



# Imperial ENGINEER

**FINANCE FOR  
UNDERGRADUATES**

**CARIBBEAN GOLD**

**BEST PROJECT  
HANDLING?**

**NUCLEAR FUTURE**

ISSUE SIXTEEN SPRING 2012

For members of The City & Guilds College Association and The Royal School of Mines Association

# In this issue...



## ASSOCIATION NEWS & REVIEWS

- 3 Presidents report
- 4 Decade Lunch
- 4 New Indian alumni association
- 5 On-line student help
- 5 Historic Bottle win
- 5 Graphene lecture
- 6 Diary dates
- 6 CGCA dinner
- 6 RSMA dinner
- 7 Student unions report
- 22–27 Alumni news and views
- 26–27 Obituaries

## FACULTY NEWS

- 8, 9 Developments around the Engineering Faculty

## FEATURES

- 10, 11 Electric land-speed record
- 12 An appropriate process?
- 13 Prince Philip retires from City & Guilds
- 14, 15 21st century Caribbean gold
- 16, 17 Investigating the desert
- 18–21 Small reactors and a nuclear future
- 21 Comment & Review



**COVER: Above luxuriant vegetation in the Dominican Republic. Below, gold is being mined. Picture by Robert Hildebrand. Article page 14 to 15.**

## Imperial ENGINEER

### EDITORIAL BOARD

Bill McAuley (Managing Editor)  
Bill Bradford  
Paul Holmes  
Chris Lumb  
Colleen Shilstone Richardson  
Teresa Sergot

### PRODUCTION EDITOR

Lynn Penfold

### PRINTING

Bishops Printers, Portsmouth

### CORRESPONDENCE and ENQUIRIES

Teresa Sergot  
Engineering Chapter  
Level 2, Faculty Building  
Imperial College, London SW7 2AZ  
Tel: +44 (0) 20 7594 1184  
Email: [t.sergot@imperial.ac.uk](mailto:t.sergot@imperial.ac.uk)  
Website:  
[www.imperial.ac.uk/engineering/alumni/](http://www.imperial.ac.uk/engineering/alumni/)  
CGCA website: [www.cgca.org.uk](http://www.cgca.org.uk)  
RSMA website: [www2.union.ic.uk/rsm/rsma/](http://www2.union.ic.uk/rsm/rsma/)

STORY IDEAS FOR THE NEXT ISSUE BY AUGUST 13 2012

FINAL COPY DEADLINE: SEPTEMBER 28 2012

The editorial board of *Imperial Engineer* reserves the right to edit copy for style and length

*Imperial Engineer* is printed on Forest Stewardship Council registered paper



THE END of my term as president is approaching fast and this is the last time that I will be writing the welcome in *Imperial Engineer*. It has been a great honour to be your president for the last two years. Particular highlights for me have included the many opportunities I have had to meet members at the City & Guilds Association's (CGCA) social events and the opportunity to work closely with the members of the General Committee – a group of volunteers who work tirelessly on your behalf.

As I hand over to my successor, I am pleased to see that our attempts to boost membership, particularly amongst fresh graduates, are beginning to take shape. Largely thanks to Nigel Cresswell's enthusiasm, the CGCA is beginning to embrace social media as a vehicle for maintaining contact with the membership and to foster more active participation in topical debate. Our new approach to student membership is almost certainly going to result in more fresh graduates retaining their links to CGCA after they graduate. I am also happy to report that, after some difficult times during the last few years, we now have a very constructive relationship with the College's alumni office.

The annual dinner this year was, as always, very enjoyable. Professor Sir William Wakeham (Bill) gave an entertaining and very interesting talk (see report on page 6). I apologise to those who missed out on tickets due to the restricted numbers at Cutlers' Hall.

Next year is the 100th dinner and we hope to have a venue that will accommodate about twice the normal number of guests. I hope to see many of you there and look forward to enjoying the Association's excellent wines and port – something that, as president, I never quite managed to do (because of my speaking responsibilities)!

We have enjoyed a very close relationship with CGCU over the last year. We would like to continue to build on this and the students have asked if we could provide Association speakers for student events. They are keen to have experienced alumni who can talk about their careers and give advice to current students. If you are interested in doing this, please contact Nigel Cresswell.

Thank you for your support over the last two years and best wishes to my successor. The Annual General Meeting will be on June 13 this year and I hope to see many of you there.



**Chris  
Hankin**



**Mark  
Burridge**

## PRESIDENTS REPORT

THE RSMA has been very active over the last few months. Our annual dinner, where Richard Lloyd gave an amusing speech, was well-attended. At the dinner, the Peter Harding medal was awarded to Alan Dickson for his work keeping alumni together in Australia. (See article, page 6) Edoardo Borgomeo (Earth Sciences and Engineering) also received the prize for his essay on 'Science and Engineering in the Future of Venice'. RSMA also sponsored, and some alumni attended, the first Materials Society dinner.

You will also be pleased to know that we won the Bottle Match again with an amazing margin. (See page 5) We have also continued to make progress in encouraging more membership and will be conducting another drive for this later this year.

The new London Sundowners ran successfully at the start of the year and John Sykes is working on setting up a regular programme. The students have also asked for a joint event, so John will look into this too. In the longer term, John is looking for a London-based alumnus to organise these event on an ongoing basis.

There has been less progress in organising international Sundowners, due to some problems accessing the database, but John is intending to produce an international calendar to be printed in the autumn *Imperial Engineer*.

Turning to electronic means of keeping in touch, membership of the LinkedIn Group is now approaching 1,000 members and John is open to suggestions on how to make the best of the Group. He's also looking for a student to run the Facebook group(s) and a Twitter account. Meanwhile, junior vice president Elly Jay is recreating the RSMA website.

Another initiative being launched this year is the 1851 Club. Initially, its target will be to raise enough money from mining, oil, materials, engineering and finance companies so that the annual interest can fund the DLB fieldtrips and symposium, the new (and to be annual) Materials Society dinner, support students in gaining practical experience and a new activity (maybe a symposium or industry visit). Although these ambitions seemed fairly modest, we feel that having some small-scale early successes would get the ball rolling. We'll let you know more about this at the annual dinner.

We have now set the dates for the AGM/summer barbecue and the dinner. They will be held on Thursday June 28 and Friday November 30 respectively. Please save the dates. Please also reach out to your fellow alumni to let them know in case they are not on the mailing list (and if they are not on the mailing list, ask them to update their details and, if necessary, 're-join' the RSMA). For those in the mining field, you will note that the annual dinner is the Friday before the Mines and Money week so hopefully this will make it more convenient for overseas members to attend.

## CGCA alumni links grow

'THE CGCA LinkedIn group has passed the 370 members mark, drawn from alumni, staff and current students,' writes hon sec Nigel Cresswell. It is one of the channels CGCA uses to communicate with members and prospective members.

'We've had a number of discussions about engineering and the future direction of CGCA, as well as announcing events and helped in tracking down the supplier of CGCU scarves!' continued Nigel.

'All members of the group are able to start discussions and post comments, so please take advantage of this to interact with other members. It's free to register on LinkedIn. To do so, search the groups' list for City & Guilds College Association' and submit a request to join. Make clear your connection with the Faculty of Engineering.'

## Wine tasting

THIRTY alumni, students and guests enjoyed a wine tasting in March, sponsored by the CGCU and CGCA. The wines were both new and old world, priced from £9 to £40 a bottle giving a good impression of what one gets for one's money. Winner of the tasting was Rudolf Umla and then it was off to Bill Wyman's Sticky Fingers restaurant to complete the evening.

## Thinking alike

REPRESENTATIVES from CGCA recently met Imperial's Office of Alumni Development (OAD) to discuss improving cooperation. One area that would work well for all parties is to encourage CGCA members to attend OAD events around the world.

**More to follow?**  
FOLLOW computer links at the end of articles throughout this issue to read more. Or go to [www.imperial.ac.uk/engineering/](http://www.imperial.ac.uk/engineering/) to read more of articles marked at the end with an asterisk \*.

## New alumni association in India

IMPERIAL'S Rector Sir Keith O'Nions launched a new chapter of the Imperial College Alumni Association of India, Bangalore, during his visit to the country in December. It incorporated stops in four cities in five days. He hosted a reception on December 2.

Alumnus Vibin Joseph, who graduated from the Business School in 2008, is the new chair of the Bangalore chapter. Speaking at the event, he said: 'The Bangalore alumni I've met tonight are extremely keen about the new chapter. It will provide a great opportunity for

the younger alumni to look up to the older generations for guidance and advice. This club could become an aspiration for the next community of Imperial students who are applying and will hopefully become part of this community.'  
<http://bit.ly/w3QjG9>

## Civil servant joins management

NEW COLLEGE secretary and registrar, John Neilson, started work on May 1. He replaces Dr Rodney Eastwood, who gave almost 25 years service to the College, taking Imperial through many key moments in its history. He has headed into retirement with the gratitude and fond appreciation of the entire Imperial community,

Previously, John Neilson was director of financial management in the Ministry of Defence. He also spent six years as director of research based in the Department for Business, Innovation & Skills, where he advised on the £6 billion spent annually on public research in universities and institutes.

The college secretary is one

of the College's principal administrative officers, and John is now responsible for the registry, the central secretariat, health and safety, risk management, legal matters and internal audit. Alongside these he is clerk to the Imperial College Court and Council, and joins the College's management board and the senior management committee.



## Four decades hear about present

ALUMNI from four different decades – 1961, 1971, 1981 and 2011 – gathered at the Polish Club in November. The decades would have been one greater if John Macara, who graduated in 1941, hadn't been prevented at the 11th hour from making the journey from his home in Beaconsfield.

The 53 attendees included some 38 alumni, accompanied by 11 partners and friends and four current students, who all enjoyed an extended catch-up session over a drink before sitting down for a hearty lunch, with Spanner and Bolt in attendance.

Once all were seated Professor Chris Hankin, CGCA president, set the scene by extending a warm welcome and gave a brief resumé of CGCA news, and of current life in the Faculty of Engineering and College as a whole. As the meal got under way, organiser David Law (MechEng 73) called on representatives of each of the decades present to share their own particular reminiscences during the gaps between courses.

First to speak was Alan Higginson (Elec 81), one of the organisers of a very active

group of 1981 graduates who meet most years. Alan was followed by two members from the Civils class of 1971 - David Sorton and Tony Atkins. Next came Professor Ron Lawes (Elec 61), who ended his remarks with a passionate plea for the reinstatement of the 'City & Guilds College' name, demanding 'Give us our College back!'. For the current students, CGCU president, Jacky Kwan, gave a run-down on student affairs, before calling on all alumni and students to share in a Boomalaka.

