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and The Royal School of Mines Association

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Front Cover photo: Umbrella Street in Belgrade
Back Cover photo: Statue of Djura Jakšić (1832-78), Serbian writer and artist, outside his house in Skadarska St., Belgrade.
Cover images courtesy of CivSoc

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Richard Kitney

On behalf of the Association I would like to offer my thanks to Dame Judith Hackitt (immediate Past President) for her splendid work whilst she was President. Dame Judith had to step down early in order to take up an important role on the Grenfell Tower Fire Enquiry. She was asked by the Home Secretary to conduct an independent review of building regulations and fire safety – with a particular focus on their application to high-rise residential buildings. We wish her well in this important task. Next, I would like to thank Colin Kerr and his colleagues for organising yet another splendid CGCA annual dinner. The dinner was held on Friday, 23rd February at the Ironmongers Hall, with around 120 people in attendance. The principal guest was Professor Nigel Brandon, Dean of the Faculty of Engineering. Nigel gave an inspiring speech – stressing the importance of ongoing links between the Faculty and the Association. He made particular reference to the work of the Old Centralians Trust (more on this topic later). We were particularly delighted to welcome Dr Paulina Chan, a prominent member of the CGCA Hong Kong Branch. Another interesting CGCA event was the '5&10' Reunion Lunch, organised by Peter Chase, in November – with a total of 48 in attendance (1952 (3), 1957 (10) and 1967 (35)). A highlight of the lunch were the excellent anecdotes from a number of the alumni.

I would like to thank Peter Chase, Nigel Cresswell and other members of the Committee for their administrative support, as well as the CGCA Departmental Reps. There have been a number of Departmental events sponsored by the CGCA during the year; for example careers advice evenings in Mech Eng and Chem Eng. The Association has also purchased three PCs for the Students' Union. Progress has been made on the replacement of the missing honour shields. We have been able to make replicas of the 1901 and 1902 shields, which look very good. Peter Chase is now working on contacting previous CGCU Presidents to obtain a list of officers for each year so that we can construct all the remaining missing shields. Not so good news is that the College wants to hang the shields in the stairwells of the City and Guilds Building. The Association would like the shields to be hung in the foyer above the ME 220 lecture theatre.

Towards the end of 2017, the CGCA took action to align itself with the GDPR and the impact they have on the existing privacy for electronic communication regulations. This began by using the Imperial ENGINEER mailing to contact every member by post to get their agreement to continue to receive electronic mailing about the CGCA, events, products and services. To date, more than 1000 members have responded. A few terminated their membership, but over 95% consented to receiving electronic marketing. I would like to thank Nigel Cresswell for his diligent work in this area.

Next, I would like to thank Peter and Alison Buck for their splendid work in producing two excellent editions of Imperial ENGINEER. Both editions included regular, but highly informative, articles on developments around the Engineering Faculty as well as specialist articles – for example, the article by Sebastien Gonzato on Technology and Ecology. Sebastien is a fourth-year Chemical Engineering student and winner of this year's RSMA essay prize. The spring edition had an interesting article on autonomous vehicles by John Routledge, an alumnus of the Innovation Design Engineering joint Master's Degree run by Imperial College and the Royal College of Art. Our thanks to Chris Lumb and the other board members of OC Trust for their fine work in supporting students and student activity. In the financial year coinciding with the academic year 2016/2017, the trust distributed over £55,000 in support of wider student activities to over 180 students from a wide range of backgrounds – as well as supporting a number of student hardship cases. Finally, I would like to thank Roger Venables, our Immediate Past Vice President. Roger kindly agreed to be co-opted onto the Committee to supervise the transition of the CGCA into a Limited liability company.

PRESIDENTS REPORT

Tim Cotton

Ok, so I wasn't expecting to be writing to you all in the capacity of RSMA President as, technically, my two years were up. However we have seen, and continue to see, a turnover in Committee members and as such the Committee and I felt that, for consistency, I should stay another year. This was taken to the AGM in June this year and approved by the members present. Encouragingly, at the AGM we elected three new members to the Committee so I am confident that we can arrange for a handover by next June.

Unusually there has been a significant amount of activity over the Spring / Summer period for the RSMA. Firstly I am very happy to report that in June the RSMA Final Year Student Bursary Prize was launched for award to students who are beginning their final year in September 2018. We are planning to award up to three prizes across ESE and Materials. The scheme has been created to reward students who show the true RSM Spirit and act as an ambassador for the RSM. Successful candidates must be able to show commitment, achievement and excellence above that of their peers in areas such as academic excellence, community & RSM Union involvement, sporting prowess, or contribution to a sport or club within the RSM. Financial hardship will also be considered as a criterion. Working with Department Directors of Undergraduate Studies at ESE, Materials, and the Faculty of Engineering, we have had nine applicants and will be short-listing and awarding the bursaries shortly. Remember the funds have been raised by YOU through your kind generosity at events and specifically by those members who have supported the 100 Club. This is an amazing achievement and is a concrete example of former students of the RSM who want to give back to the current student body. Lastly, the 100 Club is slowly growing and I would encourage you, if you are able, to sign up and support the RSMA via the 100 Club or by a one-off donation. Your support is truly appreciated!

Once again due to work commitments the RSMA committee was unable to field a representative at the Imperial Alumni Fair in early May. Over the next few months the committee will review if there is anything different we can do to get more Members at the event and thus make it worthwhile to attend. In May the RSMA, and the rest of the UK, had to adapt to the new UK Privacy laws. This has meant the Association has to abide by very prescriptive regulations on how we may, or may not, contact our members. This has impacted the College as a whole and we have been working with the College Alumni Relations team in managing the transition to these new privacy laws. The Committee has a good working relationship with these departments and I am happy to report we have a way forward that ensures we are compliant and it is likely that the membership will see minimal interruption.

The 2018 Annual General Meeting of the Association was held on the 28th June at the Union Bar, followed by the final year Bar-B-Q, which was again well attended by the students plus a number of alumni. See the report inside this issue for an update and few photographs. The 134th annual dinner will be held on Friday 23rd November at the Rembrandt Hotel in Knightsbridge. Last year was a tremendous event with nearly 120 members and guests and it is hoped that as many members as possible will attend this year. The dinner remains the most significant event in the Association's calendar. With this issue of IE there is a flyer that contains the booking form, and a group e-mail will also be sent out to all members telling them how to book.

Following the success of the last four years' events, in December the committee will again give a presentation to the students on the history, aims and membership of the RSMA in order to get students to join the RSMA whilst studying. In 2018 this was combined with an RSMU Careers Evening, which was a great success. The committee continues to maintain a very active relationship with the RSMU and for the 2018/19 academic year the new RSMU representatives are Marta Wolinska and Sam Casement, respectively President and Hon Sec. For all you die hard sport fans out there, the RSM will be hosting CSM in London for the annual sporting weekend culminating with the Bottle Match on Saturday 23rd February 2019.

I hope you find this issue informative and I look forward to seeing some of you in the RSM and /or at an RSMA event in the near future.

2018 RSMA AGM and Final Year BBQ

A dozen or so RSMA members braved the hot June weather and climbed four flights of stairs to the top of the Students Union Building to have the Annual AGM of the RSMA.

The members heard various reports from the President, Treasurer and Chair of the RSMA Trust and salient points are noted below. The President, Tim Cotton, highlighted that technically this should have been his last meeting but due to significant turnover of Committee members it was felt best that Tim continue as President for another year to provide some consistency; all members present concurred. At the meeting, three new Committee members were elected; Ben Moorhouse, Seb Turner and Richard Griffiths; these and other members and officers are listed in the box below.

The Treasurer reported that the RSMA and Trust are in good health and have the necessary funds available to continue to support the RSM. However more work is needed to invest the capital of the Association and Trust in better homes that offer some form of return on investment above 0%! In addition a push is being made to get members to pay the full £15 for membership and a mail shot and email campaign is being planned. On a more positive note, the Treasurer announced that the funds from the 100 Club are being used to provide three £1000 bursary prizes. These will be awarded in the Autumn 2018 Term to final year students who show the true RSM spirit and act as an RSM ambassador. There have been nine applicants and names are currently being short-listed.

The Chair of the Trust reported that the present RSMA Trust Deed established the Trust in October 1992 and was amended in June 2005. In 2018 the Trustees reviewed the Deed's provisions and produced a new trust deed with a view to clarifying, modernising and formalising how the Trust has been running for last 5 years. In summary the changes were that the board comprise only trustees, four of whom would be appointed ex-officio. Reappointment would be permitted for a maximum of nine consecutive terms to be followed by a break of a full year – unless the remaining trustees considered there to be exceptional circumstances. Trustees may not receive any private benefit from the Trust (this was always the case but it was not spelt out previously) and finally Trustees could now seek an indemnity from the Trust. In keeping with the new Deed, the President, Honorary Treasurer and Honorary Secretary of the RSMA and the President of the RSMU are appointed as trustees ex-officio.

The following members offered themselves for election, and were elected, as trustees:

- Professor Rees Rawlings
- Professor John Monhemius
- Fiona Cassidy
- Coen Louwarts
- John O'Reilly
- Glynne Lloyd- Davis.

In other Trust matters, the following awards were made and presentations will be made at the 2018 Annual Dinner:

- *Peter Harding Memorial Award* went to Professor Rees Rawlings
- *Rees Rawlings Young Member Award* went to Eleanor Jay

Finally after an informed debate on the topics presented, the group adjourned downstairs to the Union Bar where the 2018 Final Year BBQ was being held. This was a change in venue for the first time in many years and the Imperial College Union Bar and Catering team did a fine job in feeding and watering the 40 odd members and guests. During the evening, the draw for the 100 Club was won by Larry Bottomley who has since re-donated the prize back to the RSMA. The added benefit was that the Union Bar is now air-conditioned and this, combined with good food and drink and a bit of singing, made for a very enjoyable evening. Once again, great thanks are due to alumnus Eddie Gadd who donated two pins of his finest Ramsgate Brewery Ale for the function. Go to http://www.ramsgatebrewery.co.uk and I guarantee you will not be disappointed with the products.

Photos: Matt Hayward RSMU

Past and present RSMA Committee members

L to R:
Rob Tomkies, Outgoing RSMU President;
Avni Patel, Outgoing RSMU Hon Sec;
Seb Turner, New RSMA Committee Member;
Danny Hill, RSMA Committee Member;
Ben Moorhouse, New RSMA Committee Member;
Hannah Bungey, RSMA Hon Sec;
Tim Cotton, RSMA President;
Noah Hawkins, Past President RSMU;
John O'Reilly, Past President RSMA.

After the AGM, the group adjourned to the Union Bar

Election of officers and committee for 2018/19

President:	Tim Cotton
Senior Vice-President:	*Vacant*
Junior Vice-President:	*Vacant*
Past-President:	John O'Reilly
Hon. Secretary:	Hannah Bungey
Hon. Treasurer:	David Bishop
VP International:	John Sykes
Membership Secretary:	Coen Louwarts
Members:	Lorraine Craig
	John Monhemius
	Rees Rawlings
	Daniel Hill
	Eleanor Jay
	Ben Moorhouse
	Seb Turner
	Richard Griffiths
	Marta Wolinska (President RSMU)
	Samuel Casement (Hon Sec RSMU)
	Vacant (Materials Staff Rep)
Overseas:	Giles Baynham (Canada)
	Celia Hayes (Australia)
	Harry Fisher (Australia)

Converting CGCA

into a Company Limited by Guarantee

As you may be aware, the CGCA Committee agreed to begin activities to convert CGCA from an unincorporated association into a Company Limited by Guarantee. Your Committee has now started the necessary work to prepare the way for the creation of the company and the transfer of all of its assets and operations into that company. We wish to bring you up to date and seek any inputs to the process that you can offer. Here is where we have reached and where we would appreciate your comments.

A) Where we are at

1) The purposes of this proposed change are threefold:
   i. To reduce to a minimum the personal liabilities of members of the General and Executive Committees for the affairs of the Association, and in particular for the potential liabilities for a breach of the GDPR regulations, of which we have heard so much in recent months.
   ii. To improve or enable contractual relationships with suppliers, by building trust and confidence in the Association's position, responsibilities and effectiveness.
   iii. To enhance the banking services available to the Association, especially the ability to use direct debits for the collection of subscriptions.
2) For those unaware, the 'Company Limited by Guarantee' structure provides these enhanced features in such a way that there are no shareholders, and in a way that enables the equivalent of dividends in a shareholder company to be the provision of benefits to members and, where appropriate, preferential access to the Association's activities and outputs.
3) One key point that has been decided is that this work will be entirely focussed on the change in legal status, converting the Association's current Constitution into Company Articles that maintain all our current features and procedures that remain relevant, without amending those features and procedures beyond the necessary. If, during the conversion process, people suggest changes to the current Constitution beyond the necessary, they will be considered by the new Board of Directors as soon as practicable after incorporation.
4) A number of Committee Members are familiar with the establishment and operational aspects of such companies and one of those, Past President Roger Venables, is leading the work necessary and will be drafting most of the original documentation needed.
5) To assist Roger and the Committee, we are appointing Collard Partners, Chartered Accountants, to comment and assist generally in the necessary company establishment processes. We will also be finding an accountant to be the new Company's auditors and advisors.
6) On timescales, you will be aware that our financial year is 1st January to 31st December, and your Committee has agreed that we should do all that we can to effect the change so that City & Guilds College Association Limited can start operations from 1st January 2019. To that end, we have already fixed the date for the necessary Special General Meeting, as Tuesday 30th October. The calling of the SGM was enabled by 30 members emailing the Hon. Sec. Nigel Cresswell to requisition the meeting for this specific purpose.
7) The proposed founding Members of the new Company are the exisitng officers of CGCA plus the two previous Presidents. On incorporation the operational mode of the Company needs to be established; Collards advise that the Executive Committee should become the Board of Directors.

B) What we need or would find helpful from you

1) Despite the restricted scope of this exercise as set out in para A3 above, we would welcome any comments you may have on the process we have embarked upon. Please address them to Roger Venables, cc'd to the Hon. Sec. Nigel Cresswell.

Please address your comments on this process to:

Roger Venables at roger@Venablesconsultancy.co.uk

cc'd to Hon. Sec. **Nigel Cresswell** at GuildsHS2018@outlook.com

Living with GDPR!

Photo: Ivan Marc/shutterstock.com

The *General Data Protection Regulations*, GDPR, became enforceable law throughout the EU in May 2018. It impacts any form of organisation that stores or processes any living person's personal data, including CGCA. It includes an 'opt in' concept and this has interacted with several other laws related to personal data by making those laws also require an 'opt in'.

One such law is *Privacy for Electronic Communications Regulations*, PECR, which controls electronic marketing, such as emails offering services. Basically, this interaction means an organisation is not allowed to store your email address to send you electronic marketing unless you have 'opted in' to that organisation sending you electronic marketing.

This is the reason CGCA has been asking you to tell us your preferences. If you have done this, and are happy with your preferences, then all is fine. If you wish to state or change your preferences, then please go to https://www.cgca.org.uk/issues to create and send an email with your current preferences.

A common issue raised by members is that by paying to be a member surely that member wants to be told about events such as the Annual Dinner. However, the situation is a little more complicated. By paying membership fees, the member has opted in to membership and everything included in the membership fee. At any time, CGCA can send emails to any member provided it only contains details of their membership. This is because by remaining a member we have a contract with you.

Events such as the Annual Dinner are not an integral part of the membership contract. They are part of a separate contract that is formed when you apply to attend an event. Because of this, if you either haven't told us your preferences for receiving electronic marketing, or have specifically opted out, you will not receive any emails telling you about CGCA related events, products or services in future.

Part of implementing GDPR is that all organisations must tell you clearly why they process your personal data and how it will be handled. This is known as a 'Privacy Statement' and we have revised our statements to make them more complete and clearer. There are two statements:

- The *Members' Privacy* statement which tells you how we handle your membership data.
- The *Event Attendees Privacy* statement which tells you how we handle the personal data of anyone, member or not, that attends a CGCA or related event.

Please go to the CGCA website (http://cgca.org.uk) to see the latest versions of these statements.

Nigel Cresswell
CGCA Hon Sec.
CGCA Data Controller.

CGCA 2018 AGM

On 19th June, the CGCA AGM was attended by 32 members in the Council Rooms in 180 Queens Gate.

The President, Professor Richard Kitney, introduced himself as he took the role on after the last AGM. He thanked Dame Judith Hackitt for her efforts before having to step down to conduct an Independent Review of Building Regulations and Fire Safety for the Government following the Grenfell Tower disaster. In his review of the year, he thanked Peter Chase, Nigel Cresswell and other committee members for their support; Eilidh and Nicola from the Alumni Relations team for their support; Nigel Cresswell for his leadership on GDPR conformance; Peter and Alison Buck for the excellent issues of Imperial ENGINEER; Colin Kerr for his work on the Annual Dinner which was a great success with 120 attendees, including many students; Paulina Chan from CGCA Hong Kong for attending the Annual Dinner; and Roger Venables for his input over his 2 years as immediate Past President. The 5 & 10 year reunion was a success, with 57 attendees spanning from 1952 to present day. The OC Trust had a very successful year distributing £55K to 180 students, as well as making many student awards for non-academic activities.

In a brief look to the future, Richard identified alumni/student events at Departmental level, increasing student membership and working with the Faculty as priorities.

Hon. Treasurer, Peter Chase, presented the 2017 accounts. During the year, we spent £5K more than in 2016, giving an £8K operating deficit. GDPR increased IE costs, but investments rose to more than cover these costs. The accounts were approved by the meeting. Peter proposed Messrs Cooper Gibson & Co be appointed as auditors until the next AGM in 2019. This was approved by the meeting.

Officers and Committee members were elected (see table to the right).

Roger Venables will be co-opted to the Committee to lead the transition from Association to Company Limited by Guarantee. Roger presented information about CLG, the structure and how it helped CGCA.

Following the AGM, President Richard Kitney gave a talk entitled *Synthetic Biology/Engineering Biology – a rapidly growing area of the Bio economy*. The article (below and opposite) is based on that talk.

Officers and committee for 2018/19

President:	Richard Kitney
Senior Vice-President:	*Vacant*
Vice-President:	Atula Abesekera
Immediate Past-President:	Judith Hackitt
Hon. Secretary:	Nigel Cresswell
Hon. Treasurer:	Peter Chase
Editor IE	Peter Buck
Younger Members Secretary	Tim Munday
Events Coordinator	Charles Parry
Annual Dinner Event Manager	Colin Kerr
Decade Reunion Event Manager	Peter Chase
Departmental Representatives:	
Aero Engineering	Tim Munday
Bioengineering	*Vacant*
Chemical Engineering	Judith Hackitt
	Peter Lynch
Civil & Environmental Engineering:	Atula Abeysekera
	Colin Kerr
Computing:	*Vacant*
Design Engineering:	*Vacant*
Electrical & Electronic Engineering:	Christopher Baker-Brian
Mechanical Engineering:	Charles Parry.

Synthetic Biology / Engineering Biology

a Rapidly Growing Area of the Bio economy

In 1844, Joseph Turner painted his iconic picture *Rain, Speed and Steam* – this was an image of the Industrial Revolution. Today, we are entering what many describe as a Fourth Industrial Revolution.

By way of background, let us consider the industrial model that has been in operation since the middle of the 19th century. This comprises oil-based feedstocks, feeding through synthetic chemistry to industrial processes, leading to products. This model today is in many ways unsustainable – in terms of carbon, because it uses oil, coal, natural gas and other carbon feedstocks. These feed through synthetic chemistry to the everyday products, such as a wide range of plastics, adhesives and petroleum. There is therefore a need to make the transition to sustainable bio-based economies. World Bank figures show that many areas of Europe are now moving to a low carbon economy. This will take many years, and many areas of the developing world, particularly in Asia, will still have high carbon economies. A second important potential development is the concept of the circular economy, which comprises recycling waste of various kinds in imaginative ways.

