and continuous improvement. They celebrate the professional development efforts and achievements of registrants across the four Science Council registers: Registered Science Technician (RSciTech), Registered Scientist (RSci), Chartered Scientist (CSci) and Chartered Science Teacher (CSciTeach).

The results of the Awards were announced during the CPD Awards Week in November and we were delighted to learn that IST registrants were again very successful and a number were included in the list of winners and commendations.

We are proud of all of our registrants, and the ones named above were successful in this year's CPD Awards. Well done everyone!

Papin Prizes

The 2021 UK Higher Education Technician Summit, which runs every two years, publicly celebrates the skills, talent and experience of technicians from across the country through the "Papin Prizes", a series of awards made to technicians across the UK who have demonstrated excellent practice.

The Papin Prizes are named after Denis Papin, a 17th century technician who worked with Robert Boyle. Papin invented the steam digester and was one of the first technicians to publish in his own name.

The Papin Prizes recognise the invaluable role played by technicians in higher education and research. Their aim is:

- To provide national recognition and reward for excellence in technical services
- To raise the professional status of technicians

We were delighted to learn earlier in the year that one of our Fellows, Laurence Dawkins-Hall had been shortlisted in the Outreach/Community category.

Laurence ultimately gained a commendation in this category, and we congratulate him on that achievement, the commendation is very well deserved.

IST The Institute of Science & Technology

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

Leading Your Technical Team (LYTT)

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. It's 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."

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

Following a period when the course has been unavailable because of COVID restrictions we are now taking expressions of interest for 2022. Courses will be 'live' and locations for 2022 are now being explored. For full course details and availability please contact: **office@istonline.org.uk**

PROUD SUPPORTER OF THE
Technician Commitment

iST

Supporting the technical workforce in the creative, digital, engineering and science technologies

Visibility

Recognition

Career Development

Sustainability

SUPPORTING THE TECHNICAL WORKFORCE

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Supporting the technical workforce in the creative, digital, engineering and science technologies

PROUD SUPPORTER OF THE
Technician Commitment

Supporting the technical workforce since 1948

The IST has been supporting the technical workforce across the UK and overseas since 1948, across all sectors and disciplines, and has a proven track record for delivering support for and promotion of the excellence of our technical communities.

The Technician Commitment initiative provides a vehicle for higher education and research institutes to enhance and celebrate their technical workforce, and this initiative has wholeheartedly been endorsed by the IST since its inception.

Technical staff are often the unsung heroes working across many sectors. Through the continuation of existing IST projects the introduction of potential new and exciting collaborations which we are currently exploring, we will step-up our commitment to the development of a professional technical workforce, dedicating our time, enthusiasm and expertise to our members and the wider technical community.

The IST's action plan aligns to the four pledges of the Technician Commitment - Visibility, Recognition, Career Development and Sustainability.

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The below details the IST's Action Plan for each of the 4 pledges.

VISIBILITY

We will continue to offer awards and prizes for staff working across the technical sector, e.g. Annual Conference prizes via which technical staff can showcase their work/interests, funding being provided from our John Robinson Memorial Fund. Opportunities to introduce new awards and prizes will be actively explored going forward.

Networking and our annual National Technical Conference – we are committed to continuing to deliver our Conference, which is tailored specifically for technical staff, and which encourages those staff to not only help organise the event but also make presentations about their area of interest and/or expertise. The 2020 Conference was a virtual event for which there were > 450 registrants. Future events will be tailored to accommodate the prevailing networking and security options available at the time.

The IST Strategy focuses on technical staff from all sectors and disciplines, with performance and achievements being currently highlighted via our website, publications and social media. Our delivery vehicles will be kept under constant review and new routes for interaction will be explored, eg. the development of special interest groups/networks

RECOGNITION

The IST is one of the Science Council's Licenced Bodies, able to award to the CSci, RSci, and RSciTech, Professional Registers and active promotion of these registers will continue, both at individual and organisational level. In addition, the IST currently has an in-house Registered Practitioner Scheme which is available to technical staff for whom the Science Council (or Engineering Council) registers may not be appropriate (eg. the creative technologies), and we will be exploring in the future how we can actively support and recognise the creative technical community.