Once the meal was over, some members were taken on tours of the campus, whilst others repaired to the rear of the Club, in Princes Gardens, where Bo was waiting to give rides around the locality.

As has often been the case, the success of this event could be judged by the reluctance of many to drag themselves away. Even on leaving, most were already making plans to attend again in 2021! **Chris Lumb**

**Top left, David Sorton. Centre, in the foreground, David, Lizzie Ackers and Tony Atkins. Right, Professor Ron**

## On-line student help

AN online calculator has been launched by Imperial to help prospective students get a better grasp of financial support available.

They and their parents can input details about their financial circumstances and get tailored information on the support they may be entitled to, from both Imperial and

government sources.

Rector Sir Keith O'Nions said: 'It gives anyone considering study at Imperial clear advice on what support they may be eligible for. It reinforces our message that if you have the ability to manage our courses, we will help you manage your costs.'

<http://bit.ly/tyadu0>

## CGCA date for AGM

THE DATE of CGCA's AGM is starting at 17:30, on Wednesday June 13, in the Pippard Theatre, Level 5, Sherfield Building. (Refreshments will be available from 17:00 on the Level 5 Concourse area, outside the theatre.)

After the election of officers, the new president, David Nethercot, will speak about 'Stealing the Mind'. This will be followed by supper in the Senior Common Room, on the first floor of the Sherfield Building for which a charge will be made.

See the enclosed flyer or contact Teresa Sergot for more details and bookings.

IN ITS 110th year and playing away in Cornwall, this year's Bottle Match was always going to be something special. This is the biggest weekend of the year for any Royal Miner and it always delivers high-tension, heavily-contested matches, too many streakers, banter and sore heads the next day.

With 150 people on board the coaches left London and made it to Cornwall in record time, before becoming stuck up a country lane and one having to be pushed out of the mud!

### Good start

We arrived at the caravan site a little late but had the comforting news that during our travels the Squash and Golf teams had won and drawn their respective contests. So the first two trophies of the weekend were returning to London (or would have done if the Golf captain hadn't got theirs stuck up a tree).

Saturday saw the bulk of the weekend's action and over-

## RSMU gains an historic victory

all great performance from the RSM students.

Ladies' hockey was first on the agenda, but after a hard-fought game CSM emerged victorious with a 2-1 win.

Next up was the men's hockey where two equally matched teams were locked at 1-1 at half time. The final quarter yielded two goals for the home side and left a score line which did not reflect the quality of RSM 3 - CS 1 RSM.

RSM netball were caught

slightly off-guard by a surprisingly strong CSM team, taking a heavy beating in the first quarter and eventually losing 38-29, a shock result and the first time that RSM has lost in this competition.

### Best result

In a stark contrast to the usual progression of Bottle Match football, the RSM lads put in a stellar performance and worked out a 0-0 draw against a quality CSM side. This marks RSM's best result

since 2005.

Finally the focus moved on to rugby, with a chance for the RSM to turn around a weekend which had begun to look a little sour.

The game kicked off and showed the Camborne miners' distinct lack of preparation and control and they earned a yellow card after just three minutes play. RSM used this opportunity to apply pressure, maintaining possession and field position but being unable to score until a 35th minute try was capitalised upon to bring the score to 7-0 at half time.

After this, the CSM side grew tired and the skill and fitness of the RSM shone through. After three more tries for the RSM without reply from the home side, our boys walked off the pitch with heads held high, chalking up an historic 22-0.

After a successful weekend, the Bottle remains to grace the Union Bar for another year, and the Royal Miners returned to London victorious. **Richard Simons, RSMU president**



## Graphene subject of lecture

A DESCRIPTION of his Nobel Prize-winning work on the 'flat' carbon material graphene was Professor Sir Konstantin Novoselov's subject for Imperial's Kohn Award Lecture. This annual event allows the public hear a talk by a top scientist.

Professor Novoselov, from Manchester University, explained why graphene, with its unusual properties, is a promising candidate to revolutionise the telecommunications and electronics industries.

By stacking ultra-thin layers of graphene and other two-dimensional crystals with different conducting and magnetic properties, scientists hope to develop cheaper and faster, more compact and more flexible electronics, which could be used to make discreet handheld or wearable devices.

In October 2011, the UK government pledged £50m towards more research into graphene and developing practical applications.

THE RSMA committee is hoping that as many alumni as possible will attend the AGM at 18:30 on Thursday June 28. The venue is College Room, 58 Prince's Gate, Prince's Gardens. The meeting will include the election of officers for the 2012 - 2013 academic year.

Following the AGM, at 19:00, president, Mark Burridge will host a barbecue for alumni and the final year students of the RSM who have just completed their academic studies.

## RSMA plans student send off

Alumni will welcome them into the RSMA. The barbecue will be held in the Garden Room and Terrace at 58 Prince's Gate.

Please see the enclosed flyer or contact Teresa Sergot for more details and bookings.

## DIARY

### Saturday May 12

Imperial College/Chapter  
Imperial Festival – Annual  
Alumni Reunion. Alumni  
Hub: Foyer Mech Eng  
Building.

### Wednesday June 13

CGCA AGM & President's  
Evening: Pippard Lecture  
Theatre 17:30. Supper:  
Senior Common Room  
19:30. Booking form on  
back of address carrier.

### Tuesday June 19

Faculty of Engineering  
Teaching Awards Ceremony  
and Reception: RSM  
Building, Room 131, 16:00

### Thursday June 28

RSMA AGM /Final Year BBQ:  
58 Prince's Gate, AGM  
18:30, BBQ 19:00.

### Thursday October 25

Careers Advisory Service/  
Chapter, Engineering  
Careers Fair: Queen's Lawn  
Marquee.

Alumni Networking  
Reception. Venue: tbc

### Saturday November 24

CGCA 2012 Decade  
Reunion Luncheon: Polish  
Club Ognisko, 55 Exhibi-  
tion Road, 12:00 for 12:30.

### Friday November 30

RSMA 128th Annual Dinner:  
Ballroom, Polish Club  
Ognisko, 55 Exhibition Road,  
19:15 for 20:00.

### LONDON WALKS

#### Saturday June 9

Walk around outside of  
Olympic site and view  
of the site (Despite best  
efforts, for security reasons,  
not allowed inside).

All welcome. Please email  
johnsheilabackhurst@tiscali.  
co.uk for further details

**More information  
and booking for any  
events, contact  
Teresa Sergot  
t.sergot@imperial.  
ac.uk or phone  
020 7594 1184**

## RSMA dinner told importance of contacts

'CONTACTS dear boy, contacts' could be the traditional summary of the speech by Richard (Lloyd) Lloyd at RSMA's 127th dinner last November. It was all part of his advice on how to go about getting a job. And always support friends, he said!

Earlier, president Mark Burrige had begun the speeches by remembering all alumni, complimenting his committee on keeping the RSMA going, welcomed guests and, especially,

thanked Teresa Sergot for her continuing help and organisation of the evening. He also spoke of the 1851 Club and the drive to raise sponsorship of study courses.

After senior vice president John Sykes had welcomed and named the guests and RSMU president Richard Simon had replied on their behalf, two awards were made.

Sadly, Alan Dixon was unable to travel from Perth,

Australia to receive the Peter Harding Medal. Instituted as a tribute to a man who did so much for RSMA, it is given to someone who has followed his lead. It was received for Alan by John Monhemius.

Earth Sciences Engineering student Edoardo Borgomeo won the prize for the best essay. See the next Imperial Engineer for his views on science and engineering for the future of Venice.



**Matt Cockayne, Roger Davey, Mark Burrige, Elena Clarici, Coen Louwart, listen to speaker Richard Lloyd.**

## Economy needs engineers – CGCA speaker

THE CGCA'S annual dinner followed a traditional pattern against the background of the magnificent Cutlers' Hall (right) After the guests had processed behind the mascots, Spanner and Bolt, over 120 sat down for an excellent dinner accompanied by wine from CGCA's 'cellar'.

Also during the course of the even, presentations were made by Prof Richard Vinter (dean of Engineering). They were to Hai Ming Tan, winner of the Holbein Memorial Award for being a 'sportsman' in its widest sense, chosen by CGCU.

This year's senior Bo driver Robert Goodwill received the Peter Moore Memorial Award, while Roger Liew received the Jessel Rosen Travel Award. Backed by the Award, Roger was student chairman of the E, quinox project for which students have designed, built and installed solar-powered 'energy kiosks', to provide battery charging facilities in Rwanda.

Speaking on the evening after the launch of the Queen Elizabeth



Prize (QEP) for engineering, Sir William Wakam spoke about his belief in the importance of educating engineers.

As he said: '...it seems that only recently has our political leadership recognised that...to compete in the modern world, the education of scientists and especially of engineers must be maintained and enhanced. Of course this...has not led yet to a recognition that such enhancement merits further investment, but we must travel hopefully.'

As senior vice president of the Royal Society of Engineers

and the Lords' advisor on educating engineers, and now chair of the global search committee charged with soliciting nominations for the QEP, he is in a position to help. Apart from helping recognise significant engineering achievements and engineers, it is also intended to promote engineering in the public mind worldwide.

President of Engineering Faculty Prof Jeff Magee replied on behalf of the guests. Especially he thanked Sir William for his scientific and humorous joke about hell freezing over!

# RSMU spirit still strong within students

by RSMU president Richard Simons

THIS YEAR has seen another great intake for the RSM, with huge amounts of interest from first year students as well as continued involvement from students returning from summer vacation.

Changes to several Imperial College Union policies have changed how we run bar nights and other events, but the spirit of the RSMU still lives strongly within its students.

The RSMU continues to

provide social and sporting relief for the students of Materials and Earth Science and Engineering as it has done for many years.

In recent years the RSMU has been growing in influence and responsibility, following re-acknowledgement as a constituent union in 2010 and the recent changes to allow greater representation of the welfare needs of RSM students.

This has occurred whilst the students of the RSM still sit (incorrectly in my opinion) within the jurisdiction of the CGCU.

In short, we are in good health as an institution, our students feel welcome and at home. It is hoped that the work to bring the RSMU to bigger and better things will continue for many years after.

On Friday March 9, the

MatSoc (Materials Student Society) annual calendar reached its zenith with its first formal dinner with alumni held at the Rembrandt hotel, Knightsbridge. The event was coordinated between MatSoc, with president Jim Hickey, and the Materials department. Current and past members of the department were in attendance.