Over the last few years, many governments around the world, including the UK and US, have become very interested in the concept of the bio economy. This has led to the publication of a number of reports on both sides of the Atlantic, which stress the importance of the bio economy in terms of sustainable production and manufacturing. So, the question is: *What is a bio-based economy?* The bio economy is a new model for industry and the economy. It uses renewable biological resources sustainably to produce food, energy and industrial products. It exploits untapped potential stores within millions of tonnes of biological waste and residual materials. The UK bio economy is estimated to be around £220 billion, but capable of rapid growth, due to new technology developments (e.g. through synthetic biology/engineering biology). UK Government figures show that it is possible for the bio economy, primarily driven by synthetic biology, to double to £440 billion by 2030.

The history of synthetic biology is a continuum, in terms of its origins. But a starting point is, perhaps, the publication by Francis Crick and James Watson of the structure of DNA, in *Nature*, in April 1953. This led to the microbiological revolution that is still continuing today. A second data point in the background development of the field is the publication of the initial sequencing of the human genome – again in *Nature*, in 2001. The technology developed for this project, to provide the ability to read DNA, was one of the key building blocks for synthetic biology. The other was the ability to write DNA chemically. Hence, the ability to read and write DNA (described in the field as sequencing and synthesis, respectively) represents one of the main bases of synthetic biology. This led to the development of a new industrial model that comprises bio-based feedstocks as its input, feeding through synthetic biology to industrial processes and products.

Photos: Imperial College

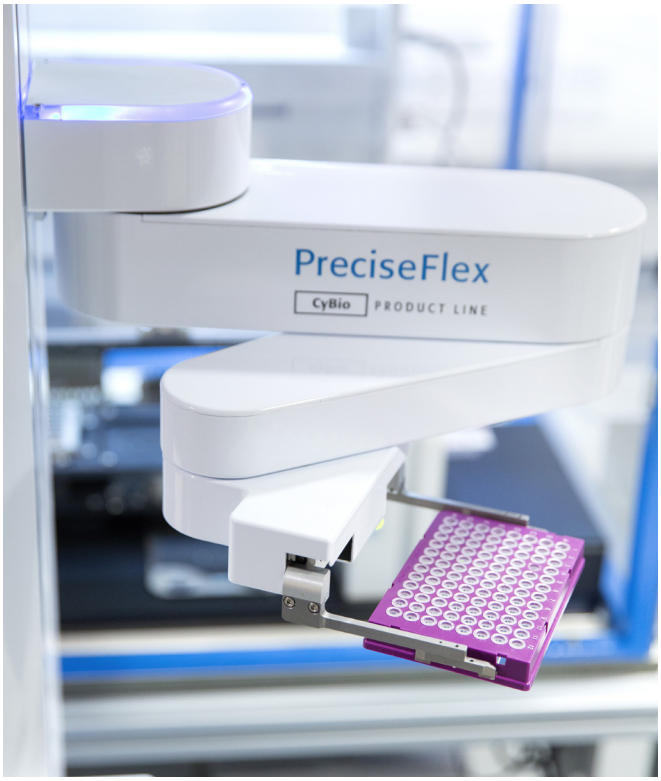
The DNA Foundry in Imperial's Synthetic Biology Hub

So, what is synthetic biology? In simple terms, it is the ability to produce synthetic DNA chemically and to place it in cells to produce products that do not normally occur. Natural DNA can be thought of as the instruction set ('computer program') that instructs the cell to produce something – e.g. proteins. Much of synthetic biology revolves around the use of bacterial cells, such as E. coli and yeast. By inserting human-designed synthetic DNA into the cell it is possible to instruct the cell to produce other products, such as biofuels, vaccines and even antibiotics. Today, unlike in 2001, the ability to read and write DNA is accurate and fast. In the case of DNA sequencing, the cost is now very low and the cost of writing DNA is acceptable and set to reduce dramatically over the next few years.

The second important basis of synthetic biology is the realisation that it is a field which represents the confluence of biology and engineering – and, particularly, the concepts of bio design – based on the engineering principles of modularity, standardisation and characterisation. Hence, the synthetic DNA instruction sets can be thought of as comprising sections of DNA known as bioparts. The properties of individual bioparts are accurately determined experimentally by a process called characterisation. In a particular instance, typically a number of these parts are combined to build a so-called gene circuit – which is the overall human-designed instruction set that is placed in a cell. The attraction of synthetic biology is that it comprises platform technology that can be applied across a wide range of fields including: health, bioenergy, crops and soil, fine and bulk chemicals, diagnostics and biomaterials. Some example applications include the development of flu vaccines. For instance, figures for the UK in March 2015 showed that in that winter there had been 400,000 GP consultations, with 11,000 elderly people being admitted to hospital with respiratory complications. This cost the NHS £22 million. Currently, it takes about 9 months to produce 10 million doses of a flu vaccine. However, with synthetic biology techniques this has now been reduced to one month – using synthetic biology and plants to produce the vaccine. This technology was developed by the John Innes Centre near Cambridge and is currently being commercially developed by a Canadian company called Medicago in the United States. Another example is the development of synthetic spider silk thread that can be used for a wide range of applications, including clothing applications, such as sports shoes.

For synthetic biology to be truly effective requires the development of the ability to translate basic research undertaken in the laboratory into industry. This, in turn, requires development and implementation standards, and effective reproducibility and reliability procedures. More specifically, the development and implementation of procedures that are common to other areas of industry – namely, design, automated measurement and continuous improvement. In this context, Design includes managing complexity with modularity and the implementation of CAD tools; Automated Measurement includes the ability for specifications to be measured and met, and for data acquisition to be automated; Continuous Improvement includes continuous analytics and process improvements, and absolute reproducibility. Moving towards these goals has involved the development of web-based information systems that, for example, contain all the data, metadata and notes relating to specific bioparts, as part of the implementation of laboratory-based automation.

Over the last few years, a key development in the area of automation within synthetic biology has been the development of DNA foundries. These comprise systems of multiple robots that are



capable of handing the cells and DNA, assembling the gene circuits and undertaking characterisation experiments. The implementation of DNA foundries has greatly increased reproducibility and reliability. As a result of these developments, it is now beginning to be possible to implement additional components in the overall process – such as the Design of Experiments (DOE) and process management systems. The new BMW 3 series is seen as a good example of the implementation of the key objectives of design, reproducibility and reliability in the automotive industry – which has direct application in synthetic biology. An article in *Automotive News Europe* at the time of the introduction of the new 3 Series showed that whilst BMW carried out the design, over 50 specialist manufacturers produced parts for the new car. Hence, the production of the 3 Series can be thought of as comprising an ecosystem with design undertaken by BMW at its centre. A similar concept is now rapidly developing within synthetic biology with bio design at the heart of an ecosystem comprising DNA synthesis companies, design tools companies, parts companies and chassis companies – integrated by information infrastructures, provided by Information Systems companies.

The elements of synthetic biology and its implementation are undertaken in two types of laboratories, namely wet and dry labs (where the wet lab comprises the DNA foundries and the dry lab computer-based design). Hence, if a two-dimensional diagram is envisaged, where the vertical axis is Dry Lab and the horizontal axis Wet Lab, the process of increasing reliability, reproducibility and speed of operation can be thought of as one of moving from manual design and human biologists to one of computer-based bio design, DNA foundries, optimisation and specialist companies.

As already stated, both the UK and US governments see synthetic biology as a key driver of the bio economy. Synthetic biology is an important example of a knowledge-based industry, which places the UK in a potentially very strong position because of our excellent science and engineering base. However, the potential of the field can only be realised with the appropriate investment from Government and increasing investment from the Private Sector.

Professor Richard I Kitney OBE FREng FRSE DSc FCGI, is Professor of Biomedical Systems Engineering; Chairman of the Institute of Systems and Synthetic Biology; and Co-Director of the EPSRC National Centre for Synthetic Biology and Innovation. He was Founding Head of the Department of Bioengineering; is a member of the Ministerial Leadership Council for Synthetic Biology and was one of the main authors of the UK Roadmap for Synthetic Biology. With Professor Paul Freemont, he has been responsible for developing the Imperial College Hub for Synthetic Biology.

DEVELOPMENTS AROUND THE ENGINEERING FACULTY

Queen's Birthday Honours

In the Queen's Birthday Honours list in June, **Roma Agrawal** (MSc Civil and Env Eng 2005) was awarded an MBE for services to engineering. Also honoured were alumni **Naomi Climer** (Chemistry 1986) awarded a CBE for services to the engineering profession; **Ian Prosser** (Chem Eng & Chem Tech 1980) awarded a CBE for services to railway safety; **Professor John Loughhead** (Mech Eng 1970, MSc 1971) who received a CB for services to research and development in the energy sector; and **Dhruv Patel** (Computing 2004) who was appointed OBE for voluntary service to the British Hindu community and social cohesion.

Photo: Nicola Evans, WSP

Roma Agrawal MBE

Other Imperial alumni honoured were: **Professor Sir Leslie Ebdon** (Chemistry 1968, PhD 1971) who received a Knighthood for services to higher education and social mobility; **Professor Angela McLean** (PhD Pure and Applied Biology 1986) who has been made a DBE for services to mathematical biology and scientific advice for government; **David Havelock** (Physics 1968) awarded a CBE for services to the economy; **Professor Julian Bion** (Charing Cross Hospital Medical School 1975) who was appointed OBE for services to intensive care; **Professor Lionel Clarke** (Physics 1974) who was appointed OBE for services to the synthetic biology sector; **Dr Nigel Watson** (Westminster Hospital Medical School 1982) who was awarded an MBE for services to general practice; and **Scott Heath** (Chemistry 2011) who was awarded an MBE for services to the LGBT community. **Professor Jonathan Haskel**, Chair in Economics in the Business School, was made a CBE for his public services to economics, including his research on productivity, innovation, intangible investment and growth.

http://bit.ly/IE29-Honours

BSA Honorary Fellows

Another honour for **Roma Agrawal MBE** (MSc Civil and Env Eng 2005), with an Honorary Fellowship of the British Science Association (BSA). The announcement being made on Ada Lovelace Day (10th October) was apposite as all this year's recipients are female: structural engineer Roma was joined by STEMettes cofounder Dr Anne-Marie Imafidon, and business woman and philanthropist Martha Lane-Fox CBE. Every year, BSA supporters are invited to nominate individuals to be considered for an Honorary Fellowship; nominees who embody the BSA's vision and mission, making an outstanding contribution to promoting science.

Roma said: "I want my work to help raise awareness of engineering with under-represented groups such as women and people from ethnic minorities, and I am delighted to be recognised by the British Science Association for it. I thoroughly enjoyed the British Science Festival in Hull and the Humber this September; events like this provide a platform to showcase how creative, collaborative and important to society science and engineering are."

http://bit.ly/IE29-BSA

Chemistry World Entrepreneur of the Year

The Chemistry World Entrepreneur of the Year was awarded to **Dr Clementine Chambon** for 'outstanding contributions to the entrepreneurial application of bioenergy to solving major environmental, social and gender challenges in rural India'.

Photo: Imperial College

Dr Clementine Chambon

Dr Chambon, from the Department of Chemical Engineering, is cofounder and chief technology officer of Oorja, a social enterprise that designs and installs solar and biomass mini-grids, providing affordable, reliable electricity to off-grid communities in India.

By providing a round-the-clock reliable energy supply, the company is improving the lives of India's rural poor, enabling them to run equipment and machinery more cheaply, leading to a significant increase in their income. Their work also has an impact in other areas including economic development, food security, health, education, gender equality and climate change.

Dr Chambon said: "I am very humbled to have been selected to receive the Royal Society of Chemistry's 2018 Chemistry World Entrepreneur of the Year Award, on behalf of my team at Oorja.

"We are grateful to the Royal Society of Chemistry for recognising our work in delivering affordable and reliable clean energy solutions to underserved communities in India. We hope to use this visibility and momentum to accelerate our impact in applying solar and bioenergy to solving major environmental, social and gender challenges in rural India."

http://bit.ly/IE29-Chambon

Royal Academy of Engineering President's Medal

Professor Sir William Wakeham has been awarded the Royal Academy of Engineering President's Medal, one of the Academy's highest accolades. The President's Medal is awarded to an individual in recognition of a significant contribution to the Academy's aims and work through the recipient's initiative in promoting excellence in engineering.

Photo: Imperial College

Professor Wakeham received the medal from Academy President Professor Dame Ann Dowling in London in September

Professor Wakeham, former Head of Chemical Engineering at Imperial, has achieved this over two decades, through his appointment as Chair of the Academy's International Committee in 2009 and subsequent success in reforming and expanding the organisation's overseas reach and influence. During this time, he built excellent relationships with the Chinese Academy of Engineering, and spearheaded collaborations with India on distributed manufacturing and with South Korea on entrepreneurship.

As Senior Vice President of the Academy, he reviewed its governance procedures, which led to substantial reforms and the establishment of a Board of Trustees to replace its Council. He also led a reform of the governance of Euro-CASE, the federation of European academies of engineering and technology, to improve its strategic focus and financial stability.

Academy President Professor Dame Ann Dowling OM DBE FREng FRS said: "Bill Wakeham has championed engineering and science education and entrepreneurship at the highest level. He has been both an invaluable supporter of the Academy and a champion of necessary organisational change. His vision, skill and sensitivity in helping us to achieve it successfully make him a worthy recipient of the President's Medal."

Professor Wakeham joined the Department of Chemical Engineering in 1971 as a Lecturer, progressing to Reader in 1979 and Professor of Chemical Physics in 1985, before serving as Head of Department from 1988 until 1996. Following this, he became Deputy Rector of the College.

In 1997 he was elected a fellow of the Royal Academy of Engineering in recognition of his world-leading research on transport properties of fluids, and was knighted in 2009 for services to Chemical Engineering and to Higher Education. He also served as President of the Institute of Chemical Engineers in 2011.

http://bit.ly/IE29-RAEng

DEVELOPMENTS AROUND THE ENGINEERING FACULTY

New Security & Resilience MSc

STEM professionals are being encouraged to develop skills addressing the world of national security, by applying for a place on the College's newest MSc developed by the ISST (Institute for Security Science and Technology), Imperial's world-leading hub for security research and engagement. The course launches in October 2019 and will be taught by academic experts who undertake cutting edge research and innovation, and have extensive experience of advising governments and industry. Students will be exposed to how science and technology informs policy, and will have contact with experts working on current day security and resilience challenges.

Photo: Imperial College

Professor Bill Lee

The course has been designed with input from potential employers, to equip students with skills that are in demand across academia, industry and the policy sector. Students with entrepreneurial ambitions will also gain from the course, giving them the opportunity to explore new ideas and learn from start-up experts.

Professor Lee, Co-Director of the ISST, said: "STEM graduates increasingly need to demonstrate breadth across disciplines, as well as depth in their core subject. They also need to understand the impact of their work, and how science and technology are essential to policy and enterprise. These points are especially true in security and resilience, where threats often require working in multidisciplinary teams, and there are many non-technical stakeholders.

"The range of threats is increasing, be they natural or man-made. As a country we need to be prepared for current threats but also ahead of the game for the next generation of attack. Factors such as geo-political uncertainties, climate change, plus evolving cyber and physical attacks are changing the security landscape. Combatting these threats requires an interdisciplinary approach from research teams that combine different skillsets, such as those of engineers, computer scientists, mathematicians, chemists, physicists and psychologists.

"There is increasing reliance on cyber-based platforms across all sectors of society, with increasing connectedness. The ability to mine and execute responses to data is increasing as well.

"Factors such as these indicate the need for an increasing cadre of skilled, objectively-trained, personnel capable of applying their skills across the security and resilience sector. Being aware of threats, and able to mitigate them, are increasingly desirable skills. There is rising demand from UK industry and government for scientists and engineers with broad knowledge of security, a global vision and a network of contacts. Our experience of working at the cutting edge of research with industry and government agencies will enable us to deliver MSc graduates who can meet this demand.

"This course is truly unique. Although programmes in security studies exist at other institutions in the UK, and foreign policy and national security programmes at institutions in the USA, no such programme, focusing on security and resilience catering specifically to STEM students exists elsewhere."

The ISST is celebrating its 10th anniversary this year. It was founded to address the need for increasing links between universities and the security sector, particularly in science and technology. Over the last decade the it has not only worked closely with government but also coordinated the ever expanding and increasingly diverse field of security science across College. It has world-leading expertise in security in sectors ranging from transport to nuclear to finance, in fields such as cyber, data analytics, physical protection and defence against CBRNE (chemical, biological, radiological, nuclear and explosive) threats.

http://bit.ly/IE29-newMSc

New BSc in Earth and Planetary Science

Photo: Imperial College

As part of its ongoing commitment to the wonders of our universe, Imperial is now taking applications for its new BSc in Earth and Planetary Science, in the Department of Earth Science and Engineering. The new course, launching in Autumn 2019, will focus on geological and geophysical processes in the Solar System, with particular emphasis on the planets, moons and smaller bodies, such as asteroids and comets.

Modern geoscience is moving beyond the confines of Planet Earth to explore the geological and geophysical processes that shaped the Solar System. The abundance of recent planetary missions, together with the development of novel techniques in studying extraterrestrial materials and processes, is yielding radical new insights into Solar System evolution. Forthcoming planetary exploration missions offer numerous new opportunities to learn about planetary origins and evolution. Geological and geophysical knowledge and skills underpin modern investigation of solid planetary bodies in the Solar System.

The new course will provide students with a strong theoretical and practical foundation in earth science, and then how to apply that to planetary science. The goal is to teach students how dust and gas in the early stages of Solar System formation eventually evolved into planets, including Earth, capable of supporting life. The focus will be on understanding Earth and other solid bodies in the Solar System. The foundation in earth science will emphasise the fundamentals of geology and geophysics. From this, students will learn how Earth's atmosphere, life, surface, interior and external influences operate, interact and evolve. That foundation will then be applied to other solid planetary bodies, to help understand solar system formation and evolution, and the physics, chemistry and geology of the main solid planetary bodies. This highly interdisciplinary degree provides skills in geoscience, physics, chemistry, mathematics, engineering and computing.

The departmental involvement with current and future planetary missions will provide unique insight into mission science and the opportunity to study recently acquired data. The course will include a variety of field trips in the UK and abroad (but not to other planetary bodies – yet!).

http://bit.ly/IE29-newBSc

Imperial forms 'flagship partnership' with TUM

Imperial and the Technical University of Munich are to develop ever-closer ties through a series of new institutional collaborations. The move underlines Imperial's commitment to internationalisation and growing its European connections after Brexit. In the last decade, Imperial academics published more than 60,000 research papers with their European peers. TUM is one of Germany's most international and entrepreneurial universities, producing highly ranked research, like Imperial, in science, engineering and medicine.

Imperial and TUM plan to forge new research links in computer science and informatics, medicine and medical sciences, bioengineering, molecular sciences, life sciences, physics, energy and new materials, and mechanical and aerospace engineering. They will develop new student exchanges, research programmes, placements and summer schools, as well as exploring new partnerships with industry.

Professor Alice Gast, Imperial President, said: "Imperial is a global university, and we are pleased to grow our international connections with a great partner like TUM."