CPD is viewed as a crucial aspect in maintaining professional standards and the IST is committed to continuing to help the technical workforce showcase their CPD activities, with excellence being recognised over a number of years, both internally and via the annual Science Council CPD awards. The IST is immensely proud that it's registrants have been very successful to date in these annual awards. Routes to potential new CPD options are continually being considered, eg. developing Conference workshops and presentations.

The current Journal and the new Tech Magazine, are in-house publications which provide members with opportunities to write and publish articles (especially when individuals have not published previously) and via which the Institute can acknowledge/recognise achievement and best practice. Other media routes for recognition are being actively explored for the future eg. podcasts.

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CAREER DEVELOPMENT

Courses – the Institute will continue to offer courses and certficates eg. Higher Diplomas in laboratory techniques, Leading your Technical Team and Building your Technical Team course. In addition we will continue to provide validation/ endorsement of external training that is geared to technical staff development. We will also seek to explore how we can develop further training packages for the technical workforce but with delivery being online, such courses being aimed at staff that struggle to get support to travel for training or for whom travel is not a practical proposition.

The IST works closely with HEaTED to help technical staff take advantage of their Technical Skills courses. In future we will also liaise with them to consider how we can build new courses which can be made available via their programme.

The IST is a Partner Affiliate of the National Technician Development Centre (NTDC) and will continue to work closely with them to develop technical careers and enhance visibility and regognition. Recent joint projects with the NTDC include the build and launch of CPD Central software, which is an online tool for logging CPD activities. This tool is tailored to technical sector needs and expanding it's roll-out with be a key activity in the future. Additional future projects with the NTDC in will include joint activities which are focused on developing technical career pathways.

SUSTAINABILITY

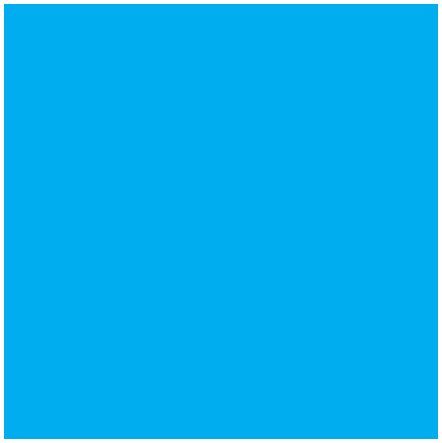
1-2-1 Mentoring – IST's membership and Fellows work across a broad range of sectors and can provide mentoring to help retain and develop the skill sets of the technical workforce. In future mentoring to support professional registrattion will be expanded in conjunction with the Science Council

We have been involved with various special groups e.g. Downs Syndrome Association/ Workfit in a project to develop inclusive work practises for young adults with DS to gain, develop and retain work roles in laboratories. We will continue to look for other opportunities for interactions with such projects eg. by developing bespoke certificated training courses for specific technical groups

T-Levels and Apprenticeships: The IST has worked closely with the NTDC in respect of establishment of Apprenticeship standards.
Members of the Executive Board are Trustees of the Science Council and are involved in T-Levels and Apprenticeships.

As members of the Science Council's Board of Trustees and working Committees, several IST Executives have been, and continue to be actively involved with the development and the maintenance of the professional standards associated with CSci, RSci and RSciTech. In the future further interactions will be actively encouraged eg. by direct registrant participation in SC support activities.

The IST is committed to supporting the technical community and enhancing and promoting its standing in the workplace, and it is without doubt that a strong and professional technical workforce is key. The Technician Commitment is an initiative which the IST strongly endorses and the Executive welcomes the opportunity to formally contribute to the TC Initiativeas as a supporting organisation.



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