The evening was an outstanding success and it was fantastic to see so many alumni come from far afield to join us for an evening of meeting, greeting, eating (and drinking!).

I would like to thank the RSMA and the Department of Materials for their support of the evening. As the dinner will be held annually from now on, we can't wait to see what next year brings.



**Junior vice president Elly Jay (left) with colleague Emily Warriss, enjoyed the RSMA dinner last November (Picture and those of RSMA dinner by Douglas McIlraith).**

# CGCU has record-breaking year

by CGCU president Jacky Kwan

THE CGCU has had an exceptional year in academic and welfare representation as well as social events.

We kick-started the year with the welcome dinner and after-party at Café de Paris, in Piccadilly Circus, marking the flagship event of the year. The party attracted over 600 students, testing the 700 capacity of the venue. Tickets were sold out even before term began.

Notable guests among attendees included former CGCU presidents, CGCA president Prof Chris Hankin and Engineering Faculty principal Prof Jeff Magee. The event was concluded with a traditional Boomalaka and short speeches.

A string of fantastic events filled the winter term, including the annual London to Brighton Run. This year's Bo team managed to carry the CGCU president and guest, head of Electrical & Electronic Engineering Prof Peter Cheung, to Brighton

in a record-breaking six hours flat with no mechanical faults or failures!

A more career-orientated networking dinner proved to be extremely popular in late November with 10 companies mixing with 150 bright-minded students.

Social events continued strongly in the spring term with a club night in Kensington and a boat party which was held jointly with the RCSU and RSMU. A group of enthusiastic students attended the CGCA annual dinner in late February (pictured).

## Record turn-out

Finally the term finished with a remarkable election. CGCU is thrilled to announce that, as a result of the phenomenal year, we had a brilliant, record-breaking election turnout, 45% of the 6000 students faculty participated, up from the 35% last year!w

Last, but not least, we are

extremely delighted to have strengthened a close relationship with CGCA.

Examples of our successful joint-organised events are a CGCU-CGCA dinner at Med Kitchen, Gloucester Road and wine tasting night at Roberson's wine merchants in High St Kensington.

These wonderful events are found to be highly popular (judged from number of attendees and feedbacks received) and would not have happened without generous supports from the CGCA.

On a final note, the Union has become bigger and better than ever and we are keen to continue the on-going success.



## DEVELOPMENTS AROUND THE ENGINEERING FACULTY

### Water use affecting India's climate?

RESEARCHERS from Civil and Environmental Engineering are part of a £1.1 million UK and Indian academic collaboration working to determine if water usage in northern India over the last 50 years is affecting the climate.

To do this, they are developing the most comprehensive computer models yet of the water cycle in the Ganges basin to determine if overuse of ground water resources is impacting on the fragile monsoonal climate in the region.

### Doing what comes naturally

A PROTOTYPE system for recovering drinkable water and harvesting hydrogen energy from human faecal waste is being worked on in Materials. It could provide an inexpensive way for people in the developing world to improve their life-styles.

'In the future, we may see homes in the UK generating their own clean water, energy and fertiliser simply by doing what comes naturally once or twice day,' said Dr Martyn McLachlan (Materials). <http://bit.ly/yRtTgC>

### Eyes right

A TEAM in Bioengineering, led by Aldo Faisal, has developed low-cost eye tracking technology to help people with limited mobility to interact with devices, such as a computer mouse or wheelchair, using only eye movement.

The eyes are directly wired to the brain stem so are not affected by spinal cord injuries. <http://bit.ly/vpcMEU>

**The source of most of these articles is the College's press releases. For more on these stories go to [www3.imperial.ac.uk/news](http://www3.imperial.ac.uk/news) or use the links at the end of some articles.**

### Machine could be prescription for success

SOME of the nation's leading science, defence, engineering and health journalists came to Imperial in December to hear about the launch of an £8 million research centre to combat the devastating effects of roadside bombs.

The Royal British Legion Centre for Blast Injury Studies at Imperial is the first collaboration of its kind in the UK, where civilian engineers and

scientists will work alongside military doctors, supported by charitable funding. The aim is to reduce the effects of roadside bombs or Improvised Explosive Devices (IEDs) which are the leading cause of death and injury for service personnel on operations in Afghanistan and Iraq.

'Previously, servicemen and women, wounded by blasts,

would have died from their injuries. Now military protection, medical science and practice has improved greatly so that there is a greater prospect of survival,' says Professor Anthony Bull (Bioengineering).

'We urgently need to know more, so that we can protect and treat people more effectively,' he added.

<http://bit.ly/uDIbde>

**A NEW carbon capture pilot plant, the most sophisticated in a university anywhere in the world, opened at Imperial in April. The £2 million unit, in collaboration with ABB, gives chemical engineering students the chance to train in a state-of-the-art facility. The plant separates 1.2 tonnes of CO<sub>2</sub> a day from other emitted gases, then stores and recycles it.**

**The plant's controls can be accessed remotely from phones and iPads, and students will learn how to manage emergencies by taking part in simulations. 'By providing this intense training**

### Pilot plant captures carbon



**before they begin their careers, we aim to give our graduates the best possible start and provide industry with the type of high-calibre, well-trained employ-**

**ees that they are crying out for all over the world,' said Dr Daryl Williams (Chemical Engineering), director of the Pilot Plant Project.**

### Helping Russia's sustainability

A £9.3 million project has been established to make oil refining in Russia more efficient and environmentally sustainable. The Skolkovo Foundation has given official approval for the establishment of a Centre of Applied Research on Heat Exchange and Catalysis, involving Imperial, the Borekov Institute of Catalysis and British Petroleum.

Researchers at the Centre will run the UNIHEAT project, which will focus on increasing energy efficiency and reducing heat loss in oil refining by up to 15% through improving refining operations, enhancing oil production processes, and reduc-

ing CO<sub>2</sub> emissions. Professor Sandro Macchietto (Chemical Engineering) said: 'Imperial has a strong track record of working with industry around the world to find innovative solutions to make the refining process more efficient and sustainable.'

### Paralympic future

A MIND-controlled bobsleigh and a sport in which players fly using magnetic propulsion were among Imperial students' inventions for the Paralympics of the future.

The equipment devised by Innovation Design Engineering students, from Mech Eng was on display in the College main entrance.

<http://bit.ly/y69NI4>

### Dig deep on Mars

'FUTURE NASA and ESA missions planned for Mars will have to dig deep for evidence of life, which may still be taking refuge underground,' Dr Tom Pike (EEE) told a recent European Space Agency meeting.

He and his team, taking part in the 2008 NASA Phoenix mission, found that despite an abundance of ice, Mars has been experiencing a super-drought that may well have lasted hundreds of millions of years.

'We think the Mars we know today contrasts sharply with its earlier history. This had warmer and wetter periods and may have been more suited to life', Tom said.

## DEVELOPMENTS AROUND THE ENGINEERING FACULTY

RESEARCHERS from Materials are in a race against time to help save the last remaining intact World War II German light bomber – a Dornier Do-17 – known as The Flying Pencil (*Fliegender Bleistift*).

Lying underwater off the Kent coast, it is now exposed to the corrosive effects of seawater which threaten to destroy the plane entirely.

Dr Mary Ryan (Materials) said: 'This is the last remaining intact Flying Pencil of its kind in the entire world, so the significance of this project to our history can't be underes-

timated. We've been analysing fragments already brought to the surface. It's absolutely fascinating to see how this bomber, which crash-landed more than 70 years ago, has been so well-preserved until now by the layers of sand. We are relishing the challenge to find a way to help save this historical treasure, so that it can be raised and put on display for future generations.'

Materials will also work with the Royal Air Force Museum to prevent the aircraft from corroding further after lifting from the Channel.

### Challenge to save bomber



**Dr Mary Ryan and Dr Amy Cruikshank with a piece of the Flying Pencil.**

### Microphones on a mission

ELECTRICAL Engineering researchers are using an electronic compass, microphones and a microchip to work out the direction and distance of gunfire.

Dr Dylan Banks said: 'We're using MEMS (micro-electromechanical systems)-based mi-

crophone technology, which is allowing us to integrate microphones within clothing fabric because they're very small, lightweight and very low power. Military personnel don't even notice the difference in weight wearing 10 microphones in the cover of their helmets.'

### Brighton involvement

IMPERIAL academics, students and alumni were on hand at the London to Brighton RAC Future Car Challenge. They lent a hand assessing, judging and competing, with more than 60 cutting-edge, low-emission vehicles. Others present will use data recovered from the cars, for their PhD research.

Dr Ricardo Martinez-Botas (MechEng) who was one of the technical judges, said: 'This is the second year of the Future Car Challenge and it's great to see Imperial so involved at all levels. Imperial has a strong track record in low emission vehicle research.' <http://bit.ly/t5NQoC>



**IMPERIAL College Robotics Society (ICRS) is preparing to enter the third Eurobot contest, with the ambitious goal of coming in the top third of teams worldwide. The Old Centralians' Trust helped sponsor their entry last year, when their competing robot (above) had to move chess pieces. It had already won the UK round and went on to take 20th place out of 50 in Astrakhan.**

### Nuclear benefits

THE House of Lords Science and Technology Committee, for which Prof Robin Grimes (Materials) is a special advisor, has criticised the government for failing to invest in nuclear energy.

'Building reactors is an international process now... and we have companies with intellectual property rights appropriate for this sector. Investing in research could generate jobs later.'

eas including future cities, mobility, digital innovation and smart energy systems. <http://bit.ly/smihev>

### Oil future?

DURING a debate on Radio 3, 'What is the Future of Civilisation as the Oil Runs Out?', Neil Hurst (Grantham Institute) drew attention to the fact that the future hinges on whether we can solve two problems. 'Can we find the increasing energy demanded in developing countries and control the impact this will have on our climate and global warming.' <http://bbc.in/rraJOz>

### Biofuels boost

A STUDY at Imperial has found that a key part of biomass processing could be made much more energy-efficient by taking advantage of the slippery properties of fluids called ionic solvents. This could bring down the cost of biofuels by around 10%.

Tree wood is a mine of really valuable chemicals fixed in a safe that needs unlocking before the different components can be used.