On the morning of the Brexit referendum result, President Alice Gast pledged that "Imperial is, and will remain, a European university." Since then, Imperial has developed a series of new European partnerships, including a major new London-based centre of mathematics, UMI Abraham de Moivre, with France's CNRS: Europe's largest fundamental research agency.

http://bit.ly/IE29-TUM

STOP PRESS: Prestigious synthetic biology award

Professors Richard Kitney (Dept of Bioengineering) and Paul Freemont (Dept of Medicine), were given synthetic biology excellence awards at the SynBioBETA Conference in San Francisco, for founding and directing the UK's national industrial translation centre for synthetic biology, SynbiCITE, at Imperial.

http://bit.ly/IE29-SynBio

DEVELOPMENTS AROUND THE ENGINEERING FACULTY

Suffrage Science Awards

Photo: Imperial College

Professor Julie McCann from Imperial's Department of Computing is among 11 leading female mathematicians and computer scientists celebrated at the Suffrage Science Awards for Mathematics and Computing.

Professor Muffy Calder from the University of Glasgow, 2016 award winner who nominated Professor McCann, said: "Julie is nominated for her novel research on low-powered and sometimes self-managing sensing and control networks, collaborating with a wide range of companies and in diverse application domains such as smart water networks and environmental monitoring. She leads numerous research projects and is a great role model for women in Computer Science."

At the ceremony held at the British Library, winners were presented with handcrafted jewellery, inspired by the Suffrage movement and passed on as heirlooms from one female scientist to the next.

http://bit.ly/IE29-Suffrage
(for this and items below)

Medtech Insight Award

Imperial start-up DNAe, the developer of a breakthrough test for bloodstream infections, was named '*Most Innovative Team or Innovator of the Year*' at the inaugural 2018 Medtech Insight Awards.

The award recognises the team that has contributed most significantly to devices and diagnostics between 1 January 2017 and 31 May 2018. DNAe was chosen for its achievement towards a fast, user-friendly, diagnostic tool.

DNAe's Executive Chairman and founder, **Professor Chris Toumazou,** from Imperial's Department of Electrical and Electronic Engineering, co-inventor of several technologies used in the platform, said: "I'm delighted our achievements have been recognised. Bringing DNA sequencing closer to the patient will arm doctors to make timely evidence-based treatment decisions."


Photo: Imperial College / Thomas Angus

Find out more about the award on the DNAe website at https://www.dnae.com/

Women in Robotics

Dr Laura Margheri, Programme Manager and Knowledge Transfer Fellow at Imperial's Aerial Robotics Laboratory (ARL), has been named one of the '25 Women In Robotics You Need To Know About' in RoboHub's long-running assessment of leading female scientists.

Dr Margheri, who shortly takes up a new role in Italy, supports the development of the scientific program of the ARL, the coordination of multi-disciplinary research projects, and the management of international partnerships. Also, she has covered the role of Chair of the Women In Engineering (WIE) Committee for the IEEE Robotics & Automation Society for 4 years, since 2014.

BioMedEng18

In September, Imperial hosted the UK's largest gathering of biomedical engineers, BioMedEng18, which saw two days of inspiring talks from biomedical engineers, medical engineers and bioengineers.

Chaired by **Professor Peter Weinberg,** from Imperial's Department of Bioengineering, the conference was also held at Imperial in 2008 and 2014, and will be held here again in 2019.

Imperial geologist tackles field trip mental health

Field trips help students and academics explore the environments they study – but some participants suffer mental health difficulties when out on excursions. Though field work is often seen as the highlight of studying or working in natural and earth sciences, the reality can be quite different.

Dr Cédric John, from Imperial's Department of Earth Science & Engineering, is a geologist and mental health champion for his department.

In a *Nature Geoscience* comment piece written with Saira Khan from City University London, he identifies some major obstacles to mental wellbeing on trips, and how they might be overcome. Caroline Brogan, Research Media Officer for the Faculty of Engineering caught up with him to find out more.

Why might field work negatively impact someone's mental health?

The romantic notion of the hardy geologist – one who embraces the elements for months on end and loves the outdoors – can harm individuals who don't fall under the stereotype. It's a great example of big expectations causing harm when the reality falls short.

In addition, working in the field can involve long periods in extreme temperatures, isolation from family and friends, and culture shock. Participants also spend day and night in close quarters with one group of people – so fostering good working relationships within these teams is key.

The main obstacles to mental wellbeing in the field, as identified in our *Nature Geoscience* piece, are the harshness of the environment itself, the quality of leadership, fear of not achieving or of not being good enough ('impostor syndrome'), and the quality of group dynamics.

How can excursion leaders help improve participants' wellbeing?

Leaders in fieldwork-oriented fields should realise that not everyone will enjoy field trips. To prevent harm and improve wellbeing, we recommend that leaders and trip goers:

- Recognise the stress that excursions can have on participants, even if they themselves feel differently.
- Receive training in mental health to help them take preventative steps, notice warning signs, intervene in a crisis, and foster non-judgemental attitudes towards those who struggle.
- Foster a culture of tolerance and inclusivity during field activities, perhaps including being trained in handling conflict, bullying, and other hostile situations.
- Help participants to regularly access their usual support system at home – for example, by planning stayovers at hotels with internet or phone access.
- Keep the length of field activities to a reasonable number of hours per day.
- Ensure opportunities for privacy and 'down time' in the evenings.
- Model healthy behaviours by openly sharing their own challenges and tips on how they overcome them.

Why is good mental health in the field so important?

Mental health issues are common: One in three people will experience a mental health problem in any given year, and nine in ten of those experience stigma and discrimination. These figures are for people in their usual environment, with their usual support systems.

Poor mental health can negatively affect a person's social, academic, and professional life. Improving mental health on campus is thus a major focus of universities, with several initiatives currently


Photo: Imperial College / Jody Kingzett

In April Dr Cédric John was one of the recipients of Imperial's Provost's Awards for Excellence in Health and Safety, established to honour staff at the College whose endeavours have resulted in significant improvements in health and safety over the last year

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ongoing at Imperial such as Mental Health First Aid training.

However, while we promote good mental health on campus, I fear we are neglecting those who travel away from the campus comfort zone, where normal help is less accessible.

Describe some issues you've seen in your own field work.

I teach and conduct research in the field, mostly in North America and the Middle East. I've found stress to be the underlying factor in most cases. It has led to conflict and marginalisation of students. Often, the desert locations we work in play a role, as they are harsh environments. Many times, the stress of the location and being far from home has exacerbated underlying issues like anxiety and depression.

I believe being able to discuss issues openly and honestly can help to stop them building up, which is why mental health training and fostering good relationships and open communication is so important.

Is there anything else you'd like to add?

Students benefit from getting hands-on experience of the environment they're studying, and trips often play a defining role in their professional, and even personal, development.

Like any type of work, the excursions can be stressful – but stress is not always negative. If stress and other potential threats to wellbeing are handled well, then field work can be a positive experience for many students.

With careful planning and training, the academic community can take major steps towards supporting the mental health and wellness of field trip participants at all career stages.

"Mental health in the field" by Cédric Michaël John and Saira Bano Khan, *Nature Geoscience,* 31 Aug. 2018.

http://bit.ly/IE29-John

Photo: Cédric John

Co-authors Cédric and Saira in Wahiba Sands, Oman, Oct. 2017

MP Chi Onwurah, Labour's Shadow Minister for Industrial Strategy, Science and Innovation delivered a lecture on '*The Importance of Diversity in STEM*'

Chi graduated from Imperial in 1987 with a degree in Electrical Engineering. After completing her MBA at The University of Manchester in 2002, she worked internationally as an engineer and consultant, and was appointed as the Head of Telecoms Technology at OFCOM in 2004. Chi was elected Labour MP for Newcastle Central in 2010, and currently serves as the Chair of the All-Party Parliamentary Group on Diversity and Inclusion in STEM.

Over 300 guests consisting of staff and students attended the talk and were given an opportunity to ask Chi questions. We share some highlights from her talk.

During her lecture, Chi described some of her experiences as a Black female engineer, and discussed being aware of the different strands of her identity. Reflecting on her career in telecoms, Chi explained: "I attended many conferences and would present to around 2,000 people in a room – and I would be the only Black woman. Everyone would remember me, but I wouldn't remember them. I was memorable, which has some advantages, but ultimately it was a very isolating and exclusive environment.

"As an engineer, I was often the only Black person in the room, the only woman, the only working-class person, the only Northerner, the only socialist and the only Newcastle United fan! It wasn't the latter that made me feel like an outsider."

Chi also discussed assumptions made about her as both an engineer and politician. She said: "There were many assumptions about Black people, Nigerians, women and Geordies. I faced people's stereotypes, rather than my actual experiences. These were assumptions that people would make explicit through questions such as 'was I really a qualified engineer?' and later when I became an MP 'will you only represent Black people in your constituency?'"

Chi reflected on her experiences as an undergraduate at Imperial, including when racist jokes appeared in a student publication. She said: "I understand from meeting President Alice Gast today and hearing about the launch of the Equality, Diversity and Inclusion Strategy that Imperial has changed hugely since I left," said Chi. "However, it is still important to recognise that these experiences matter as it informs the experience of engineers who are my age, or even younger, in terms of their training. It is one of the reasons why there are fewer female engineers."

Photo: Imperial College

"As an engineer, I was often the only Black person in the room"

As she closed her lecture, Chi spoke about the urgent need for diversity and expressed her views on tech company Apple. "They designed the Health app to ensure it extracted data that would help people's health such as exercise, diet, sleep, temperature and pulse – all the indicators of wellness," explained Chi. "And it did – if you were a man! They forgot about periods. And the reason they forgot about periods is because nobody in the design team had them. This is a visible example of exclusion, but my point is that this is happening all the time in other areas."

She added: "We will never know the fantastic technology we could have. If technology was designed by representatives of humanity, then it would be more humane. Until we have proper representation in parliament, tech and engineering, we can't say we have an equal society."

During her lecture, Chi referenced statistics which revealed that Black engineering graduates had the lowest proportion in full time work (46 per cent) and the field of Engineering has the lowest representation of women in Europe (10 per cent).

Chi took the opportunity to voice the Labour party's Proposals for a National Education Service and diversity charter challenges to ensure diversity is embedded in everyday practice. She told the audience that science and innovation would be at the heart of Labour's Industrial Strategy.

Chi also emphasised the importance of Black History Month and Ada Lovelace Day. "This October, with Black History Month and Ada Lovelace Day – we have an opportunity to hear the stories of those who have invented our world in all its glory and diversity. It is also an opportunity to consider what we want the future and our sector to look like to make UK science and engineering truly diverse and inclusive."

Imperial is marking Black History Month with a College-wide campaign that has taken over digital screens across all campuses. It is showcasing the profiles of Black staff, students and alumni from Imperial, and recognise the inspiring work of pioneering Black scientists past and present.

During Chi's talk, Professor Stephen Curry, Assistant Provost (Equality, Diversity and Inclusion), launched the College's *Equality, Diversity and Inclusion Strategy*, as well as the *Race Equality Charter* survey for staff, which is aimed at improving the representation and success of Black, Asian and Minority Ethnic (BAME) staff and students at Imperial.

Professor Curry said: "Excellence comes in forms that are changing as fast as changes in society. If Imperial is to thrive in a world that has never been more diverse and inter-dependent, we must become more conscious of the benefits that will flow from moving equality, diversity and inclusion to the heart of our institution.

"We want to tap into pools of talent that have been neglected for too long, and to increase the quality, relevance and world-changing impact of our research and education. Our strategy is a call to arms, to everyone at Imperial – staff and students – who believes that the dignity and individuality of every person here should be respected and cherished."

http://bit.ly/IE29-Onwurah

http://bit.ly/IE29-Equality

Imperial's White City Campus

Less than three miles away from South Kensington, at White City, is Imperial's new, ninth, campus. At 23 acres it is similar in size to the South Ken campus, and is promoted as part of the College's long-term programme of growth, providing a "new approach to innovation and entrepreneurship".

The new campus is situated within the White City Opportunity Area, a 272 acre strategic regeneration zone in west London, which is a rapidly growing innovation district capitalising on London's connectedness and economic strengths. Imperial's campus will bring not only a first class reputation but outstanding capabilities in science, technology and medicine. This unprecedented co-location of research, business and healthcare is expected to cement London's position as a leader in scientific development and economic growth.

Imperial's campus will bring together thousands of world-class researchers, businesses and partners from academia, to work, share ideas and turn cutting-edge research into benefits for society. These intersecting disciplines, industries and sectors will be pursuing Imperial's goals to further our understanding of the natural world, solve major engineering problems, lead the data-science revolution and improve health and well-being. The site already hosts more than 70 companies including start-ups and spin-outs.

Construction is well underway at the northern section of the site, north of the Westway (A40), which sits within minutes of Imperial's campus at Hammersmith Hospital. It will support multidisciplinary activity and research in molecular sciences, biomedical engineering and healthcare. This includes the *Translation & Innovation Hub* (I-HUB), the flagship building on the White City Campus and one of the first buildings to be opened on site in October 2016. Construction is also complete on the *Molecular Sciences Research Hub*, which is providing a new home for Imperial's Department of Chemistry, and occupation is taking place on a phased basis throughout the second half of 2018. The *Michael Uren Biomedical Engineering Research Hub*, a pioneering new research centre, is due for practical completion in 2019. Planning is underway to bring *Imperial's School of Public Health* to a brand new building on the north site, providing its talented academics and students with a state-of-the-art hub equipped to address emerging global challenges in health, well-being and disease prevention. Construction of a residential tower hosting 192 apartments, 59 of which are earmarked for key workers, is set for completion in late 2018, with occupation in early 2019. Also on site is *GradPad Wood Lane Studios*, which opened in September 2012, providing accommodation for over 600 of Imperial's postgraduate students.

South of the Westway, the dedicated community engagement hub, *The Invention Rooms*, opened in October 2017 and represents a new and unprecedented approach to community engagement and outreach. This includes the *Imperial College Advanced Hackspace*, a one-stop workshop facility for staff, students and alumni to access specialist prototyping and manufacturing equipment; the *Reach Out Makerspace*, a workshop and design studio for young people from the local community to get hands-on experience of making and prototyping; and the *I-Zone*, an Interaction Zone that consists of a café, events space, and a garden terrace, and will host a diverse range of events and activities between Imperial and the White City community. Centre House and Forest House, both located on the south site, are home to an array of technology companies including start-ups, scale-ups, and globally recognised firms. Also located on the south site will be *ScaleSpace*, a new partnership with venture builder Blenheim Chalcot, will provide 243,000 sq ft of co-location space, where businesses will be able to work alongside leaders in research, translation and innovation. Set to open in late 2019, Scale Space will also house parts of Blenheim Chalcot's existing businesses, as well as spin-outs and scale-ups from Imperial.

> *"Instead of creating an 'industrial park' outside our campus, or a 'community centre' to work with the public, we are, in White City, intentionally opening up our campus to blend these groups from the start. Intermingling in buildings, sharing labs, collaborating on research and educating the new generation of researchers."*
>
> **Professor Alice P. Gast**
> *President, Imperial College London*

Map: Imperial College

Less than 3 miles from South Kensington, the White City Campus site straddles the Westway. Much of the north section of the site is already in use or near to completion.

Photo: Imperial College / Jason Hawkes

Translation & Innovation Hub (I-Hub)

The I-Hub is a new home for innovation and collaboration, designed to attract and support research-based companies working in partnership with Imperial. Operated by Imperial College ThinkSpace, which supports the co-location of knowledge-intensive companies and organisations with Imperial, these facilities are linked to specific research and development partnerships so that collaboration with Imperial is embedded from the start. Working alongside Imperial academics, the organisations on site will develop ideas and translate cutting-edge research into commercial applications for the benefit of society.

The 13-storey building houses modern wet-labs, incubator and accelerator space, as well as flexible office space for major corporate partners, start-ups and fast-growth companies. Businesses are already partnering with Imperial in the I-Hub, including Airbus Defence and Space Division which is a key member of a cluster of Critical Infrastructure specialists being established and led by Imperial's Institute of Security Science and Technology.

Photo: Imperial College

The Imperial White City Incubator

Imperial's White City Incubator, which contains 10 laboratories, office space and meeting rooms, is situated on the ground floor of the I-HUB, and is at almost 100% occupancy.

The White City Incubator is a hub for innovation and entrepreneurship, providing office and lab space and support for early stage deep science companies. The Incubator has supported hundreds of entrepreneurs and future business leaders since opening in late 2016.

The White City Innovators' Programme, run in partnership with NatWest, is the Incubator's flagship pre-accelerator programme for Imperial-based companies and the local community. Over four weeks, a cohort of around 10 start-up founders is coached in areas such as fundraising, team building, IP, marketing, and pitch practice. The Programme culminates in a final pitch event where participants compete for a cash prize and further support from the Incubator.

The White City Innovators' Programme was started as a response to a gap in support available to Imperial alumni and local entrepreneurs. Since the Programme started, 25 young start-ups have gained valuable commercial experience through interacting with industry mentors, engaging with potential customers, and testing their business plans in real life conditions.

Michael Uren Biomedical Engineering Research Hub

Work at the Michael Uren Biomedical Engineering Research Hub will combine the latest medical research and engineering to improve the treatment and diagnosis of diverse medical conditions, from developing new ways to cure dementia, to musculoskeletal technology and even bionic limbs. Made possible thanks to an unprecedented £40 million gift from alumnus Sir Michael Uren OBE and his foundation, over 500 engineers, clinicians and scientists will work together in the new space and facilities alongside spin-out companies. They will conduct research into biomedical engineering, plastic electronics, robotics, autonomous systems and industrial biotechnology to develop new and affordable medical technologies. Just some of the research projects that will find a home in the new building include studies to understand how the central nervous system encodes movements; the development of minimally invasive implants; and research into new materials that help the body to repair itself after surgery or injury.

Due for completion in 2019, the hub will also incorporate clinical areas, providing patients with direct access to innovations in healthcare.

Photo: Imperial College

The Biomedical Engineering Research Hub has been made possible by a donation from alumnus Sir Michael Uren OBE

School of Public Health

We are in a time of exceptional opportunity for transforming public health and Imperial's new School of Public Health will work in close collaboration with colleagues across disciplines and around the world. The School's new home at White City (near to the existing campus at Hammersmith Hospital) will use the power of data and technology to deepen our understanding of disease and create low-cost, scalable health solutions for populations most in need. It will also apply global research to the local community and learn from that community to shape the future of public health around the world.

The Mohn Centre

Thanks to a £25m gift from alumna Marit Mohn, the School will establish the Mohn Centre for Children's Health and Wellbeing, founded on the premise that all children deserve the best chances in life. By preventing chronic disease and infection in the early years of life, we can ensure that future generations have every opportunity to thrive and succeed. It will support pioneering research, education, and community engagement to improve the diagnosis, prevention and treatment of childhood illness on both a local and global scale. Through the Centre, Imperial will draw together its world-leading expertise in child and adolescent health to address challenges such as asthma, childhood obesity, malnutrition and infection. The landmark gift will support the construction and fit-out of the Mohn Centre, as well as the creation of an academic chair in population child health for the Centre's Director.

Molecular Sciences Research Hub

Providing a new research home for the Department of Chemistry, the Molecular Sciences Research Hub is a state-of-the-art facility for chemical and molecular sciences, bringing together synthetic biology, bioengineering, data sciences, technology and health research. Up to 800 scientists, clinicians, engineers and commercial partners will collaborate under one roof in a way that they have never been able to before, conducting world-changing research in imaging, sensing and analytical chemistry; advanced catalysis and synthesis; and molecular design.

It also looks to become an international centre for public and political engagement with science including a home for high-profile public lectures and an art-meets-science exhibition space.