### Molly on BBC4

PROFESSOR Molly Stevens (Materials) was the subject of Radio 4's *The Life Scientific* in November. Professor Jim Al-Khalili discussed with her how she became interested in tissue engineering and what she hoped her work would achieve. <http://bbc.in/ttN8cQ>

### Cities of the future

LONDON is becoming a global leader in future cities' research, since Imperial Cisco and UCL have entered into a three year initial agreement to create a Future Cities Centre in London's Shoreditch. The Centre will focus on thematic ar-

### Pit stop

SEVEN-TIMES Formula 1 world champion, Michael Schumacher, surprised students when he appeared at Imperial to share some insights into his experiences on the track. <http://bit.ly/uk9lcQ>

# Guildsmen help students break electric land-speed record



**Buckeye Bullet 2.0 – 2005-2008, hydrogen-HeLox fuel cell source, achieved 308 mph in 2008.**

In May 2000, students at the Center for Automotive Research, Ohio State University, USA, had a dream of building an electric car, with the intention of breaking the existing land-speed record. They turned to two Imperial College Guildsmen – Tony David and Nigel McQuin – to design, manufacture and deliver the electrical drive train components for this world-class project. One of them, Nigel McQuin tells the story of their involvement

IN 2004, the land-speed record was held by White Lightning which achieved a mile-averaged speed of 245 mph in October 1999, at the Bonneville Speedway, Utah, USA. The objective was to be the first to break the 300 mph barrier. This would require a careful selection of aero-dynamics, chassis, suspension and drive train design components to propel the electric car and driver safely along the speedway course.

The huge strength of the Ohio University team project has been their multi-discipline student team members, drawn from aero, elec, mech, business and accounting faculties. This has allowed them to design/build/race the electric car and also to run the whole effort in a small business start-up structure. A very large number of sponsors contribute to the project, bringing in expertise, hardware or just plain dollar donations. This has contributed to the remarkable success of the team over many successive years.

Bonneville Speedway is a white salt plain, spread across 30,000 acres, 90 miles west of Salt Lake City. The racing surface is a flat

salt-packed lake bed with a limited maximum travel distance of just seven miles. This constraint imposes special design considerations for an electric car. The three timed miles begin after just two miles. Our target was to enter the first timed mile at 250 mph – a speed already in excess of the previous record.

Such a rate of acceleration, zero to 250 mph in 45 seconds, and under two miles, surpasses any production car and requires a massive delivery of power to the wheels to convert the limited energy source on board into kinetic energy. At the same time, the aerodynamic losses are growing. At a final speed in excess of 300mph, the driver sees mile markers flash by at intervals of less than 12 seconds. However, at only 90 seconds and five miles from

the start, the experience is quickly brought to an abrupt end by the deployment of the two parachutes.

Although the operating time of the power train is short, the components are exposed to especially severe conditions. The salt grinds into a fine powder that gets into every opening and adheres to every surface. Combined with only traces of moisture, the salt becomes electrically conductive and attacks electrical connections and metal components more aggressively than conventional road dirt and debris. Also, the air temperature on the speedway course can reach 40°C in the full afternoon sunlight and enclosed vehicle spaces can reach 55°C. These temperature conditions must be accounted for in the design of the vehicle systems, especially for the energy storage devices that may be very temperature sensitive.

**Buckeye Bullet 1.0 – 2000-2004, NiMH battery source, achieved 315 mph in 2004.**



In Buckeye Bullet, 1.0 vehicle power source is a NiMH 900 Vdc battery pack, configured in series and parallel strings. The dc bus is fed into a high-power, pulse-rated, PWM inverter which produces a variable frequency three-phase AC power feed. An AC high-speed, induction motor drives a race-proven mechanical drive train including a five-speed dragster-class manual transmission.

The gear ratios are selected to maintain the inverter and motor drive running at the most favourable operating speed to maximise efficiency and acceleration. The final drive is a compact differential coupling which powers the 300 mph class rubber tyres at the drive axle. Braking is achieved by dual spring-launched parachutes, with mechanical disc braking at lower speeds.

In the later version 2.0 and 2.5 vehicles, hydrogen-Helox fuel cells and Li-Ion power sources were also successfully employed. These delivered a lower voltage of 550Vdc and required the motor and inverter to operate at higher currents.

The liquid-cooled inverters were designed by Tony Davis and built by Saminco Electric Traction Drives Inc. and American Traction Systems of Fort Myers, Florida. They use insulated gate bipolar transistors (IGBTs) switching at a frequency of 8 kHz, and are designed to withstand typical engine bay conditions.

The inverter is designed to deliver 300 hp continuously but it is able to deliver more than twice the rated power for short bursts. In the 2.5 vehicle, a 500kW inverter designed for a locomotive traction system was used.

The inverters were tuned to obtain optimum performance and efficiency from the motor under peak output conditions. They are configured in a torque-control mode with motor currents regulated by closed-loop flux-vector control. A torque reference is derived from the driver's accelerator pedal that provides an analog signal to the inverter. A gain adjustment and also a rate-of-change limitation are applied for the purpose of controlling the maximum acceleration and jerk rate. This limits tyre slip and



**BB-2.5 – 2009-2010, Li-Ion battery source, achieved 306 mph in 2010.**

shock loading on the drive train.

Another important feature of the drive inverter is the synchronized dynamic braking used during gear shifting. This rapidly retards the motor from approximately 10000 rpm to 7400 rpm to lessen the shock to the transmission when the next gear is selected.

Through McQuin Electrical Power Consulting Inc, I have been responsible for the design/ construction of the traction drive motor that accelerates the vehicles and supervision of the ongoing maintenance/upgrades. We provided a three-phase AC induction cage machine with four poles, 0 – 10500 rpm operating speed range and a maximum mechanical over-speed of 12,000 rpm. The stator and rotor laminations were manufactured of high-frequency grade, low loss magnetic material, to minimise the total iron losses from both hysteresis and eddy currents at operating frequencies up to 360 Hz. The rotor cage construction is of reinforced cast copper, which minimises the rotor heating losses and provides a stiff motor characteristic well suited to inverter drive applications.

To minimise the total weight of the drive motor, an aluminium housing was used. Based on previous vehicle experience, bearings, shaft seals and terminal box configurations were selected for the necessary power rating and operating speeds. In view of the harsh salt environment and the limited duty cycle of operation, a detailed thermal study determined that the de-

sign could be made total-enclosed with a passive cooling system.

### Conclusions

The Buckeye Bullet 1.0 became the first electric powered vehicle to exceed 300 mph when it achieved 314.93 mph on August 16, 2004 claiming the new US record. The subsequent version 2.0 and 2.5 vehicles have both achieved speeds over 308 mph in 2009 & 2010 respectively.

*The authors acknowledge the hard work and dedication of the 60+ students of the Ohio State University team, and the contributions of the numerous project sponsors in the development of these vehicles. A complete list of the project contributors can be found on the official team websites, [www.buckeyebullet.com](http://www.buckeyebullet.com), and [www.roadtobonneville.com](http://www.roadtobonneville.com).*

**NIGEL MCQUIN (EE77) lives in Pittsburgh and runs his own independent electric-power consultancy which specialises in the design of specialty motors/generators and special instrumentation systems, as well as providing forensic services for electrical equipment failure, accidents and injury investigations. [NPMcQuin@iee.org](mailto:NPMcQuin@iee.org)**



**TONY DAVIS (EE74) lives in Fort Myers and is the director of engineering at Saminco Traction Drives and also American Traction Systems. Both companies specialise in the design and manufacture of drive systems and motor management controls for industrial haulage and transport applications. [Tdavis@samincoinc.com](mailto:Tdavis@samincoinc.com)**



Steve King outlines two different ways to approach a contract, following the article about London Underground contracts in the last edition of *Imperial Engineer*

# An appropriate process?

THE NEED to achieve more for each pound of public money spent is a continual theme of politicians, even in the best of times. During the last four years it has been the theme of endless speeches and policy initiatives.

Railway expenditure has been in the order of £8bn per annum since 2006 (Source - HMT PSEA). It is seen as a suitable way to balance out the economy as a high proportion of the money spent is in the form of wages.

To obtain better value from infrastructure construction, the client, consultant and contractor costs all need to be considered. All client bodies are looking at this, but there are some distinctly different approaches being considered. London Underground and Network Rail illustrate two of the different approaches

## London Underground

London Underground (LU) have adopted a very strict set of procedures. Contractors are expected to take single-point responsibility for all matters that might affect the works - including, potentially, when things are known to LU but not disclosed at tender stage. All risk is supposed to be included in the tender, although contractors will be forced by competition to take a highly optimistic view.

Contractors are expected to adopt as their own designs prepared directly for LU by consultants. These designs may have been prepared years before, so the

contractor has to consider the risk that the design is to obsolete codes of practice, or cannot be built because of other changes made in the intervening years.

This, combined with the use of the New Engineering Contract (NEC) and around 80 pages of amendments, is intended to give LU certainty of outturn cost.

Projects are managed to a single centralised model which must cater for project values from just a few thousand pounds right up to the £400m+ Crossrail and Victoria Station contracts.

## Network Rail

Network Rail (NR) are looking at a completely different model. The whole business structure is being rethought, and power is being devolved to the regions and aligned with train lines. As Network Rail does not run trains, they are also aligning themselves with the Train Operating Companies (TOCs).

They will also be going to the market at an earlier stage, with contractors and consultants involved in the development of options.

NR use a wider range of contracts than LU. They also have more tailoring of the project management model to suit the project size.

Each approach has some positives and negatives. The LU approach helps to keep down the client costs. One standard set of processes means staff are following uniform rules. Fewer staff are needed, and they do not need to be as experienced, or even have a construction background.

The NR approach requires more

local judgement, so more experienced staff will be needed. This approach presumes that it will be possible for experienced, specialist staff to save the project more than their additional remuneration costs.

I favour the second approach and feel we need to speak up about the value of knowledge and judgement in delivering projects on time, to quality and at a good price.

## High initial cost, low outturn?

The use of single point responsibility and NEC contracts gives greater surety of outturn cost. Contractors often do not even cover the costs of a variation (compensation event - CE), as the process is long-winded and costs of preparing the CE are often not recovered. This helps the client, particularly on refurbishment contracts where there can be many low value CEs.

The negative aspects of this approach are that it locks in high delivery cost from day one. Contractors know that they will have to put large numbers of people on the project to manage the reporting and deal with the CE process. This leads to higher preliminaries. Preliminaries are the costs that are incurred in delivering the project. On a typical £0.5m project with no direct impact on the railway itself, I would expect preliminaries of 30%+ on an LU project using

*(continued opposite)*



# Duke retires from leading City & Guilds

HIS ROYAL Highness, The Duke of Edinburgh was delighted when he was presented with a handmade display cabinet on December 14 at Buckingham Palace to mark his nearly 60 years as president of City & Guilds. He retired on his 90th birthday last June. The cabinet was made by bespoke fine furniture-maker, Nick Gutfreund. Nick was highly-commended in the 2010 Prince Philip Medal awards.

Making the presentation was C&G chairman (since 2006) Michael Howell and Morton Neal (Civil 53, chairman 1979-91).

Prince Philip is using the cabinet to display the personal regalia of his parents, Prince Andrew of Greece and Denmark and Princess Alice of Battenberg, side by side. 'We are touched that he has chosen such personal memorabilia to be displayed,' said Michael Howell.

Prince Philip made an enormous contribution to City & Guilds over the years, including establishing The Prince Philip Medal in 1962. This honours those who started at the bottom of the career ladder and have reached highly responsible management positions. Winners hold senior appointments in a wide variety of industries, public services and academic organisations and have one thing in common - they've all been helped on their way by City & Guilds certificates.

The President's Award was first presented in 2003 to mark the Prince's



50 years as president. It is presented to the lecturer or trainer of City & Guilds qualifications who has obtained the overall highest marks based on the evidence supporting his or her City & Guilds 'Medal for Excellence' nomination.

The Prince also used to present prizes to some City & Guilds learners who were notable for the success they had in their qualifications and, in 1995 opened C&G's headquarters at 1 Giltspur Street.

## Historical note

Imperial maintains close links with the City & Guilds of London Institute, which in 1885 opened its 'Central Institution' for technical education



**FROM LEFT: Michael Howell, Nick Gutfreund, Morton Neal and Prince Philip. Inset, Nick with the cabinet.**

on the site of Imperial's current main entrance and business school. In 1907, it became part of the new Imperial College and was re-named the City & Guilds (Constituent) College.

Princess Anne has replaced her father as president.

*(from opposite)*

NEC and 18% on a Network Rail project on a JCT or similar contract.

Is the additional 12% in initial cost worth it for the greater outturn cost certainty?

## Local processes

The Network Rail model allows a degree of flexibility in developing local processes. The LU model is strongly against it.

However, too strong a drive to centralise the management of the project delivery can lead to an excess of local arrangements to work around bottlenecks in the system. This will lead to additional cost as the effort is duplicated. It may also lead to errors if the information is not correctly merged afterwards.

## Enemy or friend?

As noted above, London Underground use an amended form of the NEC.

Network Rail is championing partnerships, although the emphasis seems to have shifted from the larger scale frameworks to more modest or shorter term partnerships.

Does best value come from being very cautious, or more open? As a client, you can assume that your suppliers are out to take advantage of you. You can take steps to protect yourself, and potentially spend quite a bit of money on that protection. You can deal firmly with any claims and drag out payment to the last possible time.

A more open approach does bring the risk of a contractor trying to take advantage or failing to perform in some way.

However, despite that risk, the industry needs experienced contractors who know how to deliver projects well and at a good price. Yes, the contractor does want to make money, but if they are delivering good value, should they be treated with suspicion for doing so?

Clearly much more could be said

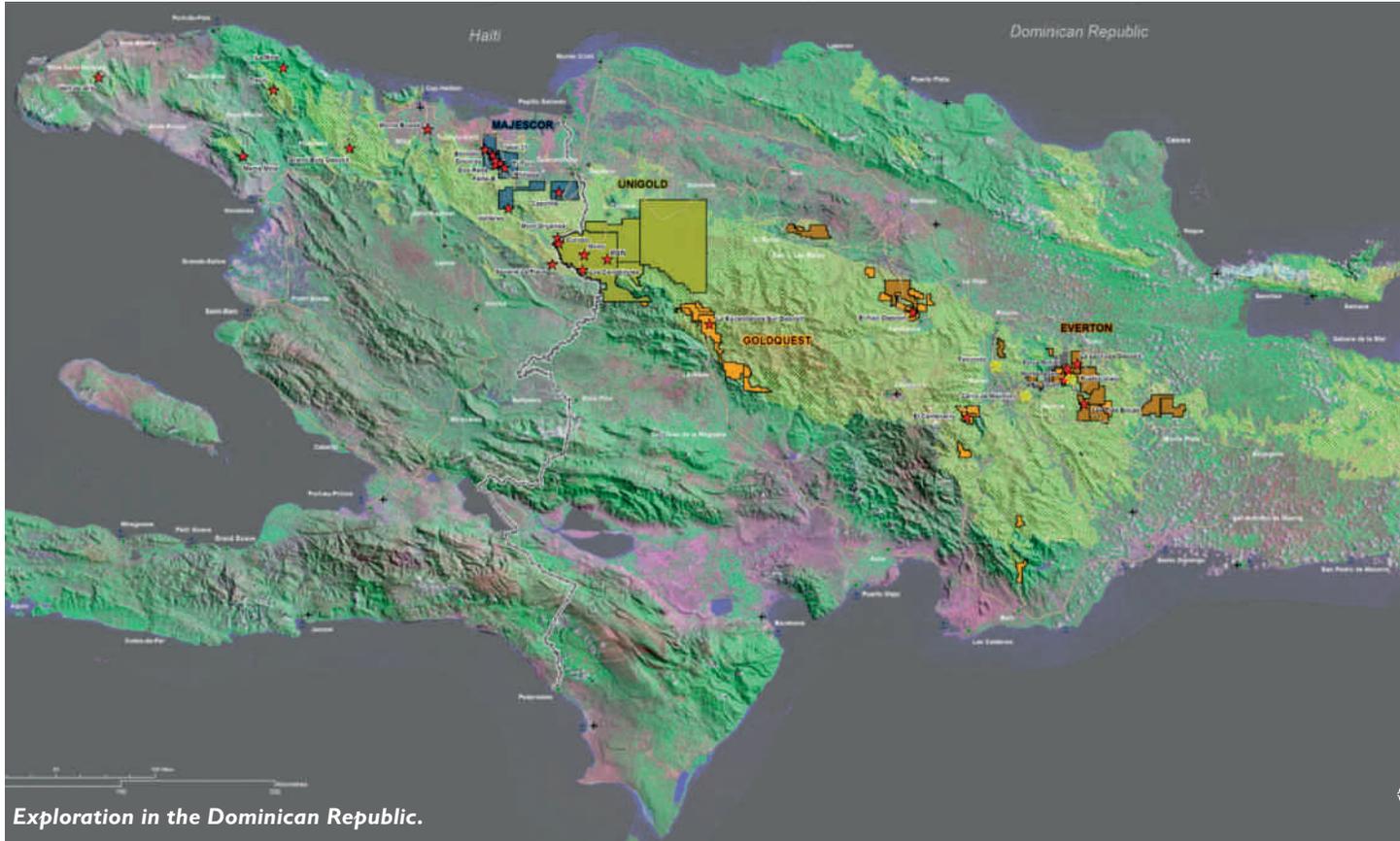
on the pros and cons of the different approaches. As they are so polarised, it will be interesting to watch the industry develop over the next couple of years. No doubt each will claim that their approach is more successful, and a careful sifting of the evidence will be needed.

**STEVE KING (Civils 90) worked on projects from power stations to grade I-listed buildings after College. He then concentrated on estimating, value engineering and bid management for contractors, as head of department. Over the last six years he's spent much of his time as contractor's engineering manager and design manager for Network Rail and London Underground.**  
**SKing2@amco.co.uk**



Andrew Cheatle (Geol 83), president and CEO of Toronto-based Unigold Inc

# Finding Caribbean gold in the 21st



Exploration in the Dominican Republic.

THE CARIBBEAN, famed for its sun-soaked islands, exotic flora and palm tree-fringed bays and white sand beaches, is re-awaking as a significant gold producing region.

Gold exploration in the region is accelerating as the islands' treasures take on a new promise. But these are not the treasures of the *Pirates of the Caribbean* fame, but those of modern-day miners and those found by exploration geologists.

The long history in the region captures the true romance of discovering the unknown. When Christopher Columbus fortuitously discovered the Caribbean islands, Europe was alerted to the potential of the Americas as a whole.

Gold was, indeed, found on Hispaniola soon after its discovery and briefly extracted from primitive mines.

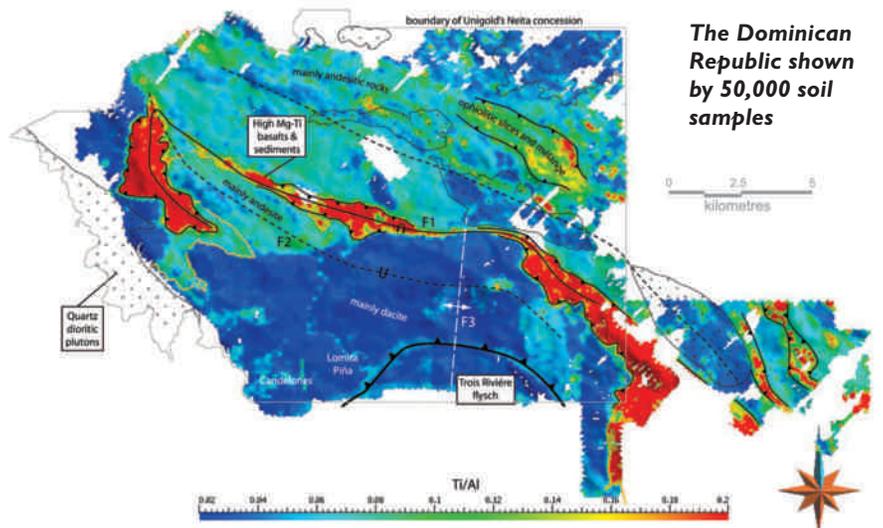
Since that time, estimates of gold endowment (past production plus known resources) of the Caribbean's Greater Antilles totals 36 million ounces (Moz) gold. Other mineral wealth (extracted ore) in known resources is estimated as 277Moz silver,

7 million metric tonnes (Mt) copper, 1Mt lead, 3Mt zinc, 14Mt nickel, 1Mt cobalt, 2Mt chromium, 3.5Mt manganese, and 706Mt aluminium.