Photo: Imperial College / Fergus Burnett

The Invention Rooms

Photo: Imperial College / Jody Kingzett

The Invention Rooms is a dedicated space for innovation and the community in White City. Under one roof, the College's inventors and entrepreneurs make use of specialist prototyping equipment, while local people of all ages and backgrounds can build things, learn coding, develop digital skills and turn their ideas into working prototypes using workshops, design studios and interaction spaces. 'Making' programmes held at the building challenge young people to channel their creativity into ambitious projects, and encourage the next generation of scientists and inventors in White City. The Invention Rooms include the Reach Out Makerspace, The Imperial College Advanced Hackspace, and the I-Zone café and event space.

Alumna Marit Mohn and her Mohn Westlake Foundation, gave £4m to help establish and support The Invention Rooms.

Advanced Hackspace

The Lu Ban Metal and Wood Workshop

The Hackspace is a unique network of workshops, labs and co-location spaces housing prototyping technologies, bespoke and commercial, in one of the largest such facilities of its kind in the world. In these creative facilities, Imperial staff, students and commercial partners from different disciplines have access to specialist prototyping and manufacturing equipment, from robotics and digital technology, to synthetic biology and molecular fabrication. Here they can work together to rapidly convert research ideas into breakthrough prototype products and solutions.

The Lamarr Challenge Room

The Helen Porter Biohack Lab

Photos: Imperial College / Thomas Angus

Lifecradle

Malav Sanghavi is the founder of LifeCradle, a low-cost neonatal incubator which he developed as an Imperial student at the Advanced Hackspace. The incubator is 90% cheaper to produce than current models and provides the basic functions necessary for a child's survival in their first days of life.

Working with the local community in White City

"Imperial has an opportunity to bring something new and empowering to a diverse and enterprising community, of which we are proud to now be an integral part."

Professor Maggie Dallman

Vice-President (International) & Associate Provost (Academic Partnerships), Imperial College London

Imperial is committed to making a positive impact in White City by working in partnership with neighbours to create new opportunities, unleash local talent and make a difference in areas such as education, employment, enterprise and health.

The College's vision is to combine the skills, talent and insights of local residents, businesses and organisations with the expertise of Imperial's students, staff, partners and friends. The plan is to be a long-term partner in the community that brings people together to find solutions to both local and global challenges.

This means building a campus that is inclusive and engaging, with a programme of regular events, projects and pop-ups at neighbourhood festivals and fun days that help to share the wonder of science and technology with the local community through creative, hands-on activities.

What the Tech?

What theTech? is a digital literacy programme founded by Imperial students, which invites elderly White City residents to get help with their computers and gadgets. At weekly sessions elderly members of the local community can bring along their electronic devices – such as smartphones, tablets and laptops – to get help and support from Imperial's student volunteers. Students help with a range of different skills, from how to send photos and videos, to how to download apps, as well as advising residents how to be safe online.

Supporting Change

Imperial is working to support local people develop their professional and leadership skills with programmes like *Agents for Change*, a collaborative initiative aimed at boosting the confidence and ambition of women living in the local area and laying the foundation for a new women's leadership network.

Photo: Imperial College / Jody Kingzett

Smart Baby Buggy

Ramona Williams from Fulham shared her idea, for a smart buggy to help visually-impaired people, with Imperial's community engagement team, who pitched it to the College's Department of Bioengineering as a student project. 10 Students were interested and turned it into reality.

The modified buggy uses a combination of ultrasound and LIDAR sensors to get a 180-degree wide field of hazard perception. These signals are gathered by a processor in the base of the buggy, and then out to vibration motors in the handlebar. Through different types of vibrations, the designers have created a touch-based – or haptic – language for communicating to the user when they are approaching hazards.

The buggy has a cradle in its base for holding the user's smartphone to gain information about the ground ahead of the buggy. By installing an app designed by the team, the smartphone can recognise various landmarks such as braille bumps, corners, and drop-offs, and inform the user via headphones.

The buggy also has a bracket for holding the user's cane, and a bright yellow 'Visually impaired parent' sign on its front to inform oncoming traffic and people.

Photo: Imperial College / Thomas Angus

Reach Out Makerspace

The Makerspace is a specially designed workshop and design studio for people from the local community to get hands-on experience of prototype development – using 3D printers, laser cutters, and wood and metalwork machinery, as well as equipment for craft and textiles. It is here that Maker Challenge programmes give young people the opportunity to make anything from wearable technology to household gadgets.

The Makerspace is open to people of all ages from the White City community

Maker Challenge Grand Final, March 2018

Lumi Lamp

As part of the Maker Challenge, Maddena Hadafmand from Phoenix Academy designed the Lumi Lamp, a nightlight which could monitor breathing and movement to sense when a person falls asleep, and automatically switch off when a state of deep sleep has been achieved. The 12-week programme is open to 14-18 year-olds from schools in the White City area and runs throughout the year, with programmes during each school term and in the summer holidays.

Photos: Imperial College / Thomas Angus

aBLE in Pondicherry

Zoë Slattery is a student in the Department of Electrical & Electronic Engineering who chose an unpaid project in India for her summer placement this year, helping to develop a mobile phone application to assist women and girls who are being sexually harassed. She told us about the need for the app, the company she worked with, and what her work experience was like.

Background

Despite recent introductions of legislation concerning sexual violence, female education and gender equality, India was still voted in a recent poll as the "worst G20 country in which to be a woman" (Amnesty International, 2018)[1]. aBLE is focusing on the issue of public sexual harassment within Indian communities, and the role that technology can play in preventing and reporting such incidents. Five years after the brutal Nirbhaya case, in which a young medical intern was gang-raped and tortured in a moving bus in South Delhi (Bandyopadhyay, 2018)[2] – which caused global shockwaves and condemnation of Indian authorities – 79% of Indian women still report having experienced some form of public sexual harassment or violence. aBLE is working to create an app which can be used to safely and efficiently report uncomfortable public situations before they escalate.

Following the Nirbhaya case and the subsequent increase in reporting of public sexual harassment, several female protection apps such as 'Watch Over Me', 'Circle of 6' and 'Himmat' emerged globally as methods of reporting incidents. These generally took the form of creating an alarm which alerted either phone contacts or the emergency services. Some included extra features such as a loud noise, scream detection activation, tracking services or video recording of the incident, however none have taken hold in the Indian market. At aBLE they believe there are two main reasons for this. Firstly, the logistics of alerting only phone contacts is not feasible. It is unlikely, especially for women travelling alone, be they students or professionals, that their family and close contacts will be at a nearby location when an incident occurs. Secondly, the motivation to use such technology only directly extends to the women themselves, and other incentives should be created for an expanding user base.

The unique selling point of aBLE is that it works on creating safer communities, rather than safer individuals. Instead of the current approach of using only individual phone contacts, aBLE targets small neighbourhoods in which trusted, vetted community members can act as 'superheroes'. These members will be alerted when an incident occurs within a certain radius of their location. This approach works well in the target communities, generally smaller villages, which tend to have a high level of community cohesion due to their close-knit, familiar nature. aBLE also provides an incentive for community members other than women who feel vulnerable to sign up, by creating aBLE-certified harassment-free neighbourhoods. These will in turn create a closer community, increase safety and increase values of businesses and properties within the area.

"We are playing with the dignity of women. Respect for women, their security – this should be the priority for all 1.2 billion people in India." **Narendra Modi,** *Prime Minister of India*

Placement

My main role in this industrial placement was as the technical lead software engineer in charge of furthering progress on the app itself. In addition to this however, due to the small, start-up nature of the company, it was necessary to take on several different roles and responsibilities. These included organising part-time programmers, interviewing graphic designers, producing grant applications, creating marketing materials and performing feasibility studies for the company's future. This breadth of duties was initially difficult to handle as it involved a high level of personal responsibility and self-organisation.

This industrial placement was an amazing experience filled with opportunities for personal growth. It was by no means, if such a thing exists, a conventional work experience. There were a huge number of challenges, which made completing work to pre-defined timescales and co-ordinating with other members of the team difficult or at some times impossible. However, I have been given a unique and useful glimpse into the industry of humanitarian engineering, the sector in which I hope to work in the future. I have learned a huge amount about my own work ethic and practice, and about the management of a humanitarian social enterprise.

Sources:

1. Amnesty International, (2018), "The Worst Place to be a Woman in the G20", [online], Available at: http://bit.ly/IE29-Amnesty, [1 June 2018]
2. Bandyopadhyay, Sujan (2018) "A Closer Look at Statistics on Sexual Violence in India", [online] Available at: http://bit.ly/IE29-TheWire, [1 June 2018]

aBLE is currently recruiting new members looking for projects either in programming, testing or social research. Students (or alumni) who are interested can contact Zoë (zs3815@ic.ac.uk)

Hi! My name's Zoë and I'm studying Electronic Engineering at Imperial. I've always been passionate about how engineering can be used for humanitarian purposes, and have worked with organisations such as **Engineers without Borders** and **aBLE** to learn more about this. In the future I plan to make this my full-time career and work in sustainable, international development engineering. My project in India was an amazing learning experience for me and one I'd definitely recommend to anyone interested in the same area!

CivSoc International Tour

On Saturday March 24th, 70 Civil Engineering students from Imperial gathered together in Beit Quad for the beginning of what became a spectacular tour to Belgrade, Serbia. The tour was supported by, amongst others, the OC Trust. This article is based on the tour report written by Hippolyte Mounier-Vehier, the CivSoc International Tour Officer 2017-18.

Photos courtesy of CivSoc

Saturday: Travel to Belgrade

Each student was given their official tour jumper and a copy of the Tour edition of Livic. (Livic is the official CivSoc magazine). Everyone was excited to start the holidays after a long and hard-working spring term.

A coach was hired to bring the group to Luton Airport so we could catch our flight to Belgrade. Once we had arrived in Belgrade, everything went smoothly at immigration and another bus was ready to pick us up and bring us to our hostel.

The trip was long and we arrived at 2 am at the hostels. The group was split between two hostels, one with 52 people and another with 18. Overall the hostels were of good quality and had excellent service, helping us with any problems we had. After such a long trip the group was happy to get some rest before the early wake-up the next day.

Sunday: Walking Tour

Sunday's main activity was a walking tour around the centre of Belgrade. We woke up to crisp temperatures but beautifully sunny skies. Three guides picked us up from the hostels and showed us where to exchange money and get breakfast before starting the tours.

Our hostel was situated next to Trg Republike (Republic Square) where the tours began. We were guided down to Skadarlija, the bohemian quarter: cobblestone streets lined with Kaffana restaurants and fun bars. Here we were given some local spirit 'Rakija' to taste. We were then guided through the streets of the city towards the Belgrade Fortress. We witnessed the rich culture and mix of architecture present in Belgrade; Western and Eastern influences and Soviet buildings are all mixed together. We were also shown the only mosque in Belgrade. The tour finished at the fortress which gave us great views of the city, and the Danube and Sava confluence. The guides kindly indicated the different monuments that are printed onto our Tour jumpers.

Once the walking tour was complete, the group was given the afternoon off to explore the city. Many groups went for lunch in restaurants recommended by the guides to try Serbian specialties such as Cevapi.

to Belgrade March 2018

Monday: University and Site Visits

Monday was likely the most important day of the week with our two biggest activities. Everyone woke up bright and early in order to walk to the University of Belgrade from the hostel at 9 am. We were kindly greeted by Igor Uzon, the president of the civil engineering Student's Parliament (equivalent of CivSoc). We were guided into a very well decorated hall where we were given several presentations.

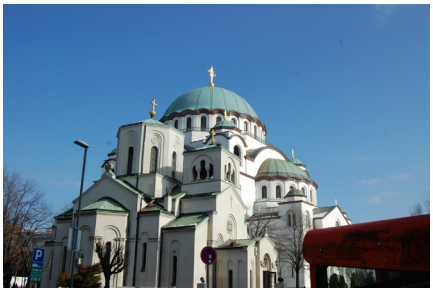
First of all, we were warmly welcomed by the Vice Dean of Engineering. Then Igor gave us some presentations about the civil engineering faculty in Belgrade as well as some examples of the key engineering projects of Belgrade: the Ada Bridge, and the Belgrade Waterfront.

We were also given a presentation about the Student's Parliament and the work they do. To finish off, I was given the opportunity to present Imperial College to our hosts, and I had prepared a PowerPoint presentation for this in advance.

We then visited the Faculty building and were kindly provided with a buffet lunch, which was a pleasant surprise. Our visit finished with a guided tour of the Fluid Mechanics and Hydrology lab. Our guide gave a tour to each year group separately giving explanations of corresponding difficulty.

We had time to spare before heading to the site visit, our hosts therefore walked us down to the Saint Sava church which is still under construction and is one of the biggest churches in the world. It was impressive to see such monuments still being built today and we were given a glimpse of the interior being built. The crypt was finished and had remarkable frescoes on the walls and the dome has an impressive mosaic.

Afterwards, we walked to the Belgrade Waterfront, one of largest developments in Europe. We were welcomed by the HR team onsite, who showed us very detailed models of the final project, giving us a good understanding of what the final waterfront will look like. We received a good explanation of the project and they were very good at answering our questions about the site and the project which has caused a lot of controversy among the Serbian public. As we were such a large group it was deemed unsafe to let us approach the active works too closely, we were able to walk around the perimeter of the site and we were shown key parts of the construction.



Saint Sava church, the largest Serbian Orthodox church, dominates the Belgrade skyline and has a magnificent dome and beautiful crypt

Museum of Contemporary Art, Belgrade

Tuesday: Free day

Tuesday was designated as a free day giving the students freedom to go and visit the sites that were not included in the walking tours. Everyone in the group was up in good time to make the most of the day. Different groups explored different areas including the nearby municipality of Zemun, as well as the various museums. The waterfront was pleasant to walk along and gave a great view of the city from across the river.

Wednesday: Novi Sad

The final full day was reserved to visit Serbia's second largest city, Novi Sad, about 80km from Belgrade. The early wakeup was not easy but it was worth it as Novi Sad was a lovely town and the beautiful weather made it a very special day.

This city had well preserved architecture and the group wandered through the streets and headed towards the fort on the other side of the river. The fort provided wonderful views and most of the group settled down for some lunch in the sun. Everyone was happy to discover this city and to enjoy the relaxed mood in the pedestrianised streets.

The coach brought the group back to Belgrade in time for the end-of-tour dinner, which was held at the Tri Sesira restaurant.

We enjoyed a local Serbian meal as well as live music and some entertainment from a few of our students. Our hosts from the University of Belgrade joined us to celebrate the end of Tour and remember the great week we had spent.

Thursday: Last look then back to London

The students were given a free morning to enjoy the last few hours in Belgrade, and tick off the last items on their lists.

The trip back to London was smooth and despite our flight being delayed 30 minutes we arrived back in the Beit Quad before 11pm on Thursday Night. It was hard saying good bye to everyone after being together almost nonstop for 5 days. The feedback was very positive, everyone who came is already excited for next year's tour, wherever it may be.

Thank you

The organisation of this tour would not have been possible without the help of many people. First of all I would like to thank the CivSoc Committee for helping me throughout the year, in particular Susie McAllister, who organised last year's tour to Lisbon.

I would also like to thank the generous sponsors that helped make the trip affordable to all students. We received generous help from the Civil and Environmental Engineering Department of Imperial, the Old Centralians' Trust (CGCA), the Imperial College Union, Robert Bird Group, and Vinci.

On behalf of CivSoc and all the students who attended, we would like to say thank you and we hope our partnerships will continue into the future.

Wednesday was spent in Serbia's second largest city, Novi Sad, about 80km away from Belgrade

Geothermal heat and climate variability

This article is based on a talk by Professor Wyss Yim (Geology 1971-74) to the Global Warming Policy Foundation in Westminster, London on August 29, 2018.

Geothermal heat released through terrestrial and submarine volcanic eruptions is an underestimated cause of natural climate variability. Satellites since the early 1980s and ARGO ocean profiling floats since the early 2000s are providing observational records that enable us to study the influence of geothermal heat on regional climate. Both cooling and warming of the atmosphere and the hydrosphere as well as severe weather events can be caused by volcanoes. During large terrestrial eruptions, high plumes inject ash and sulphur-rich particles into the troposphere and stratosphere causing warming initially, followed by cooling. Large amounts of gases including carbon dioxide can also be released into the atmosphere. Lavas flowing into oceans warm the seawater below the surface. Studies based on observation records have shown that the natural release of geothermal heat was responsible for recent climate change including the long-lasting 2014-2016 ENSO (El Niño–Southern Oscillation) and Arctic sea ice variability during the past decade.

Monsoons are a major type of regional climate variability caused by the solar heating of continental land masses distributed in the northern and southern hemispheres. Other smaller less well-known regional climate variability includes the Arctic Oscillation, the North Atlantic Oscillation, the Madden-Julian Oscillation, the Pacific Decadal Oscillation, the Quasi-Biennial Oscillation, the Indian Ocean Dipole and the Southern Annular Mode. They represent pressure changes which may be triggered by volcanic eruptions in combination with other factors including the sun.

Three models of volcanic eruptions with variable amounts of geothermal heat contribution can be identified. They include:

(1) Terrestrial/sub-aerial model

The main features of the terrestrial model are shown in Figure 1 below. This type of eruptions switches on hot air initially followed by cooling. The injection of ash, gases and aerosols causes: shortwave radiation blockage; pressure changes; moisture redistribution; continental cooling; ozone depletion; circulation changes including changes to jet streams, and severe weather events. Lava flows entering oceans may be an additional cause of warming. For measurement, the Volcanic Explosivity Index – a scale ranging from 0 to 8 based on the volume of erupted tephra – is used.

(2) Submarine model

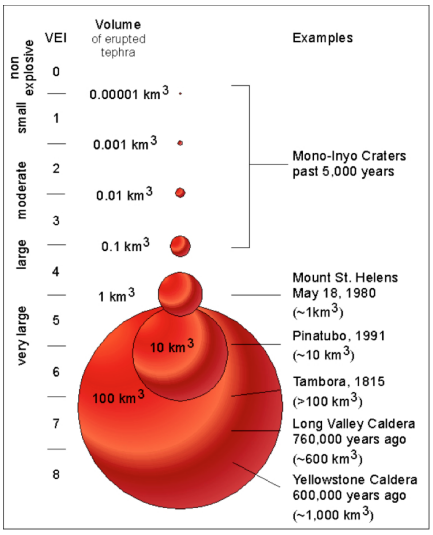
The main features of the submarine model are shown in Figure 2 below. This type of eruption switches on hot seawater causing: ocean warming; pressure changes; circulation changes including changes to jet streams; moisture redistribution; continental warming, and severe weather events. No scale is available for measurement at present.

(3) Mixed submarine and terrestrial model

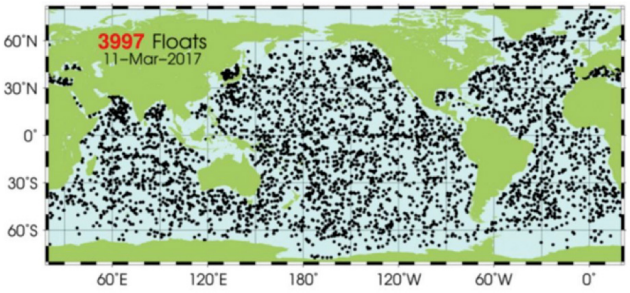
This type of eruptions is initially submarine and later terrestrial following the birth of new volcanic islands rising above the sea level. Their impacts on weather are a combination of (1) and (2).

Satellites were first used for tracking volcanic eruption clouds in the early 1980s. In 1982, the first study was made on the VEI 5 eruption cloud arising from the El Chichón volcano in Mexico. The debris injected into the stratosphere took 21 days to circle the globe and was responsible for the second wettest year in the city of Hong Kong since records began in 1884, caused by the predominance of onshore wind during the year. Currently NASA's A-train satellites are equipped with CALIOP (Cloud-Aerosol Lidar with Orthogonal Polarization) for the vertical profiling of volcanic eruption aerosols.