It is the re-emergence of gold mining, at the world-class Barrick Gold/Goldcorp's Pueblo Viejo mine in the Dominican Republic, that has spawned recent interest and activity in the broader region. The former mine produced 5.3Moz of gold and 24.4Moz of silver from oxide ore

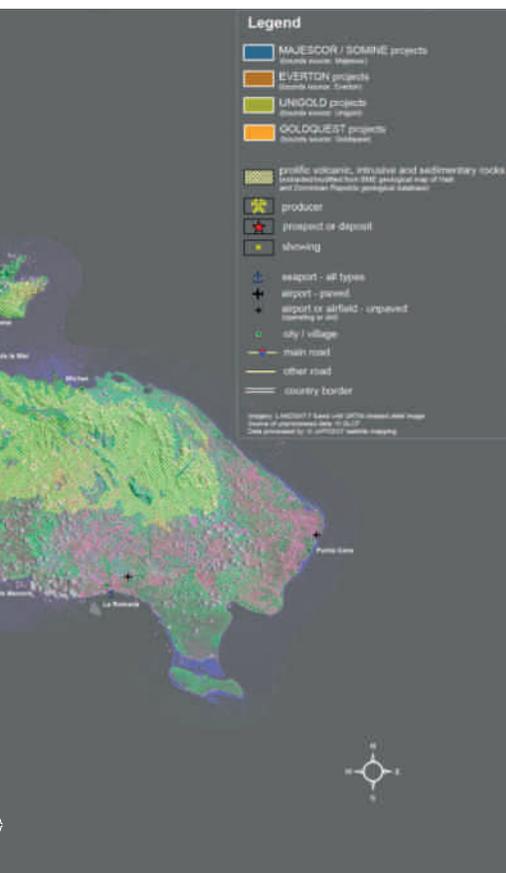
between 1975 and 1996 and contains an additional 35Moz of refractory mineralisation at a one gram per metric tonne (g/t) gold cutoff grade. From 2013 onwards the mine is planned to produce over a million ounces of gold a year, making it one of the largest gold producers in the western hemisphere.

The Caribbean hosts some of the world's most important deposits of bauxite and lateritic nickel, as well as



The Dominican Republic shown by 50,000 soil samples

# 1st century



mentioned significant resources of gold and silver, copper, zinc, manganese, cobalt and chromium. A brief understanding of the geological evolution, as understood for the island of Hispaniola helps us to understand how this happened.

## Geological setting

The Dominican Republic, part of the island of Hispaniola where Columbus set up his first headquarters, has a promising geology. Gold mineralisation is located within the Central Cordillera of Hispaniola. In the most general sense, the rocks of Hispaniola represent Cretaceous arc complexes that migrated eastward, along with an oceanic plateau, from the Pacific to the Atlantic ocean. Here they collided with the southern margin of North America. The geology of the island reflects this complex history.

Locally gold mineralisation varies with local geology, for example at Unigold's Neita property in western Dominican Republic. Diffusely-bedded dacitic tuff and hyaloclastite breccia are intercalated with marine

sedimentary rocks and all are intruded by andesitic sills.

These rocks, and their andesitic basement, were overthrust by high-magnesium basalts, related terrestrial sediments and ophiolitic rocks. They were deformed several times to create complex fault patterns and three different sets of folds. The two older sets of folds are recumbent to isoclinal and are crudely coaxial with W-NW trends. The third set of folds are broad open folds of northerly trend, which provide down-plunge views through the older folds and thrust faults. Economic values of gold mineralization at the property occur within the dacitic breccias.

Exploration in this region is, therefore, focused within the 75km-wide Cretaceous-age tuff formation volcanic sedimentary rocks which host the world-class Pueblo Viejo gold deposit.

Gold exploration today is sophisticated and a highly-technical profession. The rich, gold-bearing, Cretaceous-age volcanic belt, which extends in a band across the island, is giving rise to some exciting new gold discoveries.

Unigold's announcement on January 16 sent share prices surging. That week was perhaps the busiest of my life!

Unigold's concessions extend over four contiguous properties in western Dominican Republic, close to the border with Haiti.

Over the past 10 years, the company has completed a comprehensive geological survey across the properties, taking and analysing over 50,000 soil samples for gold, silver and multiple elements as either pathfinders or to define underlying geological formations. We have also performed a range of induced polarisation geophysical and magnetic surveys. By analysing this rich data, Unigold has been able to establish a pipeline of targets for future exploration.

**ANDREW CHEATLE (Geology 85) is president and CEO of Unigold Inc and Councilor at Large for the Association of Professional Geoscientists of Ontario (APGO), Canada. His career spans 27 years and has focused on gold mining and exploration in Africa, Australia, Canada and, most recently, in the Caribbean. In his role with the APGO, he is a regular speaker on geology and ethics in seminar series to undergraduates. Andrew lives in Thunder Bay and Toronto, Canada. ([www.unigoldinc.com](http://www.unigoldinc.com) and [www.apgo.net](http://www.apgo.net)).**



## Corporate social responsibility

Excellent geology or 'street address' is only part of a modern successful exploration play. In today's world of instant communication, texting, cell phones, Facebook and environmental monitoring it is also important to have the 'social license to operate.' Sincere corporate social responsibility (CSR) is a key component of a geologist's work.

In many respects the exploration geologist is the first contact that a community will have with a corporate entity. Being a good corporate citizen, especially in areas where unemployment is high and infrastructure is less well-developed, is as much a state of mind and philosophy as it is action. For example, Unigold owns its own drilling rigs and has trained a large number of local people to operate them.

Unigold prefers to employ staff from the local community and keep them on its own payroll. Over 100 locals are currently employed, ranging from drilling and soil sampling technicians through to mechanics and electricians and from IT experts and security guards through to cooks and financial administrators. Consequently, Unigold is now the major employer. Involvement in the local communities runs deeper too.

At Christmas, for example, over 400 food hampers are donated to families, especially those with young children. In addition Unigold is always willing to lend a hand in odd jobs that it has the equipment and skills to perform, such as local road repairs or facilitating water pipe installation from the village well to the school. This relationship takes time, effort and sincerity. It is one of ongoing trust and support and flows in both directions. Over 95 percent of the local landowners have signed agreements to allow the company access their land for exploration purposes.

# INVESTIGATING THE DESERT: geotechnical ground investigation for pipelines in North Africa

Yannis Fourniadis of Arup writes about its involvement in major energy infrastructure projects in North Africa

IN 2010, Arup was retained by a consortium between an international oil company and a local partner to provide geotechnical and civil engineering consultancy services for a major natural gas development in North Africa. The proposed development comprises gathering systems, pipelines and processing facilities located in the Sahara Desert, about 1000km from the shores of the Mediterranean.

Arup filled a technical role which included the design of a ground investigation programme; geotechnical logging of soil and rock samples from boreholes and trial pits; assessment of flood and scour potential of ephemeral desert streams (wadis), and investigation of materials for road construction.

## Geological setting

The geology of the region comprises sandstones and mudstones of early Cretaceous age (145 to 100 million years [Ma] old), overlain by clays and limestones of the late Cretaceous (100 to 65Ma). These rocks are overlain by variable thicknesses of Tertiary and Quaternary sediments (2.5Ma to present).

The recent geomorphological evolution of the area has been shaped by different climatic conditions to those operating at present, *viz* of intense tropical weathering in a tropical rainforest or savannah environment. Such features include the occurrence of metre-thick crusts (hardpans) of iron and silica, as well as the development of an underground drainage network (including pipes and small caves) in the soluble limestone layers. Both of these



**Figure 1 - Fossil trees (left) and strong iron-rich crusts (right) provide evidence for more humid conditions in the recent geological past**

features requiring prolonged periods of warm and humid conditions for their formation.

More recently, in the Quaternary period, the climate ranged from hyper-arid (similar to the present-day) to humid, when the region played host to a number of mega-lakes, some of which are believed to have been up to 350,000km<sup>2</sup> in area (comparable in size to the present-day Caspian Sea). The legacy of these humid episodes can be seen in a number of low-lying parts of the Sahara (where the lakes would tend to have formed), where the remains of lake bed sediments, such as thinly laminated silts and clays with fresh water fossil shells, can still be seen today.

Understanding the complex geological and geomorphological evolution of the region was vital in assessing the potential geological hazards, that might affect the proposed natural gas infrastructure development, and designing an appropriate geotechnical ground investigation campaign.

## Geotechnical and geological hazards

As a result of the geological evolution of the region, highly variable ground conditions were encountered along the proposed pipeline route. Particular challenges, with direct engineering cost and programme implications, were:



**Figure 2 - A 5m-thick deposit of thinly laminated silt and clay, evidence of the presence of a large lake in what is now a desert**

**GROUND INVESTIGATION  
FACT FILE**

- 250km approximate length of proposed pipeline
- 150m of rotary cored rock
- 3000m<sup>3</sup> of excavated soil and rock
- More than 100 desert streams (wadis) individually assessed for flood and scour potential

- Identifying a feasible route up two significant cliffs for the proposed pipeline, taking into account geotechnical (slope stability, erodibility) and civil (drainage, trafficability) engineering issues.
- Calcite, iron and silica hardpans at or near the surface, which often required rock-breaking equipment for their removal.
- Aggressive conditions to concrete and steel associated with soil and groundwater rich in sulphates (gypsum).
- A number of geological hazards



**Figure 3 - A continuous, 1.5m band of grey-white dolomitic hardpan, with a strength higher than concrete, underlying a thin layer of reddish brown loose sand and gravel**



**Figure 4 - Trial pitting at the base of a major cliff line that the proposed pipeline will have to ascend**

were identified along the proposed pipeline route, and the ground investigation was tailored to collect sufficient data to provide fit-for-purpose engineering solutions for the expected hazards.

- Gully erosion and internal erosion (piping) of debris mantled slopes during rainstorms.
- Flash floods following high intensity rainfall, and scour along ephemeral desert streams (wadis)
- Loading and loss of support and pipeline exposure due to dune migration.

Behind the first two hazards lay the infrequent high-intensity rainstorms that the area may experience, and which can be of such intensity as to deliver the mean annual rainfall amount (c 30mm of rain) in a single day.



**Figure 5 - Rock falls along the steep cliffs that the pipeline will have to ascend are a significant hazard, especially during rainstorms**

the proposed 250km-long pipeline route. Coupled with geophysical testing (seismic velocity, electrical resistivity) and targeted laboratory testing of soil and rock samples, the ground investigation provided adequate data to inform the design of the proposed geotechnical and civil engineering structures.

**Outcome**

The working conditions in the Sahara were, as was to be expected, harsh (temperatures in excess of 40°; strong winds; sand storms). When coupled with logistical difficulties and a tight programme, these conditions certainly made for challenging work.

Arup’s engineers and geologists met the challenges, and carried out the ground investigation works to a high standard. The innovative engineering solutions formulated are expected to result in cost and programme savings for the client during the construction phase of the development.