Since the early 2000s. the ARGO global array of ocean profiling floats for the observation of temperature, salinity and currents to a depth of 2000m below sea level became available. Because of this development, the occurrence of submarine



The Volcanic Explosivity Index (VEI) used for the estimation of terrestrial volcanic eruptions. Source: Newhall and Self (1982)



ARGO global array of ocean profiling floats. Source: NOAA.

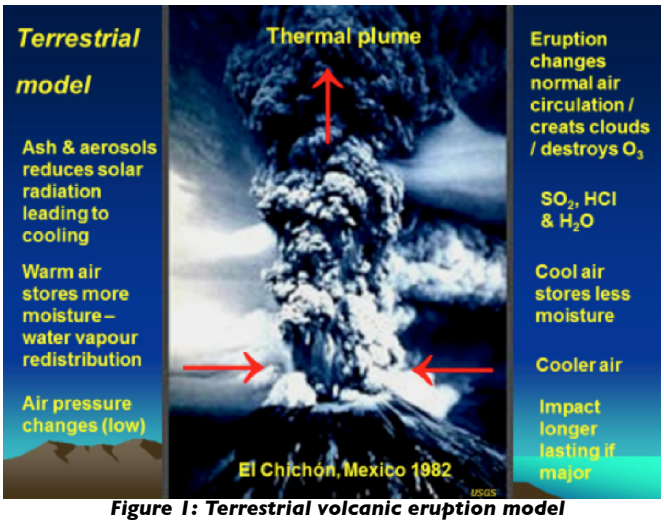


Figure 1: Terrestrial volcanic eruption model

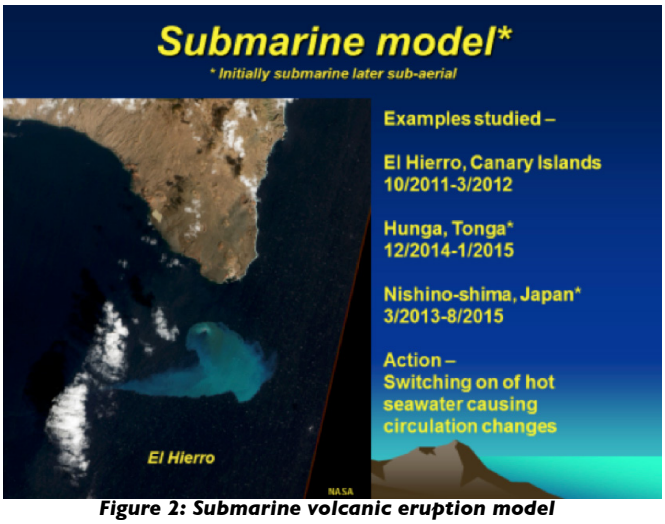
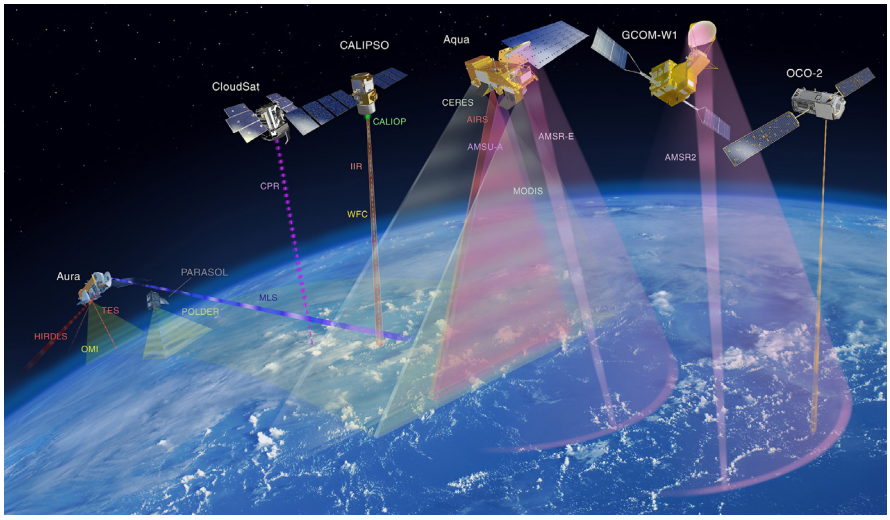


Figure 2: Submarine volcanic eruption model



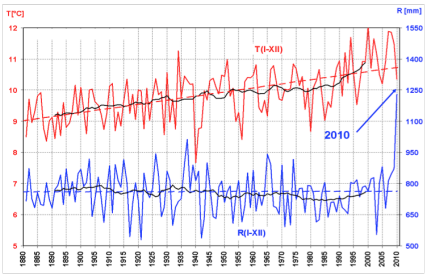
NASA's A-train including CALIOP used for the vertical profiling of volcanic eruption aerosols. ***Source: NASA.***

volcanic eruptions can now be detected much earlier.

2010 Eyjafjallajoküll eruption and extreme rainfall

The VEI 4 Eyjafjallajoküll 2010 terrestrial eruption in Iceland lasted 39 days from April 14, 2010. Based on the recommendations of the London Volcanic Ash Advisory Centre, the civil aviation authorities made decisions on airspace closures and opening. By April 21, 2010, 95,000 flights had already been cancelled.

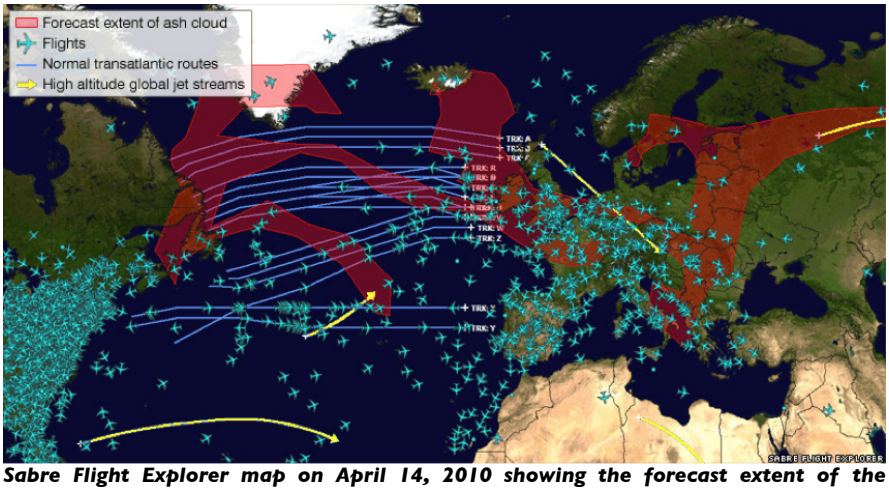
A poorly known severe weather impact caused by the migrating eruption cloud into central Europe was the record heavy rainfall and the widespread disastrous flooding. In the weather map of Europe based on satellite analysis on April 29, 2010, successive occluded cyclonic frontal systems transporting Eyjafjallajoküll eruption aerosols penetrated deeply into the continent via Scandinavia. This was responsible for torrential rainfall and severe flooding in Slovakia Republic, Czech Republic, Poland and southern Germany. Most severely affected was Slovakia Republic where a new record for annual rainfall was set in Hurbanovo since records began in 1881.



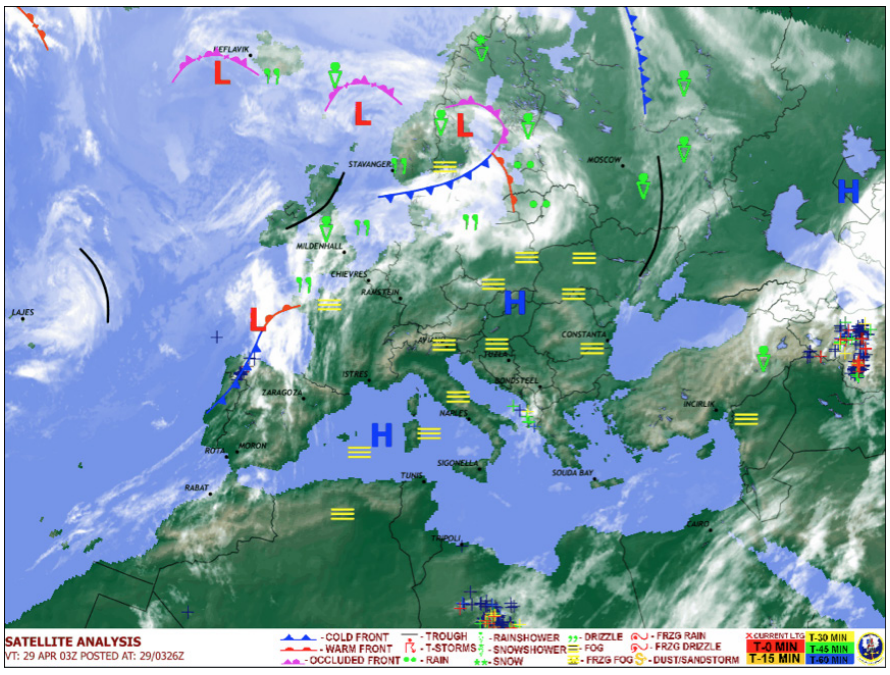
Annual temperature (red) and annual rainfall (blue) record from 1881 to 2010 in Hurbanovo, Slovakia Republic ***Source: Pecho et al. (2010)***

Climate variability

Notable climatic events caused by volcanic eruptions examined by the author in past issues of Imperial ENGINEER are summarised in the table overleaf.

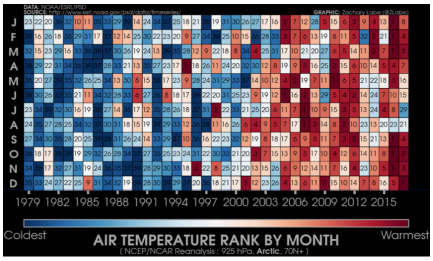


Sabre Flight Explorer map on April 14, 2010 showing the forecast extent of the Eyjafjallajoküll eruption ash cloud, flights and the normal transatlantic routes

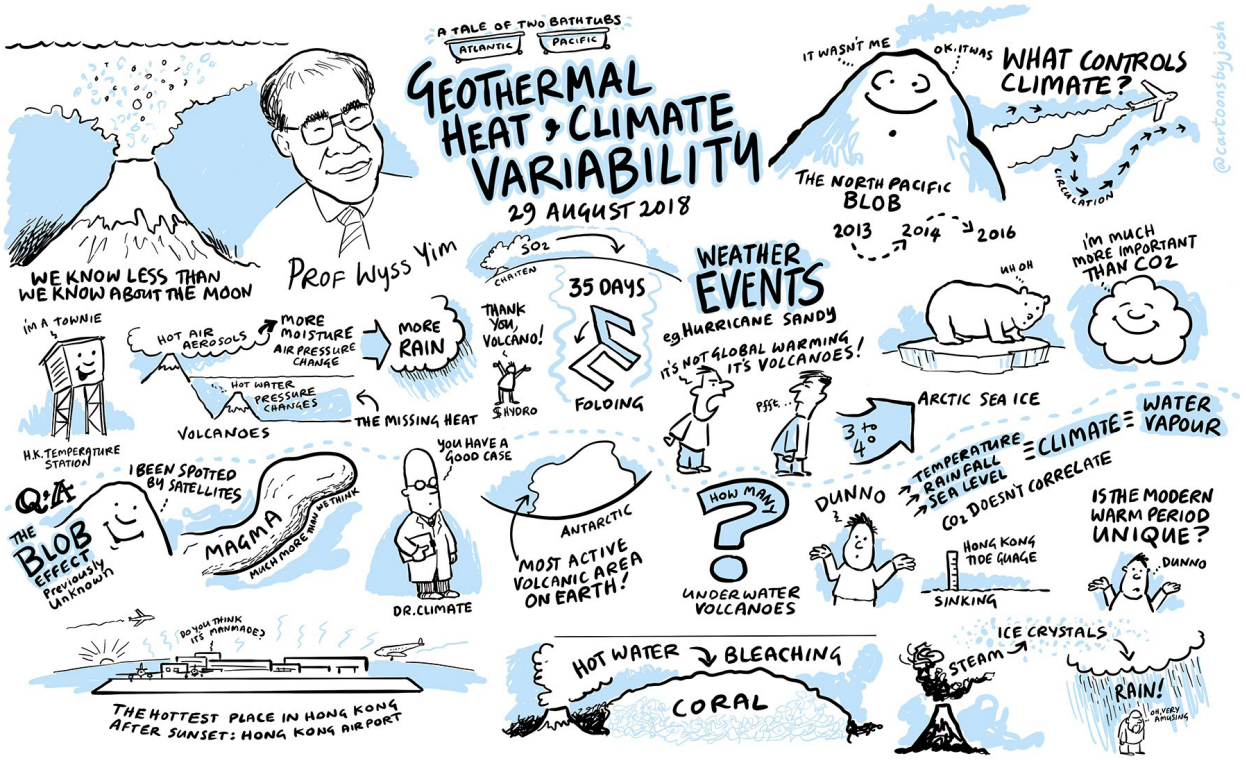


Weather map of Europe based on satellite analysis on April 29, 2010 showing successive cyclonic frontal systems transporting Eyjafjallajoküll eruption aerosols including ice crystals penetrating deeply into the continent via Scandinavia causing torrential rainfall and severe flooding. ***Source: USAF***

Based on the National Oceanic and Atmospheric Administration (NOAA), the past four years have been the hottest in modern history with 2016 the hottest, 2015 the second hottest, 2017 the third hottest and 2014 the fourth hottest. This rising global temperature trend appears to be in support of the Arctic temperature rank by months from 1979 to 2017. However, based on the release of geothermal heat into the North Atlantic Ocean by the El Hierro submarine eruption from October 2011 to March 2012 and into the North Pacific Ocean by the Nishino-shima eruption from March 2013 to August 2015 (initially submarine and later terrestrial),



Arctic air temperature rank by month 1979-2017 ***Source: NOAA***



A cartoon illustrating selected topics covered by the talk **© Cartoons by Josh www.cartoonsbyjosh.com.**

this has provided the better explanation in agreement with the observational records including NOAA's global maps of sea-surface temperature anomalies, NASA's ocean surface topography and the National Snow and Ice Data Center's record of Arctic sea ice changes. While global temperatures have been rising in the past decade, the identified driving force was two episodes of ocean warming caused by the natural release of geothermal heat into the North Atlantic Ocean and into the North Pacific Ocean. The possible explanation for NOAA's ten globally hottest years, their connection with volcanic eruptions and ENSOs can be interpreted as shown in the table below.

Rank	Year	Possible explanation
1	2016	ENSO conditions and North Pacific Blob dissipation
2	2015	ENSO conditions and North Pacific Blob
3	2017	Unrelated to ENSO
4	2014	ENSO conditions and North Pacific Blob
5	2010	El Hierro eruption causing North Atlantic Ocean warming October 2010-March 2012
6	2005	–
7	2013	Nishino-shima eruption causing North Pacific Ocean warming March 2013-August 2015
8	2009	–
9	1998	ENSO conditions
10	2007	–

Summary table of NOAA's ten globally hottest year and their possible explanation

Conclusions

The conclusions drawn include:

1. Terrestrial and submarine volcanic eruptions are underestimated natural causes of climate variability.
2. The study of observational records has revealed a connection between severe weather events and volcanic eruptions.
3. Water vapour/cloud distribution in the atmosphere is much more important than carbon dioxide in climate variability.
4. Volcanic eruptions can be the cause of both abnormally dry and abnormally wet years.
5. Possible contributors to the strong and long-lasting 2014-2016 ENSO include the Nishino-shima eruption during March 2013 to August 2015, the Hunga eruption during December 2014 to January 2015 and the Wolf eruption during May to June 2015.
6. Climate models can be improved by considering the impact of multiple volcanic eruptions on circulation changes.
7. The missing heat attributed to carbon dioxide storage in oceans may be better explained by geothermal heat released through submarine volcanic eruptions.
8. Volcanic eruptions are natural experiments for us to learn from.

Notable climatic event(s)	Volcanic eruption(s)	IE Issue
Torrential rainfall in South Africa, Australia & southern China including Hong Kong's worst rainstorm on June 7, 2008	Chaitén, Chile	IE12, pp10-11
Global drought year 1991	Pinatubo, Philippines	IE14 p10
Numerous impacts in 2012 including Hurricane Sandy, UK floods & record low Arctic sea ice	El Hierro, Canary Islands	IE19 pp12-13
Disastrous 2010 winter storms in Madeira & France (Xynthia)	Montserrat, Caribbean	IE24 p19
North Pacific Blob 2014-2016	Nishino-shima, Japan	IE25 p15
ENSO 2014-2016 & Great Barrier Reef coral bleaching	Nishino-shima, Japan; Hunga, Tonga; Wolf, Galapagos	IE26 pp14-15
Record low Arctic sea ice 2012 & gradual decline in Arctic sea ice 2014-2016	El Hierro, Canary Islands; Nishino-shima, Japan	IE28 p26

Summary table of climatic event(s) involving volcanic eruption(s) examined by the author in past issues of Imperial ENGINEER

Professor Wyss Yim DSc PhD DIC FGS was at Imperial College in the Department of Geology from 1971-1974. After that he spent 35 years until retirement at the University of Hong Kong where he taught civil engineering, geosciences and environmental management students, and, helped found the Department of Earth Sciences. He was awarded the DSc by the University of London in 1997. Wyss served as the Deputy Chairman of the Climate Change Science Implementation Team of UNESCO's International Year of Planet Earth 2007-2009.

Of Steel, Aluminium,

On a recent trip to Europe (see also Alumni News) Nigel Fitzpatrick (Metallurgy 1962-65, 65-68) was moved to wonder about the fuel used by the cruise ship on which he was travelling and reminded of the COP21 conference as he looks forward to COP24. Here he tells us about the trip and the ship in his own inimitable way of combining a travelogue with a deeper message.

Steel

Just before the 21st 'Conference of the Parties' in Paris (COP21), an article in IE23 compared the impact of lighter vehicles with the direct reduction of iron ore using natural gas to reduce the use of metallurgical coal, as steps towards holding global average surface temperature to a rise of 2°C by 2050. Directly reduced iron (DRI) can replace blast furnace produced pig iron in electric arc furnaces melting steel scrap. The 5% of global GHG emissions the steel industry contributes to global emissions can at least be reduced, if everyone agrees. DRI gives better margins than pig iron when scrap is to hand.[1]

Aluminium and Ships

Alcan's Banbury works (whose aluminium products had been key to the Spitfire) hired me out of RSM in October 1968.[2] Their preceding 'remelt metallurgist' joined the start-up of the coal-fired power smelter at Lynemouth. The deep end plunge began a quarter-century of fuel reduction, process improvement and energy product development which included helping Alcan move away from No 6 (Bunker C) fuel in Quebec, recycling the 'used beverage can' and launching lower carbon vehicle products. My clean transportation and energy role continued on at BC Research Inc advising even BC Ferries and the aforementioned Lynemouth coal-fired power station a little, before departing with Azure Dynamics Inc, to conclude as a volunteer at Vancouver Airport, grandfather etc.

With time whittling our walking range and as a heat wave began to encircle the globe, July 2nd 2018, found Joan and I on a cruise ship, *MSC Preziosa*. We wondered what fuel was used as we looked at the children's play area close to the stack.

We were on our way (with approx 5,600 others including crew) to St. Petersburg via Stockholm and Tallinn returning via Kiel to Copenhagen, Hanseatic trading ports all.

Shipping of all sorts is responsible for roughly 3% of global CO_2 and GHG emissions (CO_2-eq) and we wondered about the overall situation.[3] Ships are registered in jurisdictions that keep rules brief and fly the so-called 'flags of convenience'. However there are 197 parties to the Paris Agreement and 181 have ratified to date.[4] For once these registries are surrounded, as evidenced by this text: "*The International Maritime Organization (IMO) adopted in April 2018 an agreement that aims to reduce GHG emissions by at least 50% by 2050 compared with a 2008 baseline.*" [5]

"– we believe it is imperativeto maintain flexibility in designing energy supply policies and to restrict the build up of carbon dioxide to a prudent level" IIASA 1981

Energy in a Finite World: Paths to Sustainability
1981 International Institute for Applied Systems Analysis which was formed after six years discussion between USSR and US

Liquefied Natural Gas is a step towards clean air. We learned that MSC who were carrying us will have five LNG ships in their fleet built by 2026.[6,7] Ferries are like cruise ships as they are more under the public eye than commercial vessels.[8] BC Ferries, claiming LNG leads to lower costs, have four LNG-powered ferries in service and a fifth being converted. Three of these are from Poland as are the two conversions.[9] Particulates will be usefully reduced. However, Natural Gas is not enough to meet the IMO and Paris objectives. These may "only be possible with a switch to non-fossil fuel sources (hydrogen, ammonia, battery electrification, biofuel) from 2030" according to another opinion.[10] MSC uses GE electric motors receiving power from engine-driven generators for propulsion. GE is exploring onboard coupling of gas and steam turbines as already done for many years in stationary power generation.[11] A pilot system is on board a Korean ferry fueled with liquefied petroleum gas LPG.[12] GE hail the fuel flexibility of turbines and so are penciling in a route to blending with or switching to

MSC Preziosa

Market Square in Tallinn, Estonia, where a town hall was mentioned in 1322

Photos: Nigel Fitzpatrick

Ships and a Climate Lens

Passing through the S-1 gap in the tidal barrier that crosses the Gulf of Finland

Global brands in St Petersburg.
Joan is with Julia who was our guide. We each had an ice cream bought at the little stand you can see which was running a small generator to keep things cool. I walked back to take the photo and two leather-jacketed folk passed me. Then I saw the Harley and stepped back a little more.

carbon-free or biofuels, as available.

We stopped at Tallinn in Estonia and learned about medieval trade and the Hanseatic ports. Sea coal from Northumberland may well have then flowed past Poland to Estonia.[13] Memory of a meeting at Lynemouth power station surfaced. Costs of local deep-mined coal were rising and surface-mined coal from Poland had just been delivered for a trial.[14]

Next morning we woke up in St. Petersburg having missed some ocean engineering going in. But we did get a view of it from our starboard cabin an hour after leaving St. Petersburg that evening.[15] Visible from space, a 25km tidal barrier crosses the Gulf of Finland with Kotlin Island at its centre. Embankment dams and sluice gates are interrupted by two navigable openings for shipping. The picture here is from the starboard side of *MSC Preziosa* as we passed through the 200m wide closable gap known as S-1. A ring road around St Petersburg runs along the embankments and tunnels under at this point.

A space traveller seeing S-1 might think we know how to handle tides and climate change.[16] Once the traveller is on the ground in St. Petersburg brands seen elsewhere will be spotted. It may be deduced that our species does not always make decisions logically even when we know what to do numerically.

At Kiel we docked with a view of the German Naval Shipyards. Thyssenkrupp advertise submarines assembled there. They offer silent underwater range extension using hydrogen fuel cells. This range extension option can be bought with the submarine or added later.[17] Sweden's Saab offers a quiet Stirling Engine for a similar purpose.[18] These energy conversion technologies are just samples of the many that are ready to expand if the commercial environment were to change; for example with a tax on carbon.

German Naval Yards at Kiel including Thyssenkrupp submarine assembly yard

A Climate Lens

Returning to 'warmer than usual' Canada we attended a discussion on a proposed new train connection between the University of British Columbia and Vancouver. We learned about newly minted rules for such projects from our MP.[19] Federal infrastructure funding awards will henceforth be reviewed with a 'Climate Lens': Climate guidelines that put numbers to mitigation and adaptation contributions made to 2050 targets. Engineers and urban planners are empowered to sign off on the methodology and different points of view will be as one. Canada may bring this example of quantitative federal legislative management to the 24th Conference of the Parties in Katowice, Poland in December.

COP 24 is a chance for climate change mitigation. Let's hope the venue gives delegates and leaders present the courage and skill that Poland brought to an earlier stand for civilization, when it provided the largest contingent of non-UK pilots in the "few",[20] including the highest scoring Hurricane squadron with lower than average losses.[21]

BC ferries

In September Joan and I were attending a Rio Tinto Aluminium retiree lunch in Victoria. The speaker was the General Manager of the Rio Tinto aluminium smelter in Kitimat. I've been a retiree for 25 years and this was my debut!

We came from Vancouver on the *Spirit of British Columbia*, which has been converted to LNG. To be sure we were really using natural gas I went to the 'Chief Stewards office' and the youngest of 4 there confirmed that we were running on LNG, all was going well and saving approximately $15,000 per day (off the record probably).

Port of Vancouver has 27 terminals. When you board at Tswassen you are just south of the most southerly Deltaport where coal is loaded for export.

Containers ship from Deltaport also. By chance an MSC container ship was loading containers as we we left.

Joan and Nigel on the Spirit of British Columbia from Vancouver to/from Victoria

Notes

1. http://bit.ly/IE29-DRI
2. Tom Warren, BBC, http://bit.ly/IE29-Banbury
3. http://bit.ly/IE29-GHG-Ships
   "2.1 GHG EMISSIONS FROM SHIPS
   Ships are responsible for roughly 3% of global CO_2 and GHG emissions (CO_2-eq), emitting approximately 1 billion tonnes of CO_2 and GHGs per year, on average from 2007 to 2012 (Smith et al., 2015). As other sectors reduce their GHG emissions, shipping will account for an increasingly large share of global climate pollution. Without further action, the international shipping sector could account for 17% of global CO_2 emissions in 2050 (Cames, Graichen, Siemons, & Cook, 2015)."
   "Just three ship classes (container ships, bulk carriers, and oil tankers) account for 55% of CO_2 emissions."
4. http://bit.ly/IE29-Paris-Status
5. http://bit.ly/IE29-IMO
6. http://bit.ly/IE29-MSC
7. http://bit.ly/IE29-MSC-LNG
8. http://bit.ly/IE29-NABU
9. http://bit.ly/IE29-BCFerries
10. http://bit.ly/IE29-EPS
11. http://bit.ly/IE29-COGES
12. http://bit.ly/IE29-COGES-Pilot
13. Colin McEvedy, *The Penguin Atlas of Medieval History*, Penguin Books, 1961
14. Condensed from program notes by Sandi MacDonald for the United Player's performance of Jan 24-Feb 16 of Lee Hall's *The Pitmen Painters* directed by Jack Paterson, which are based on historical advice from Nigel with help of Alan Harle, RSM Metallurgy 1965-68, The Ellington colliery tunnels adjacent to the Alcan power station went out miles under the sea. Miners spent much of the day getting to the face. Ellington was destined to become the last remaining operational deep coal mine in North East England and the last in the UK to extract coal from under the sea.
    - The pit ponies left the colliery in 1994;
    - The Ellington colliery closed in 2005;
    - The smelter was closed in 2012;
    - Later the same year Rio Tinto Alcan sold the power station to German energy giant RWE.
15. http://bit.ly/IE29-S-1
16. http://bit.ly/IE29-EBRD
17. http://bit.ly/IE29-SilentSubs
18. http://bit.ly/IE29-Saab-A26
19. http://bit.ly/IE29-ClimateLens
20. "If we can stand up to him, all Europe may be free and the life of the world may move forward into broad, sunlit uplands. But if we fail, then the whole world, including the United States, including all that we have known and cared for, will sink into the abyss of a new Dark Age made more sinister, and perhaps more protracted, by the lights of perverted science." Winston Churchill, Westminster, 18 June 1940
21. http://bit.ly/IE29-BoB

Research in Industrial Projects for Students program

Iuliana Tabian is a 4th Year Student in Aeronautical Engineering. This summer she was sponsored by the OC Trust with a Travel Grant to enable her to participate in the Research in Industrial Projects for Students (RIPS) program organised by the Institute of Pure and Applied Mathematics (IPAM) at the University of California Los Angeles (UCLA). This article is based on the report Iuliana wrote for the OC Trust on the experience.

I would like to express my thanks to the Old Centralians' Trust for helping me to take part in the RIPS program at UCLA. This allowed me to experience how research is undertaken in an American University, to develop a lot of skills, to network with successful people in their field, and to make a lot of memories.

Photos: Iuliana Tabian

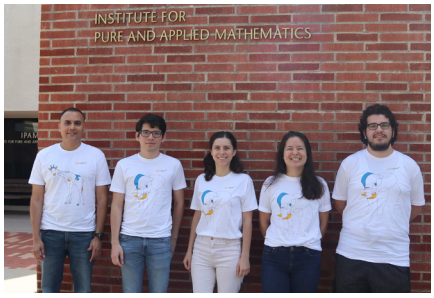
The program consisted of a group of four people, supervised by an UCLA professor, working together on the same project, proposed by an industry sponsor. The project was intended to be research-focused, in the sense that no solution was known by anyone beforehand. The fact that the program combined both research and an industry challenge was great, as we could get a sense of both.

Along with the program, we had some lectures by well-known professors, and also workshops about industry and academic careers. We also had a lot of preparation for public speaking, for holding a presentation to a large audience, for writing a publishable-quality report and many others. By working in teams, we had the opportunity to learn a lot about team-working and team dynamics and I truly think that I developed a lot of useful communication and team-working skills during this project. Also, networking with successful people in academia or the industry and with the other participants in RIPS was a big opportunity to share passions for mathematics, science, technology, space and to make life-lasting connections.

The program was very well organised and the company that proposed our project was very eager to collaborate with us. This means that we showed them our progress through weekly presentations at the company. During the many site visits we had, we could get a sense of what the scientists are working on and how our project will really help them progress. Also, we had the final presentation both at IPAM and at the company, and everyone was impressed by our results. In the relatively short amount of time, we worked hard and we came up with a pipeline that worked pretty well in solving the problem, so the project was a great success. Right now, we are working on publishing a paper and some of the members will participate in the Joint Mathematics Meeting in Baltimore to present our solution.

Spending two months in the UCLA campus was truly exciting as there were lots of facilities I could use and, also, I had a sense of a strong community all the time. Being a 'Bruin' is a nice feeling and everyone around seemed very friendly and engaged in the community.

Living in Los Angeles for a summer was very relaxing and I took all the opportunities this city has to offer, including going to the beach, playing frisbee, looking at Venus through the telescope at the Griffith Observatory and seeing the Space Shuttle Endeavour at the California Science Center. I also took one weekend to visit the Grand Canyon, which is truly amazing, and I am so thankful I could see it.



Pros and Cons

Since the earliest days of Science Fiction, authors have found it to be an effective way to comment on the problems that they see in society. That is just as true today as ever, and the high representation of STEM professionals (the Pros) among SF fans – probably higher than any other professional group – gives us both an opportunity and a responsibility to effect change. One of the areas where this is becoming most noticeable is in the organisation and running of SF conventions (the Cons). IE Editor Peter Buck (Computing 1976-79), a regular attendee at cons, provides some background. If you've never been to a SF convention, but enjoy reading, consider giving it a try – you'll be surprised how many of the attendees are just like you!

As I write this, the world of Science Fiction (SF) is expectantly hushed (mostly), waiting for a significant event. The regeneration of Doctor Who is frequently hyped and widely anticipated by fans, but this time (in case you hadn't heard) the previously unthinkable has happened – the Doctor will be female! Breaking this glass ceiling (a metaphor used to great effect in a BBC teaser trailer for the new Doctor) is not just of significance to SF fans, of course. Doctor Who has long been, and still is, one of the depressingly few role models for children in mainstream media which demonstrate that smart, educated people, who understand science and technology, can save the planet. With sexism, discrimination, and under-representation being significant current issues for engineering and other STEM disciplines, there can be no better time for The Doctor to regenerate as a female and categorically show young girls that this role model is as much for them as for their brothers.

Of course, the wider world of SF is no stranger to these same concerns, evidence of which is readily apparent in the shortlists for book prizes, awards, and even just in those titles that are chosen for review in the national press and glossy magazines. Despite much prejudice over the years, it is undeniable that female authors have been a strong and significant force in Science Fiction and Fantasy (SFF) since the earliest days. One only has to think of Margaret Cavendish, Mary Shelley, Jane Webb Loudon, Ursula K. Le Guin, Anne McCaffrey, C.J. Cherryh, Julian May, Marion Bradley, Pat Cadigan, Doris Lessing, Margaret Atwood, and J.K. Rowling. Even so, it is generally harder for female authors to get published, and many readers are still less likely to pick up a book if the author's name is obviously female.

Pros

Times they are a-changing however, as another pop-culture icon might say, and STEM professionals can undoubtedly help to lead the way. Empirical evidence suggests that, unlike in most other realms of literature, STEM professionals comprise a significantly larger proportion of 'genre'[1] readers. The best SF uses science, technology – and extrapolations thereof – to hold a mirror up to society. Who better to write and read those stories than the very people who understand both the science and the way it is capable of being employed. That said, poorly researched SF – where the science is laughably infeasible – is perhaps more irritating to STEM readers than to those with less scientific knowledge.

Photo: Simon King – Creative Commons Attribution-ShareAlike 4.0 International license

London Comic Con, May 2017

Cons

Which brings us to conventions. Not in the sense of acceptable behaviour (although I'll come back to that later), but in the sense of meetings for fans of genre fiction (whether drawn, written, spoken, sung, or dramatised on film or TV). Even if you've never been to a SFF convention (or 'con'), you may have some (probably mis-)conceptions of what this hidden subculture is like (perhaps from TV shows like *The Big Bang Theory*, films like *Galaxy Quest*, or webisodes like *Con Man*). But I would be willing to bet that a, not insignificant, number of the readers of Imperial ENGINEER know exactly what cons are like because they, like me, attend one or more on a regular basis. For those who aren't familiar with them, here's a brief overview of the con scene.

Commercial cons

There are essentially two types of convention, commercial and fan-run. Those that are commercially run, like the Comic Cons frequently featured in the press and other media, tend to concentrate on (obviously) comics and the stars of SFF film and TV as well as wrestling[2], and increasingly gaming. In the US, there are a few heavily promoted such conventions in major cities, the best known of which is the San Diego Comic Con which attracts 130,000 attendees, the majority of whom will be attending for a few hours at most. There are similar, if smaller, conventions held in other cities across the US and elsewhere. There are a couple of companies who run conventions like this in the UK, at locations such as the ExCel in London, NEC in Birmingham, SEC in Glasgow as well as conference centres across the UK and around Europe in cities such as Amsterdam, Brussels, Munich, Paris. The London Comic Con, like that in San Diego, attracts around 130,000 attendees. For a modest entrance fee (around £25) these cons provide the opportunity to browse in a marketplace of merchandising in a large hall, with booths around the the edges where fans can pay to 'meet'[3] comic and game artists, TV and film stars, and wrestlers from the UK, USA and elsewhere. With the increasing popularity of SFF in films and streaming media services, the number of fans prepared to spend their money for a chance to be photographed with their favourite

1 That's the literary world's way of distinguishing science fiction and fantasy, SFF, (also known collectively as speculative fiction) from what they consider to be the respectable fiction that should be eligible for awards, reviews and serious discussions on BBC Radio 4.

2 Not as bizarre as you might at first think, as stars of WWF wrestling have much more in common with comic-book and TV characters than they do with sportspeople.

3 'Meeting' usually involves little more than a brief interaction while the star is signing a studio photograph for a fee, or posing for a photograph with the fan for a larger fee. The required fee is dependent on the popularity of the star, often ranging from £25 to £100.

Photo: Peter Buck/Elsewhen Press

You never know who you'll meet – here at Worldcon in London in August 2014

Photo: Peter Buck/Elsewhen Press

Villagers at Nine Worlds in August 2017

Photo: Peter Buck/Elsewhen Press

Book launches – Zoë Sumra, PR Ellis and John Gribbin, Nine Worlds, August 2017

character from *Game of Thrones*, *Star Trek* or the *Avengers* films is a significant and world-wide phenomenon. So much so, that there are now even conventions which concentrate on just one particular TV show or film series.

Fan-run cons

The fan-run conventions, on the other hand, tend to be more literature-oriented. Run as non-profit events, they take place over a few days (usually a long weekend) and have more in common with a scientific conference – often with multiple threads of panel discussions covering a wide-ranging array of topics, accompanied by a small vendors' room containing publishers, booksellers and merchandising. Guests of honour are invited to participate in the panels, usually well-known authors. Publishers, especially small indies, often use the opportunity to launch their latest book. Many cons also have 'science' guests of honour[4]. Subjects addressed in panels can range from the prosaic (literally, like '*writing a believable character*') through the didactic ('*how to design your interstellar spaceship*'), the analytical (one recent session was '*Cavorite to Coaxium*' examining made-up materials in SF from HG Wells to the latest Star Wars film, presented by PR Ellis, a retired chemistry teacher) and the societal ('*how well are minorities represented in SFF?*'), to the pedantic ('*dragons in science fiction?*') and the downright nerdy ('*Han shot first*'). Although the entrance fee is higher than for a Comic Con (typically £100), there are no extra fees to attend any panels or signings, and the guests of honour can usually be found in the bar, when they're not in a panel, and are generally happy to chat over a drink. Usually held in large hotels or conference centres, the attendees (known as members) generally stay for the whole weekend. For many it is a fixed and regular appointment in their calendar, and a chance to catch up with other fans who also attend regularly – even after the day's panels are over there are many long and heartfelt discussions continuing in the bar, often into the early hours.

The largest such convention is the World SF Convention (Worldcon) which takes place over five days in the summer, at a different location each year. More frequently in the US than not, it was last in London in 2014 at the ExCel centre, and will be in Dublin next year. Worldcon started in 1939 and now attracts around 10,000 members from around the world. There are other similar conventions, such as Eurocon, held around Europe each summer since 1972, this year in Amiens, next year in Belfast; (the 2019 Belfast Eurocon is the weekend after the Dublin Worldcon and many attendees will likely go from one to the other, using the Dublin–Belfast train fittingly called *The Enterprise*). The annual British National SF convention, held each year since 1948 over the Easter weekend, is known as Eastercon. Like Worldcon, it is organised by a different committee of fans every year and each is in a different location – Harrogate this year, Heathrow next year – usually in a large hotel or conference centre and generally attracting up to 1500 members. Other, smaller, conventions are held throughout the year around the UK, some for a weekend, others for a single day. In 2013, a new convention was established in London, called Nine Worlds (from Norse mythology) with a permanent organisation established to arrange and run the convention, providing a continuity that can be missing from some of the others. Nine Worlds attracts 1500-2000 members, mostly from around London, with a younger demographic (more 20-somethings) than most of the other conventions. A large proportion of Nine Worlds members dress in costume (cosplay) for most of the weekend. It embraces all of 'geekdom' not just literature, including gaming and film/TV. Although it doesn't have official guests of honour, many authors, both successful and up-and-coming, participate as members.

Inclusivity

Perhaps the most distinctive aspect of the fan-run conventions is in their adoption of inclusivity and accessibility policies. While UK cons have been improving, many US cons have not. Indeeed, over the last few years there has been much criticism from both fans and authors of the US-located Worldcons which have tended to be much more parochial and reactionary than those elsewhere. Matters came to a head this summer in San José when the entire programme was scrapped with less than a month to go, and replanned to be not so dominated by white middle-aged men!