**Acknowledgements**

*I wish to extend my thanks to the Arup project manager, Chris Martin (Civil 08) for securing publication permission for this article.*

**Geotechnical ground investigation**

A number of boreholes were sunk at the location of the proposed facilities to inform foundation design, while a large number of trial pits and trenches were excavated to assess the ease of excavation of the soils and rocks that were along

**YANNIS FOURNIADIS graduated from Imperial in 2007 with a PhD in engineering geology, where he developed a model for assessing landslide hazard in the Three Gorges area in China. Yannis then joined the geotechnical department of Arup in London, where he combined his engineering geology and geotechnical skills to identify and mitigate ground risks for major infrastructure and building projects worldwide. Yannis has now joined GHD in Perth, Western Australia, where he is involved with the geotechnical design of infrastructure for the mining industry. [yannis.fourniadis@gmail.com](mailto:yannis.fourniadis@gmail.com)**



# Small reactors and how they fit into a nuclear future

This article, taken from a paper published in *Nuclear Future*, reviews known nuclear developments and potential uses and imagines a nuclear future.

by Peter Riley

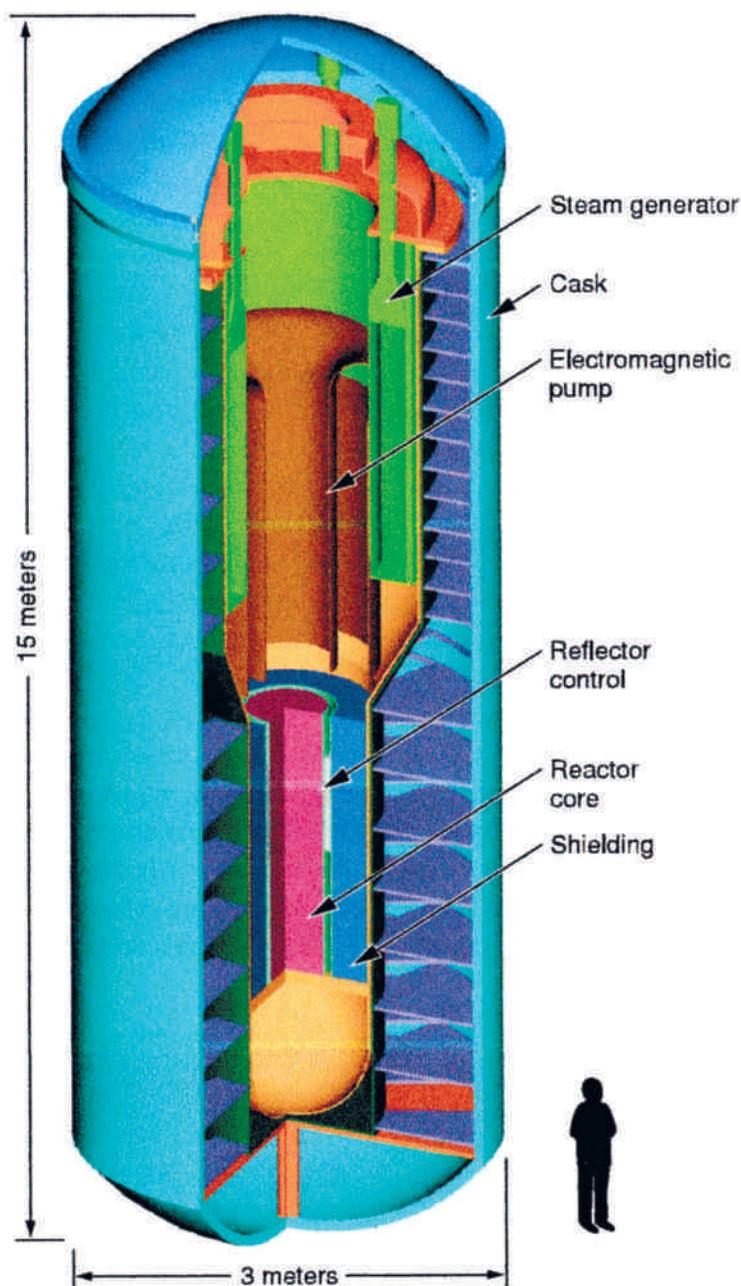
INDICATIONS are that nuclear energy will continue to be a significant factor in the world for the foreseeable future. While the influence on public views of damage to Fukushima reactors and used fuel storage, caused by March 2011's tsunami, has yet to be seen, internationally the application of established designs of nuclear power plants is spreading.

In the USA, Russia, France, China, India, Korea and South America development of advanced reactor projects has continued. Development of new nuclear technology and reactor types, particularly small and miniature reactors, is already leading to potential application in ways previously seen as tentative.

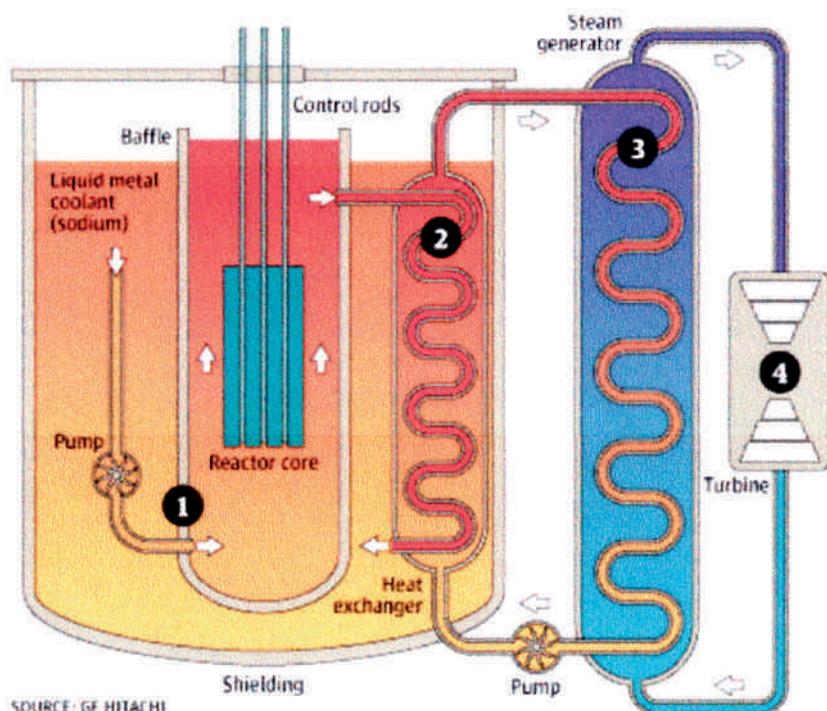
The International Atomic Energy Authority (IAEA) has extensively reviewed small reactor development -

- The Generation IV International Forum (GIF) in its 2008 annual report identified goals for nuclear energy systems;
- US energy secretary Steven Chu described small modular reactors as 'one of the most promising areas' for the future of nuclear power;
- Russia is building the first of eight, small floating nuclear plants for deployment in Arctic regions;
- Amongst others, TerraPower (a company backed by Bill Gates) and Toshiba are investigating technology for mini reactors.
- The World Nuclear Association (WNA) has carried out a detailed analysis of small nuclear power reactors worldwide and the US Nuclear Regulatory Commission (NRC) has identified a number of potential policy and licensing issues for some of those designs.

The House of Lords' Science and Technology Committee's third report, 'Nuclear Research and Devel-



Lawrence Livermore, Los Alamos, and Argonne national laboratories are designing a self-contained nuclear reactor with tamper-resistant features. Called SSTAR (small, sealed, transportable, autonomous reactor), this next-generation reactor will produce 10 to 100 megawatts electric and can be safely transported on ship or by a heavy-haul transport truck. In this schematic of one conceptual design being considered, the reactor is enclosed in a transportation cask.



SOURCE: GE HITACHI

**GE-Hitachi Prism 311 MWe fast reactor**

opment Capabilities’ (recommendation for greater UK involvement in nuclear research) includes reinstating active membership of the GIF at the earliest opportunity.

In this article I am summarising known developments.

**Small and miniature reactors**

The development of nuclear reactors following the completion of the current stage of ‘new-nuclear’ in about 2030, will be with new fuel cycles. Post new-nuclear reactors will include small and miniature (mini) units for generating electricity, district heating and desalination.

‘Small’ is defined by the IAEA as less than 300 MWe and project that up to 96 will be in operation by 2030. There is no agreed definition of ‘mini’ reactors so, for the purposes of this article, the 50 MWe level will be used.

The World Nuclear Association (WNA), in its review of small nuclear reactors, that implicitly includes mini reactors, covers in detail the development of -

- light water reactors (PWR);
- high temperature gas reactors (HTR);
- liquid metal cooled fast reactors (FNR), and

- molten salt reactors (MSR) for power production.

The table, below, based on the WNA report, summarises those reactors with advanced development.

**Potential applications**

Much of the electrical future will be decentralised. Extra loads will be

imposed on the grid system by the need for electrical transport, desalination and domestic power. Reinforcing the grid may not be the best solution to coping with support for small grids such as wind farms.

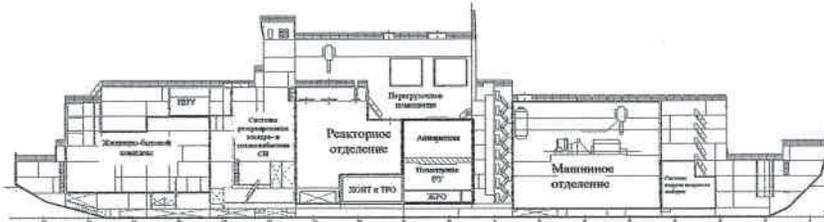
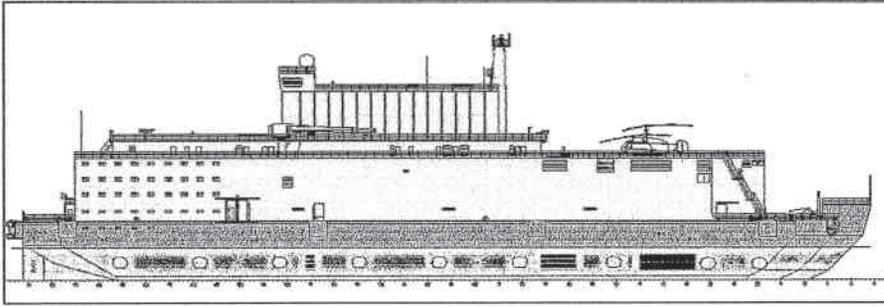
Small power stations, local to load centres, provide an answer. The load centres, being small towns, factories, battery charging stations, hydrogen production and wind farms, will demand power from a few to hundreds of megawatts: an ideal application for small and medium nuclear power plants. Marine transport already uses nuclear power for military use and transport is an obvious area for the future. It is conceivable that even rail transport could be nuclear powered.