At most UK cons now, acceptable behaviour and language are spelt out in policies provided to all members. Anti-harassment, anti-racism, and anti-discrimination policies are common at all of these conventions. One of the most advanced in this area is Nine Worlds which actively promotes and enforces their policies; in addition, members write the name they wish to be known by on their badge, along with a sticker identifying the personal pronoun they prefer. They can apply a coloured overlay to indicate whether they wish others to initiate a conversation with them or would prefer to be left alone, and they can wear their badge on a yellow lanyard to indicate that they do not wish their photo to be taken. Where SF fandom leads, hopefully society follows.

4 For me, a highlight of one convention, NovaCon in Nottingham, was having a long chat with the science guest, John Gribbin, in the bar – when I was studying for my A-levels in the 70s, John's articles were the best-written and most interesting in *New Scientist*.

Photo: Markku Lappalainen (markku.lappalainen@worldcon.fi) Creative Commons Attribution 4.0 International License.

Future Shock, and Do YOU Suffer From It? A panel with Walter Jon Williams, Chris Gerrib, Kathleen Ann Goonan, Charles Stross and Nick Price at Worldcon, Helsinki, August 2017

Encourage others into mining!

I was sorry to see the obituary for the 'Quintissential Minesman' John Fairfield in the latest issue (IE28) of Imperial ENGINEER. I see his interest in mining is attributed to an encounter with Professor David Williams, but I think I can also claim to have played a part.

I got my Mining degree in 1952 aged 20, having been one of the young ones in a class half of whom had been in the Armed Forces during WWII and were much more mature than me. So when an Army officer came to speak in the mining lecture theatre to those of us still liable for National Service and spoke of the Royal Engineers tunnelling in Malta and Gibraltar, I decided to do two years in the Army. On my second day in I was told National Servicemen could not do tunnelling (too many had complained to their MPs that they suffered claustrophobia). Being awkward, I failed to get a commission by "talking about nothing but mining" to the interviewing officers at the selection board, and as a result got my posting and spent 18 months in the Tunnelling Troop, Fortress Engineer Regiment, Gibraltar.

My first job after demob was with a tunnelling contractor driving locomotive haulage roads for NCB collieries in the Midlands. On one weekend break in the spring of 1955 I went down south and called at my old school, Epsom College, and spoke to boys in the Maths Sixth about metal mining.

After a spell in the engineering department of Turner Brother's Asbestos in Rochdale, during which time I met the girl I married, I got a job in the Indian Copper Corporation's underground Mosaboni copper mine. Towards the end of that tour in India, I was awarded a Rio Tinto Bursary to do a post-graduate year back at the RSM in Mineral Processing. So it was that, towards the end of the summer term in 1961, I attended the undergraduate's Final Year Dinner.

As we assembled before going into the dining hall, one of the students came over to me and said "*I am here because of that talk you gave at Epsom College six years ago!*" He told me his name was John Fairfield.

Years passed, and in 2007 I saw his name mentioned in the magazine for former students of Epsom College, as being an active member of their old students society in Australia. It gave his e-mail address, so I sent him a message reminding him of what he had said about my talk at Epsom suggesting he think of mining. I said I hoped I had not led him astray?

His reply was prompt and enthusiastic, and read as follows:

Dear Tony,

What a wonderful surprise. Yes, I still remember well that Saturday in the Chemistry lecture room, with the periodic table on the wall.

When I left Epsom in 1957, I had a place at the Royal School of Mines to start Mining Engineering in 1958, so, rather than go and play soldiers for two years, I got deferment for a year by going to work for the NCB at Gedling Colliery. After that, I decided that I would be a metal (not coal) mining engineer.

I had a ball at the RSM and was awarded a "Sportsman's degree" (Lower Second) and was President of RSM in my final year. I was one of four mining undergrads who got married in our final year.

After graduation, I joined the Consolidated Zinc Proprietary and we went to Broken Hill, NSW. CZP merged with RTMA and became CRA and eventually went back to Rio Tinto. I worked for the Group for 38 years. We had a wonderful life in mining. We moved house 24 times in 38 years. I had a 3 year stint with RTZ Consultants in London, but spent most of that time in N America, Spain, Mauritania, S Africa and Australia. We lived in Bolivia for 3 years, Philippines for 4 years etc etc.

In Australia for CRA, I was a GM in the lead/zinc division, GM of the Timber Division(!), GM Mitchell Plateau Bauxite, MD Dampier Salt, GM Comalco Bauxite & Alumina, GM Hamersley Iron in Dampier and after several others, finished up as Vice President of Asia Pacific. After retirement in 1995, I worked for Rio Tinto as a Mining Consultant for another 5 years. I consulted in Asia for another 5 years from my base in Melbourne and finally gave up two years ago.

We live in Mt Eliza in Victoria.

Our son, who was born in Broken Hill, is also a mining engineer and is currently COO of St Barbara Mines in Australia.

We have two children, four grand-children and a four year old great grandson.

Mining has been good to all of us. Thank you.

With very best wishes,

John

The way John came to me in 1961 to say "*I am here because of that talk you gave at Epsom College six years ago*" I found inspiring, and since then over the years I have often gone to schools and given talks about careers in the minerals industry. Even as recently as 2013 to 2016 I had a three-year spell as a STEMNET 'Ambassador' taking part in careers events at schools.

Getting now a bit long in the tooth for such things and it being twenty-one years since I retired from editing Mining Magazine, I feel it best to leave the school talks to younger 'role models'.

So, if you enjoy what you do in the mining industry, take time to go into schools and tell them about it. See if you can inspire the next generation! It sometimes works – it did for me as proven by John Fairfield!

Tony Brewis, D.I.C., B.Sc., A.R.S.M., F.I.M.M.M., F.I.Q., F.M.E.S., Socio del Instituto de Ingenieros de Minas de Chile

Johannesburg meeting

I can report that six local (Johannesburg) members gathered for our regular quarterly meeting at "The Baron & Quail" on 12th September. After more than 40 years of tradition "third Thursdays" have given way to Wednesdays as many of our members partake of senior golf activities on Thursdays. A good pint or two washing down Beef & Guinness pies in glorious sunshine, keeping the collegiate flame alive.

Richard E Gundersen

Elec Eng 1978-81 Three reunions in 1 year!

The Electrical Engineering class of 1978 to 1981 met at the Imperial College Alumni Weekend on Saturday 28th April 2018, and were privileged to have made one of the first posts on the Imperial Plexus networking website. All met in Beit Quadrangle and afterwards enjoyed a Thai meal in South Kensington. Nine former classmates attended, and met again for an Indian meal in North London on Saturday 14th July 2018. The group have met annually since graduating in 1981, but last year decided to increase this to twice a year. In fact in 2018 they will meet 3 times, since their September or October meeting in the college will still go ahead.

In the photograph above: Left to right: Sunil Morzaria, Arthur Jordan, Mike Richardson, Marek Stuczynski, John Johnson, Alan Higginson, Ian Tyes. Also attending but not in the photo were Shahid Raja and Henry Szyszko.

Alan Higginson

£25m gift from Alumna

Marit Mohn (MSc Chem Eng and Chem Tech 1973), a longstanding donor, has donated £25m to establish a world-leading children's health and wellbeing centre in the White City campus.

Marit Mohn said: "*Imperial's academic excellence and ambition for White City is inspirational – and I am pleased to play a part in it. While rooted in the local community, this new centre will drive discoveries and improve global understanding of childhood disease. We have the opportunity to change the lives of local young people in a way that will be felt for generations to come.*"

Before Nigel and Joan Fitzpatrick headed off on their Baltic cruise (see page 24), the IE Editors caught up with them in Henley.

DIARY

Fri, 2 Nov, 17:30 – 21:30
RSMA Perth, Australia
Monthly Sundowner
The Celtic Club, 48 Ord St, West Perth, Western Australia, 6005
Alan Dickson – alan@dickson.com.au
John Sykes – johnpsykes@gmail.com

Sun, 4 Nov, 7:00 – 16:30
CGCU
Boanerges in the London to Brighton Veteran Car Rally
Starts Hyde Park, London, UK

Mon, 5 Nov, 19:00-20:00
Friends of Imperial College
Cassini, JUICE and beyond
Michele Dougherty FRS CBE FRAS, Professor of Space Physics, Head of Department of Physics
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-Cassini

Wed, 7 Nov, 15:30 – 17:30
Sir Hugh Ford Lecture Series
Rolls-Royce: A story of aviation propulsion from 1915 to 2050
Paul Stein, Chief Technology Officer, Rolls-Royce plc
Lecture theatre 200, City and Guilds Building, South Kensington Campus, Imperial College, London SW7 2AZ
http://bit.ly/IE29-Ford

Wed, 14 Nov, 17:30 – 18:30
Vincent Briscoe Security Lecture
Digital policing: The changing role of technology in law enforcement
Cressida Dick, Commissioner of the London Metropolitan Police Service
Lecture theatre 200, City and Guilds Building, South Kensington Campus, Imperial College, London SW7 2AZ
http://bit.ly/IE29-Briscoe

Wed, 14 Nov, 17:30 – 18:30
Cracking the neural code and disentangling the wiring diagram
Professor Simon Schultz
Sir Alexander Fleming Building, South Kensington Campus, Imperial College, London SW7 2AZ
http://bit.ly/IE29-Schultz

Sat, 17 Nov, 12:30-15:00
CGCA Traditional '5&10' Reunion Lunch
55 Prince's Gate, Exhibition Road, South Kensington, London SW7
Booking form was included in the last issue of IE and on the CGCA website

Wed, 21 Nov, 12:30 – 14:30
Imperial Engineering Alumni Quarterly Johannesburg Lunch
Baron & Quail, Woodmead, Johannesburg, South Africa
Contact Richard Gundersen@yebo.co.za

Thu, 22 Nov, 19:00-20:00
Friends of Imperial College
Life on the edge: quantum biology
Johnjoe McFadden, Professor of Molecular Genetics, Surrey University, Alumnus
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-QuantumBiology

Fri, 23 Nov, 19:00-23:00
RSMA Annual Dinner
The Rembrandt Hotel, 11 Thurloe Pl, Kensington, London SW7 2RS, UK
Booking form included with this issue of IE, and on RSMA website.

Fri, 23 Nov, 12:00
RSMA Toronto, Canada
Informal RSM meeting at noon (EDT) on the Last Friday of every month.
Jason George Pub, 100 Front Street East, Toronto

Thu, 6 Dec, 17:30 – 18:30
The 25th Professor Roger Sargent Lecture
Biological Control Systems: Systems Biology of Diseases and the Design of Effective Treatments
Professor Babatunde A. Ogunnaike, University of Delaware
Lecture Theatre 3 (Room 333), Roderic Hill Building, South Kensington Campus, London SW7 2AZ
http://bit.ly/IE29-RSL

Thu, 6 Dec, 19:00-20:00
Friends of Imperial College
Meeting the challenge of climate change
Professor Sir Brian Hoskins CBE FRS Chair of the Grantham Institute – Climate Change & the Environment
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-Climate

Fri, 7 Dec, 17:30 – 21:30
RSMA Perth, Australia
Monthly Sundowner
The Celtic Club, 48 Ord St, West Perth, Western Australia, 6005
Alan Dickson – alan@dickson.com.au
John Sykes – johnpsykes@gmail.com

Fri, 28 Dec, 12:00
RSMA Toronto, Canada
Informal RSM meeting at noon (EDT) on the Last Friday of every month.
Jason George Pub, 100 Front Street East, Toronto

2019

Fri, 4 Jan, 17:30 – 21:30
RSMA Perth, Australia
Monthly Sundowner
The Celtic Club, 48 Ord St, West Perth, Western Australia, 6005
Alan Dickson – alan@dickson.com.au
John Sykes – johnpsykes@gmail.com

Wed, 23 Jan, 19:00-20:00
Friends of Imperial College
Fire: its secret life
Prof. Guillermo Rein, Professor of Fire Science, Department of Mechanical Engineering
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-Rein

Fri, 25 Jan, 12:00
RSMA Toronto, Canada
Informal RSM meeting at noon (EDT) on the Last Friday of every month.
Jason George Pub, 100 Front Street East, Toronto

Fri, 1 Feb, 17:30 – 21:30
RSMA Perth, Australia
Monthly Sundowner
The Celtic Club, 48 Ord St, West Perth, Western Australia, 6005
Alan Dickson – alan@dickson.com.au
John Sykes – johnpsykes@gmail.com

Wed, 6 Feb
Ringing of the Alexandra Peal of bells in Queen's Tower
Alexandra Peal of bells in Queen's Tower rung to celebrate the accession of HM Queen Elizabeth II

Wed, 6 Feb, 19:00-20:00
Friends of Imperial College
Welcome to the quantum world
Dr Simon Foster and students from the Controlled Quantum Dynamics Group
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-QuantumWorld

Fri, 15 Feb, 19:15-22:45
CGCA 106th Annual Dinner
Carpenters' Hall,
Throgmorton Avenue, London EC2N 2JJ
Speaker: Sir Colin Humphreys CBE FREng FRS
Booking form included with this issue of IE, and on CGCA website.

Wed, 20 Feb, 12:30 – 14:30
Imperial Engineering Alumni Quarterly Johannesburg Lunch
Baron & Quail, Woodmead, Johannesburg, South Africa
Contact Richard Gundersen@yebo.co.za

Fri, 22 Feb, 12:00
RSMA Toronto, Canada
Informal RSM meeting at noon (EDT) on the Last Friday of every month.
Jason George Pub, 100 Front Street East, Toronto

Fri, 1 Mar, 17:30 – 21:30
RSMA Perth, Australia
Monthly Sundowner
The Celtic Club, 48 Ord St, West Perth, Western Australia, 6005
Alan Dickson – alan@dickson.com.au
John Sykes – johnpsykes@gmail.com

Tue, 5 Mar, 19:00-20:00
Friends of Imperial College
Eye catching: light and biological time
Russell Foster CBE FRS Professor of Circadian Neuroscience, Oxford University
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-EyeCatching

Fri, 22 Mar, 12:00
RSMA Toronto, Canada
Informal RSM meeting at noon (EDT) on the Last Friday of every month.
Jason George Pub, 100 Front Street East, Toronto

Thu, 4 Apr, 19:00 – 20:00
Friends of Imperial College
Aircraft Electric Propulsion: Volting into the Air
Ric Parker, previously Director of Technology, Rolls Royce, Alumnus
Sir Alexander Fleming Building, Imperial College, Exhibition Rd, South Kensington, London SW7 2AZ
http://bit.ly/IE29-FOI-Volting

Fri, 5 Apr, 17:30 – 21:30
RSMA Perth, Australia
Monthly Sundowner
The Celtic Club, 48 Ord St, West Perth, Western Australia, 6005
Alan Dickson – alan@dickson.com.au
John Sykes – johnpsykes@gmail.com

Sun, 21 Apr
Ringing of the Alexandra Peal of bells in Queen's Tower
Alexandra Peal of bells in Queen's Tower rung to celebrate the birthday of HM Queen Elizabeth II

Fri, 26 Apr, 12:00
RSMA Toronto, Canada
Informal RSM meeting at noon (EDT) on the Last Friday of every month.
Jason George Pub, 100 Front Street East, Toronto

Wed, 15 May, 12:30 – 14:30
Imperial Engineering Alumni Quarterly Johannesburg Lunch
Baron & Quail, Woodmead, Johannesburg, South Africa
Contact Richard Gundersen@yebo.co.za

An up-to-date calendar of events of interest to CGCA and RSMA members is always available on the CGCA and RSMA websites. Imperial College maintains a calendar of college events at bit.ly/IE-ImperialEvents and the Friends of Imperial College regularly organise events of interest to alumni (see bit.ly/IE-FOI)

Please note that while many of these events are open to all and often free, they usually require registration in advance. Please follow the links in the entry to get more information including if and how to register and whether there is any cost.

For more information follow links, or see page 2 for contact details

Skilled linguist and engineering innovator

PETER SPIRO (Mech Eng 1936-39)

This obituary was provided by Peter's daughter, Elizabeth:

Peter Spiro, who died on 9 February, 2018 at the age of 99, was a life member of CGCA.

He was born in Berlin on 16 May, 1918, the only child of Eugen and Elisabeth Spiro. The Spiro family was both artistic and musical – most notably his father was a prominent painter, whilst his maternal grandmother, Irma Sethe, was a highly talented violinist.

At school, Peter combined a fascination for classical history with a love of art, producing a series of paintings of the Punic and Napoleonic wars.

He also drew caricatures of his teachers, which impressed his father, who had in fact done the same whilst at school. In 1935, with the rise of Nazism, his family left Germany, Peter to an English school in Switzerland, and his parents to Paris, where Peter spent his school holidays the following summer, before travelling to London in order to study Mechanical Engineering at City & Guilds College, graduating in 1939 (his headmaster in Switzerland, despite being a Cambridge graduate, had recommended Imperial as the best choice for aspiring engineers).

Peter found the course demanding, partly because of the time he spent on extra-curricular activities.

He was very keen on rowing, and represented IC at junior and senior level. He was present when the revolutionary new Boat House in Putney was opened in 1938, and subsequently cycled there every Saturday. He also participated in the Literary and Debating Society, of which he became Chairman.

In 1998, he reminisced about this, saying:

"The thirties were politically very interesting, so there was plenty to debate".

With others, he published an unofficial – and sometimes controversial – journal called 'The Muck-rake'.

Peter recalled his college days as a very happy three years, although "of course it was an agitated time, Hitler was conquering Europe and we were at the threshold of war.

"Everything was so much smaller – City and Guilds had about 360 students, Royal School of Mines about 100. There was one female student in City and Guilds. Other women you saw were always entomologists – they were the ones dissecting beetles."

This observation resulted from Peter frequently passing the Entomology department when walking between Prince Consort Road and his Beit Hall accommodation.

On a short stay in hospital with ingrowing toenails, Peter met his wife-to-be, Lucy Tanner, known as Bobbie. The daughter of an artistic wood-carver, Bobbie was a nurse at St Luke's Hospital in Chelsea.

Peter, already fluent in English, developed further abilities as a linguist at this time, partly because of his regular trips back to Paris. These skills proved to be of great benefit to him in future.

Fortunately he completed his course in 1939:

"If I'd been one year later, I would have been interned as an enemy alien, whereas at least I had my degree."

His first job following graduation was with the London and Scandinavian Metallurgical Company. Working at premises in Battersea, Peter's 'alien' status did not discourage him from fire-watching nearly every night, for which he received the Defence Medal. He made good use of garden ornaments made at the factory before the war:

"When one of those wretched firebombs fell and you didn't know whether it was going to blow up, I developed a technique for taking one of the fountain basins, turning it over and putting it onto the bomb. After about half an hour I lifted it gently and if it was spluttering away I put it down again."

When Hitler's troops marched into Russia, Peter and Bobbie concluded that Hitler would now lose the war and it was therefore safe to marry and have children. They married in 1941- about a year after they met - causing Lucy to lose her British nationality for a year. After a week's honeymoon in Cambridge, they set up home in Kensington. Their first child, Elizabeth, was born a year later, followed by Andrew in 1944.

Bobbie died at the age of 95 in 2010.

A major war-time turning point at L&SMCo occurred when someone walked into Peter's laboratory and, realising it was a matter of national importance, said:

"There must be a simpler way of making tools than cutting them out of blocks of steel." It became Peter's fate to develop nickel electro-forming as a tool-making process, and the company went on to become one of the most important manufacturers of nickel electroformed tools in the 1950/60s. Peter's innovative work was later the basis of his book 'Electroforming', first published in 1968, which emphasised applications for electro-forming technology in plastics moulding.

In 1963, Peter moved on from tooling to producing in plastics, joining the Metal Box Company's Plastics Division. He remained with Metal Box until 1968. He then applied for a vacancy at the British Compressed Air Society, and found himself being interviewed by Rogers Knight, a Mechanical Engineering contemporary and fellow life member of the 'Old Centralians', who later became president of both BCAS and of the Old Centralians.

Peter himself had been a member of Old Centralians since college, but due to re-establishing contact with Rogers Knight, he became more actively involved and joined the committee in 1983.

He served the OCs, and CGCA, for many years, mainly as a Group Representative, and rarely missed an Association meeting or event until his latter years.

Being multi-lingual (English, French, German and to a lesser extent Italian) was a great asset at BCAS. Due to Peter's work with European committees, links were developed with PNEUROP (European manufacturers of compressors and pneumatic tools) and CETOP (the European hydraulic and pneumatic committee).

Through his combination of language skills and engineering, he served as an interpreter or technical translator in connection with numerous prestigious events.

His specialist knowledge also made him an ideal choice in situations such as when – due to a European Directive on safety – safety instructions for machinery manufactured in the UK needed to be translated into the language of the country where it was to be used.

Throughout his life, Peter maintained an interest in painting, both promoting his father's work and reputation, and doing his own painting and exhibiting.

His early memoirs, "Nur uns gibt es nicht wieder", were published (in German) in 2010, illustrated with paintings, mostly by his father but also by himself and his daughter Elizabeth.

Peter died in his sleep, at home in Wimbledon, on 9 February, 2018 aged 99, just three months short of his 100th birthday.

Avid Rugby player – and historian

JAMES PATRICK (JIM) KEHOE (Mech Eng 1958-62)

Jim Kehoe was born on 24 November, 1939. He arrived at City & Guilds College in October 1958, to study for a degree in Mechanical Engineering, graduating in 1962.

Whilst at college he was an avid member of the Rugby Club, and was Captain of the Imperial College 1st XV in 1961-62. He also played for the University of London 1st XV.

Later degrees included an MBA in General Business from the University of New South Wales (1967-70), and a further MBA in Technology Management from Deakin University (1993-96). Between 2002 and 2004 he studied for the degree of MLitt in History from the University of Central Queensland, and in 2007 he obtained a Master of Project Management from the University of Southern Queensland.

L to R: Dr Bill MacMillan (Chem Eng 58-61), Heather MacMillan, Chris Lumb (Elec Eng 58-61), Muriel Kehoe and Jim Kehoe

After graduation, Jim spent some time working for AEI in Manchester, but then returned to Australia where he spent over 25 years with IBM Australia. He later worked in Sydney as a consultant with Communication Design & Management, and subsequently with Aspect Computing Pty Ltd.

On retirement in 2005 he took up a part-time teaching appointment with TAFE NSW (Technical and Further Education), continuing until 2012, when he was advised that TAFE wished to have only full-time teaching staff.

Concurrently he set up his own consultancy – JONAKE Consulting – in 2006, and in due course published a book entitled "From Whites to Muddies" a history of Rugby Union in the Royal Australian Navy. This book was published by Ian Gordon at Barrallier Books in Canberra. From 2004 he also acted as a Historian for Services Rugby, and, having completed a history of Navy Rugby, was researching 'Australian Services Rugby Union'.

At the time of his death he was working on a History of Rugby at Imperial College.

From 1990, Jim served as the Honorary Secretary for Old Centralians / CGCA for Sydney and NSW, in which role he will be sorely missed.

Jim died unexpectedly on 9 August 2018, after a fall whilst on holiday in New Caledonia. He is survived by his wife Muriel and daughter Fiona.

Innovator and champion of workforce training

Sir ANTHONY KEITH (TONY) GILL, (Mech Eng 1951-54)

Tony Gill was born in Colchester on 1 April, 1930.

Tony attended Colchester Boys School, where he was Troop Leader in the Scouts and a House Captain. His strong principles and upbringing had made him intolerant of injustice, and he once climbed from a classroom window and went to the Headmaster's study in order to complain about what he thought to be unjust behaviour by the class master.

Leaving school at 14, his father wanted him to learn a trade. But after four weeks learning to mend radios, Tony decided this was not a long-term career, and became an office boy at Davey Paxman, a large engineering firm based in Colchester. Here he complained that the company's practice of only accepting indentured apprentices whose fathers could afford to pay for this, was unjust and impractical given the need for the engineering industry to attract more recruits. Within a few months he was Paxman's first 'non-indentured' apprentice, and in time became Chairman of the Apprentices' Association. He attended the Local Technical College to study for the National Certificate and Higher National Certificate qualifications, then progressed to a matriculation course in order to apply for University. By the age of 21 he had completed his apprenticeship at Paxman, and gained a state scholarship to study Mechanical Engineering at City & Guilds College.

Once at Guilds, finding that the degree course lacked any practical experience, he successfully campaigned for the inclusion of appropriate programmes in the degree course. This attracted attention from other students, and he was elected to be Vice President of the City & Guilds College Union for his final year but, when the President-Elect failed his examinations, and did not return to the College, Tony was elected as CGCU President for 1953-4.

During the 1953 vacation he had married his fiancée Phyl, so his final year was a busy one! Despite this, Tony went on to achieve not only a First, but the best such degree of his year!

He then undertook two years' National Service where, in addition to winning the award for being the best Officer Cadet, he was placed in charge of two workshops employing over 1,500 civilian workers.

After National Service, he joined the engineering firm of Bryce Berger, which specialised in fuel injection equipment. Tony introduced innovative ideas and was promoted to a management position. In 1958, Bryce's parent company, Hawker Siddeley, decided to move Bryce Berger into a former Gloster Aircraft factory, where there was space for expansion, and Tony was given the task of managing the re-location, which he achieved on time and within budget. This led to his being appointed a director of Bryce Berger at the age of 29.

In 1960, Bryce Berger was acquired by CAV Limited (part of the Lucas group). Tony was placed in charge of the combined business, and was made a director of CAV in 1967. Over the next twenty-one years he steadily rose within the Lucas hierarchy, becoming joint MD of Lucas Industries, with Jeff Wilkinson, in 1978.

During the 1980s he was instrumental in introducing innovative management methods, bringing in talented industrialists to achieve this end, whilst at the same time expending much effort on improving communications with the workforce and introducing training schemes, which resulted in a higher level of multi-skilling capability amongst the staff involved. As a result, Lucas was able to survive challenging business conditions brought about by recessions. In 1984 Tony was appointed sole Managing Director of Lucas Industries and in 1987 succeeded Godfrey Messervy to became executive Chairman and Managing Director. He had become a Fellow of the Royal Academy of Engineering in 1983, and in July 1991 was honoured by the Queen, receiving a knighthood.

Although he was due to retire in November 1992, unexpected changes in the Lucas senior management meant that he was obliged to continue until 1994. Following retirement, he became non-executive chairman of the Docklands Light Railway Ltd (DLR) until 1999. During the same period he served as a non-executive director for TRW Ltd, the Tarmac Group, and other companies. He had always been interested in – and committed to – education and training, so he took on a variety of rôles in engineering and technology organisations. His reputation for successful restructuring took him to the Institute of Management, where he became Chairman of the Council in 1996 and its first president in 1998. He also served on advisory councils, meeting with PM Margaret Thatcher and other cabinet ministers. His abilities were recognised by a number of universities, and he received seven honorary doctorates; from Birmingham, Birmingham City, Warwick, Coventry, Southampton, Sheffield Hallam, and from Cranfield, where he was Pro-Chancellor and Chairman of the Council from 1991-2001.

Away from work, Tony was passionate about yachting and the Opera. He would go to his marina-side house on Southampton Water most weekends, where he enjoyed sailing his ocean-going yacht, moored within a few feet of the house. He and his wife also regularly enjoyed holidays in France, Spain and Portugal with his married children and grandchildren.

Tony was a life-long member of the Old Centralians/CGCA, and after retiring he played an active part by serving on the General Committee, becoming CGCA President for 1998-99.

Tony Gill died on 6 August, 2018 at the age of 88. He is survived by his wife Phyl, daughters Jo and Sally, son Simon, and by six grandchildren.

An Engineer and a Gentleman

DAVID THORNTON REEVES (Mech Eng 1951-54)

This obituary was provided by Sally Reeves, David's daughter:

Dad passed away unexpectedly, on June 5, leaving behind him a distinguished career and an empty hole in our family.

He was born on 31 March, 1933, in Oxhey, Hertfordshire to Harold, an exceptional civil engineer and inventor, and Gladys, originally his secretary. Engineering was in Dad's blood and he spent most of his life either working or tinkering! He was a classic 'make do and mend' man.

With the onset of WWII Dad's family were evacuated from Sheffield to Derwent where they lived with the Ladybower Resident Engineer and Dad attended school at Derwent Hall, which is now under the reservoir. Post war, they returned to Sheffield and Dad remembered VE day where all the rides at the fair were free and powered by a steam traction engine generator.

Despite an interrupted education, Dad attended King Edward VII Grammar School in Sheffield and gained his degree in Mechanical Engineering at City and Guilds College in 1954. He then began his National Service, in REME. He was very proud two years later to finish his duty as a Sergeant and recently acquired his National Service medal.

Dad's engineering career began in 1956 as quoted below in his own words:

"At the end of 1958 I started my first real job as a pump designer at £13/week!

"I had just finished my two year graduate apprenticeship to W H Allen Sons and Co. Ltd., Bedford. My 'fitting test piece' had been to transform (by hammer, chisel and file) two pieces of round steel bar into rectangular shapes, with one passing through the other in any direction, losing 1% for every one thou gap, or out-of-square, or off-centre. This left me with bruised and blistered fingers and a lifelong admiration for all skilled craftsmen. So also did learning to operate machine tools, working in the pattern shop and foundry, and building and testing large diesel engines, electrical generators, steam turbines, pumps and even steam engines.

"In 1963 I applied for a job at Harland Engineering in Alloa, giving a step up to a more senior position. I was interviewed by the MD, Kenneth Atchley, son of the founder. He was a man of the old school (Oundle) but very capable and a trained engineer. He gave me a Saturday morning tour of the Works, and when I saw a large boiler feed pump set up for test with its mountings rigidly welded to the floor rails I thought 'no-nonsense Scottish engineering' and decided this was for me.

"Before leaving Allen's I had produced an exact mathematical correlation between 'relative eddy' and Area Ratio (later published in IMechE Proceedings) based on a circular casing throat. By introducing this at Harland, we were able to combine the two methods and plot test feedback against theory.

"The late 1960's saw CEGB (Central Electricity Generating Board) at its peak, demanding ever bigger and better boiler feed pumps from Harland, Sulzer and Weir. All three companies were asked to design 'Advanced Class' boiler feed pumps for 660MW generating sets.

"These were exciting times, with Sulzer and Weir going for two-stage pumps and Harland for three-stage. However, at Harland we were thinking forward to a single stage pump. I got the job of designing a test pump to investigate the problems of such a high head device, with a duty of 6000 feet head at 23,000 revs/min and absorbing 3000 hp. The six inch impeller did eventually exceed these conditions. I believe this makes it the highest power density water pump impeller ever.

"After the Weir takeover, I was involved in a very interesting information exchange exercise under an agreement with Worthington in the USA. This introduced me to several legends whom I came to know well, such as Warren Fraser, Gus Agostinelli and Igor Karassik. Later I took over responsibility for hydraulic design and development for Weir Pumps.

"Come the recession of 1983, Alloa was practically closed down and redundancy came. I got the job of Director – Fluid Machinery Design based in Europe for Worthington USA. Most of my time was spent in Italy where the more advanced developments were taking place. Here I learnt the meaning of 'style', which all Italians seemed to be born with and which showed in their work. The MD, Antonio Bonaso, was clever, vital (he played table tennis after lunch) and one of the most charismatic men I have ever met. I visited many of the United States and found the engineers to be highly articulate. One of the top Worthington priorities was the development of a modern boiler feed pump. To find out what the market wanted I did a survey. I clearly remember interviewing a top Contractor on the 86th floor of the World Trade Centre, watching helicopters pass below. I often wonder if he survived 9/11.

"In late 1984 (shades of George Orwell) Dresser acquired Worthington from McGraw-Edison. Eventually my job again disappeared. Having been in the wrong place at the wrong time twice, I decided to work for the only person who couldn't fire me: myself. Working for dozens of very varied clients (makers, users, contractors, consultants, etc.) has been fascinating."

Dad retired (sort of) in 2009 and enjoyed his involvement with IMechE Fluid Machinery Group, including a stint as Chairman. His other engineering loves were the Flying Scotsman (of which he owned a bolt!) and especially the Vulcan XH558 of which he was a Founding Guardian; we decided to set up a Vulcan 'just giving' page as it felt a fitting tribute to his memory.

Dad was meticulous, generous, kind, funny and decent. After 62 years of marriage, he is terribly missed by our mother Margaret and his family.

He truly was an engineer and a gentleman.

A youthful enthusiam for new research

DINAKAR PURUSHOTTAM DANI (Mech Eng 1935-39)

This obituary was provided by his sons, Ashok & Ajit Dani:

Our father, the late Mr Dinakar P Dani, was 96 years when he passed away in 2010. He was born on the 18 March 1914, and graduated from Imperial College in Mechanical Engineering in 1938 with a broad appreciation of technical and engineering issues. He was a Life Member of CGCA.

Imperial training instilled in him the importance of scientific rigour combined with lateral thinking and inventiveness, something which stayed with him throughout his career.

His approach to problems, whether at work or at home, was on a 'project' basis and he frequently thought 'outside the box'.

He enjoyed his time at Imperial College and frequently recalled with fondness his memories of teachers and friends, life and learning at the college.

A few months before he died, he read with great interest and enthusiasm the current quest of one of the major oil companies to obtain diesel fuel from algae with enhanced yield through application of enzymes. With great enthusiasm he wrote to me that, on his return to India all those long years ago, he was working for a chemical company which manufactured soap from palm oil. In addition to his routine work he started experimenting with algae as he instinctively felt it had potential as a fuel. He wrote saying he felt young and enthusiastic again and wanted to see a successful outcome of that research, albeit via biotech, and wanted to live a few more years to see it happen in his life time.

He focused his career on developing India's infrastructure through a wide variety of turnkey projects, such as building bridges, dams, power stations, railway tunnels and heavy engineering and chemical factories.

He patented a special piling method suitable for Mumbai soil.

He held privileged positions as Chief Engineer in major firms such as Heavy Engineering Corporation, Hindustan Organic Chemicals and Hindustan Construction.

Above all he was a family man. His wife predeceased him by a few years and he wanted to be remembered simply as the husband of Asha Dani, our mother.

Taking finals during air raids!

Prof JOHN COURT (JACK) LEVY OBE, (Mech Eng 1943-45)

Jack Levy was born in London on 16 February 1926.

He was a pupil at Dame Alice Owen's School in Islington from 1937 to 1943, before entering City & Guilds College to study for his bachelor's degree and ACGI in Mechanical Engineering.

He graduated in 1945, having taken his final examinations during air raids.

After several years in the aircraft design industry, he joined the City University, London (then known as the Northampton Polytechnic), as an Assistant Lecturer.

In 1953 he applied for and was awarded a Fulbright scholarship, that took him overseas to the University of Illinois, of which he said:

"I selected as my destination the University of Illinois because of its track record in materials research."

Having recently married, Jack took his wife, Sheila, with him to Illinois on what was essentially an extended honeymoon. At the University of Illinois in Champaign, south of Chicago, they stayed in an apartment owned by the university, and Sheila was employed in the art department of a publishing company linked to the university.

After graduating with his Masters Degree in 1954 (his Master's Thesis was entitled 'A Study of Strain-Aging in Fatigue'), he and Sheila, in his words: "Bought a Studebaker from a departing student – the custom in those days – and drove all the way to San Francisco and then back to New York where I sold the car for $50 more than I paid."

Returning to London and his post at Northampton Poly, he built up his research work, gained his PhD, and in 1966 became a Professor then Head of the Department of Mechanical and Manufacturing Engineering of the re-named City University.

He was subsequently pro Vice-Chancellor of City University during the 1970s and early 1980s, and at the same time director of a 'spin-off' university company named City Technology Limited. Also, for 20 years, he consulted on ship structures for Shell International Marine.

In 1983, he joined the newly formed Engineering Council as 'Director – Engineering Professions'. In this post he carried executive responsibility for the national development of Engineering Degree and Training standards; also for the international contacts of the profession to negotiate agreements for the recognition of UK degrees. He held this post until 1990.

Having, in his words, 'retired more than once', he then returned to his roots as a design engineer. He set up and ran 'Levytator Limited' a company formed to exploit his new design of escalator, which was patented in Europe, the USA and China (See Levytator at http://bit.ly/IE29-Levytator).

In 2013, Jack was honoured with a 'Distinguished Alumni Award' from the University of Illinois where he spent his Fulbright year, and he returned to Illinois for this to be presented.

Jack was a Fellow of the Royal Academy of Engineers, the Institution of Mechanical Engineers, the Royal Aeronautical Society and the Irish Academy of Engineering.

He held honorary doctorates from four UK universities, including City. In 1984 he was made an OBE, and in 1993 a Freeman of the City of London.

In 1999 he was awarded the Gold Medal of the World Federation of Engineering Organisations.

Jack joined the Old Centralians whilst at City & Guilds College, and retained his membership of the Old Centralians, and CGCA, throughout his career and thereafter.

He died on 27 October 2017, at the age of 91, and is survived by his wife Sheila, three children and seven grandchildren.

An exceptional supporter of RSM

RON BUTLER (Metallurgy 1949-52)

Ron was a member of RSMA and, until relatively recently, leader of alumni activities in Sydney, NSW.

He studied at the Royal School of Mines from 1949-52, and said later that the combination of Metallurgy, with Geology as a subsidiary, fitted him well for his later career, managing broad-based mineral consulting projects.

After graduating, Ron worked in the UK and Canada before moving to Australia.

He told John Sykes, International Vice President:

"On arrival in 1961 in Sydney, we received a very warm welcome from the RSMA rep, Brigadier Dicky Foot (Mining 1910-14, 1919) and we became good friends.

"When he died suddenly, in 1969, I took up the reins and have held them ever since!"

Ron was a metallurgist with Consolidated Tin Smelters from 1961.

From 1967-69, he was Project Manager at the Cape Flattery Silica Sand Mine. He said:

"I saw this operation through from detailed exploration to initial export production. It is gratifying to see that it is still in operation, exporting 2-3 million tons of high grade glass sand per year to Japan."

Ron moved to Macdonald Constructions in 1969.

Then, in 1971, he moved again, to become Chief Metallurgist with Robertson Research Australia, where he stayed to become MD in1979 and Chairman in 1987.

As a self-confessed "soft touch when volunteers are required", Ron spent his time not just helping RSM and Imperial alumni, but also being involved in a variety of activities; ranging from the JORC Committee (about 15 years), Mineral Industry Consultant Association (Founding Member 1981, Chairman 1990), to providing computer activities to nursing home residents.

Ron received the Peter Harding Medal in 2012.

The Peter Harding medal was set up in recognition of the contribution that Peter made over many decades to the RSM and IC communities as a student and an alumnus.

The prize is awarded annually to a person who has demonstrated sustained commitment and outstanding contribution to the Royal School of Mines and/or Faculty of Engineering.

Ron not only gave exceptional support to the RSM, but also to the wider College and mining industry:

He passed on Friday 3 August, 2018.

He is survived by his wife, Judith and family.

Ron Butler receiving the Peter Harding medal in the Customs House Bar in Sydney