Remote regions and small islands relying on expensive and dirty oil for electrical generation are an obvious application of small nuclear. Both Russia and the US have deployed small reactors to provide electricity to bases in the Arctic regions. In fact, Russia is currently manufacturing floating power stations for use in oil exploration. The US department of energy estimated the cost of electricity from a 50Mwe

Name	Capacity	Type	Developer	Refuelling Years	Enrichment %
KLT-40S	35 MWe	PWR	OKBM, Russia	3-4	5
VK-300			Atomenergoproekt, Russia		
CAREM		PWR	CNEA & INVAP, Argentina	1	3.4
IRIS		PWR	Westinghouse-led, international	4	5
Westinghouse SMR		PWR	Westinghouse, USA	2	5
mPower		PWR	Babcock & Wilcox, USA	5	5
SMART	100 MWe	PWR	KAERI, South Korea	3	
NuScale	45 MWe	PWR	NuScale Power, USA	2	5
HTR-PM	2x105 MWe	HTR	INET & Huaneng, China	Continuous	9
PBMR	80 MWe	HTR	Eskom, South Africa	Continuous	9.6
GT-MHR	285 MWe	HTR	General Atomics (USA), Rosatom (Russia)	6-8	20
BREST	300 MWe	FNR	RDIPE, Russia		
SVBR-100	100 MWe	FNR	Rosatom/En+, Russia	7-8	16.5
Hyperion PM	25 MWe	FNR	Hyperion, USA	10	20
Prism	311 MWe	FNR	GE-Hitachi, USA	Continuous	
FUJI	100 MWe	MSR	ITHMSO, Japan-Russia-USA		
NP-3000	100-300 MWe	PWR	Technicatome France		Low

## FEATURES

The FPU contains two main functional modules: a living module, located in the stern section of the barge, and an energy module, located in the central and forward sections. FPU operation in general is provided by regular vessel systems. Both functional modules are supported by an automatic control system.



The energy module is designed to generate electricity and heat energy. This module contains two reactor installations, two steam turbines, and an electric energy generating system. A block principle (one reactor, one turbine, one generator) is used in the equipment configuration.

unit at 5.4 – 10.7 c/kWh, compared to current charges in Alaska and Hawaii from 5.9 – 36.0 c/kwh.

In a remote corner of Siberia, at the Bilibino co-generation plant, four 62MWt units, using a graphite-moderated, boiling water design, produce steam for district heating while an 11 MWe has operated since 1976.

The US-operated, small, military power plants in McMurdo Sound from 1962 – 1972 generated 79 million kWh. A military developed boiling water reactor of 67Mwe operated at Big Rock Point for 35 years to 1997. The WNR gives numerous examples of the use of small PWRs used in marine transport. A reactor fuelled for a lifetime operation will power the latest Trident submarine.

The economy of scale in current designs of large nuclear reactors can be replaced with the economy of serial production. Construction times will be of the order of two to three years and, by modular construction using standard small reactors (say 300 MWe), a range of power plant sizes can be achieved.

### The future

Of course, there are obstacles\* to

the nuclear future, by small and mini reactors are seen as viable and suitable for a range of applications ranging from a large plant made up from a series of small reactor modules to individual, small reactor units in remote regions of developed countries and for reinforcing local grids.

In the US, the NRC is anticipating such use by addressing the potential policy, licensing and technical issues for small modular nuclear reactor designs.

The application of mini reactors in under-developed regions has significant advantages, but their deployment breaks new ground in relation to institutional control and in international legislation.

Under-developed regions, particularly African nations and small

island communities, do not have the infrastructure and institutional controls to give confidence in the operation and management of nuclear systems.

A solution to this obstacle would be for the reactor manufacturer to retain full operational control and responsibility. The Russian manufacturer of the floating power plant already proposes this. Such an arrangement would be credible in the international scene if the level of liability were of the order of that expected for conventional plant.

International conventions and national legislation provide for amendment to the definition of a nuclear installation and contain the facility for amendment where the risk is low. International conventions and national legislation except from liability the operator of marine reactors.

Design of small and mini reactors is well in hand: the wider deployment of mini reactors could be within the next 10 years, in which case the need for attention to questions of liability and safeguards is urgent.

*\*Peter Riley's complete paper enumerates obstacles to a nuclear future. To read this go to [www.imperial.ac.uk/engineering/alumni](http://www.imperial.ac.uk/engineering/alumni). This also includes the footnotes to the article.*

**PETER RILEY (Elect Eng 58) a chartered engineer and academic lawyer, lectures on the Environmental Law Masters Degree programme at the De Montfort Law School responsible for the module 'Nuclear Energy'. He is widely published and has lectured on nuclear courses at Birmingham and Manchester universities and the International School of Nuclear Law at the University of Montpellier. He has presented papers at the International Nuclear Law Association Congress on eight occasions. In his engineering capacity he has been project manager on contracts with EEC, GEC and Alstom in the nuclear field from Sizewell A in 1963 to Sizewell B in 1994 including the responsibility for the construction of the Westinghouse/GEC/George Wimpey project for the 600 MW PWR Ko-Ri Unit in the Republic of Korea.**



# Is building barriers baulked at?

I'VE SPENT my career in hydro-power and wrestled with the intangibles of project floods (PMF and PDF) and Maximum Credible Earthquakes (MCE), return periods, *etc.* I have been forced to resort on more than one occasion to using the equation risk times consequence as a basis for design of spillways and dam crest levels in areas where there is a paucity of peak or annual flood records. I therefore read the article and comments on Fukushima in the Autumn 2011 issue of *Imperial Engineer*, with great interest.

What surprises me is that there is, or has been, little or no talk of whether protective barriers should have been built around all Japanese nuclear plants at the time of their construction. This could have prevented flooding from some, but maybe not all, tsunamis.

At the time of the March 2011 tsunami event, I watched a video record of the event near Sendai and was surprised how the incoming surge water tended to find the path of least resistance around objects, especially at large engineering items, such as at highway

## COMMENT

embankments, bridges, bridge ramps, concrete-framed buildings, *etc.*

I got the impression that its destructive power was not so much in its forward momentum but in its ability to submerge or render buoyant, smaller objects. That is the waves did not appear to erode the ramps or embankments or knock over larger buildings. In that regard, the article notes that the tsunami at Fukushima was 'at a height of 13m - whether it was surge or amplitude is not stated - overwhelming the 5.9 m high sea wall'.

On that basis an 8-10 metre embankment built on the ground behind the sea wall and in front of the nuclear plant, based on my observations noted above, would likely have deflected the water around the plant. Given the scale of the surge I doubt if such an obstacle would have led to any significant increase in wave height and thus aggravate its destructive power.

The cost of such an embankment would have been trivial in relation to the overall project cost, the consequences of which we are now well aware. I know that embankments of similar scale were routinely built to form fly-ash disposal lagoons in the UK and Canada. Could they not have been built at, or built as retrofits to, any nuclear plant near the sea, so as to increase safely and defuse some opposition to the concept of nuclear power?

Tsunamis are hardly new. There are records (ref below) of major tsunamis off the east coast of Japan in AD 869, 1611, 1677, 1896 and 1933. Could it be that the nuclear plant designers baulked at even attempting to accommodate such events in the face of records of waves of 25 m high in 1896, and 24 m high in March 1933?

*Ref 1 Atlas on Seismicity and Volcanism, Swiss Re, October 1977, for map on page 21, locating Events 650 and 651, and page 34 for summaries of the events.*

**David Hammonds**, consulting hydropower engineer, Hammonds Associates, Canada  
Email: david.hammonds@sympatico.ca

## FAILURE IS NOT AN OPTION

by Philip G Varley

ISBN: 9781885331373

Published by Mile High Press and the Barrington Group

PHILIP has had an unusual career. He graduated in Chemical Engineering at Guilds in 1979 and then qualified as a chartered accountant in the UK. Following a spell with Arthur Andersen in London, he emigrated to the US in 1985, where he gained an MBA from the University of Denver and later added qualification as a US CPA. He is currently resident in Littleton, Colorado and is the managing director of The Barrington Group Inc.

He describes this work as a play book (American football style?). The subtitle is 'The 12-Step plan to successful turnarounds' and I

## REVIEW

think he can best be described as a professional troubleshooter.

Much of the book is anecdotal, and in style reminds me a little of a good third party computer software guide, using mini case studies to develop a broader understanding. He draws business analogies with piloting his private aircraft in difficult weather - survival depends on keeping a cool head and having a clear view of the desired outcome.

Philip points out that people costs are the most difficult to control and introduces the idea of an 'Organisation Chart du Jour' drawing a parallel with a restaurateur who adjusts to circumstances by varying his menu.

His book can be read as the lessons learned on a journey, along which he has clarified his ideas and focused his philosophy. He has worked for or with a number of well-known groups, both accounting and industrial, on a wide range of problems, from startup to private equity, drawing on his combination of technical and financial expertise.

The book reflects a very American approach, although he has worked worldwide in around 20 countries. Philip brings a directness that is uncommon in a Brit: this is not a criticism. He describes himself as a multi-culturalist.

His book is available from [www.amazon.co.uk](http://www.amazon.co.uk) and his company website is [www.thebgi.com](http://www.thebgi.com)

**Bill Bradford**

## Belgian pud makes their day

THE 1957 - 60 Chemical Engineers group met for their annual reunion over drinks and bar snacks in the Beit quad bar in February. Eleven of us made it this time. Once again we welcomed Dave Martin's arrival with a delicious pudding from Belgium to top off the lunch.

During the past year our group (about 20 in all, with partners) also visited Denbies vineyard near Dorking to tour the grounds, see the fermentation facilities - and, yes, you've guessed it - to taste the products.

Under consideration for this summer is a garden party in West Sussex. For further information contact me -

**Tony Davis**  
ardavis@btinternet.com

# ALUMNI NEWS & VIEWS

Six pages of who's doing what and where



From left - Don Latimer, Tony Davis, Barry Daniels, Graham Yorke, Alan Nethercott, Eric von Schmidt, David Martin, Mike Heath, Jim Friend, Malcolm Cross and Paul Gallagher.

## 40 not out

AS ALWAYS the Triodes (those from Electrical Engineering who graduated in 1977) met in the George at 1 Fleet Street at 7pm on the first Friday of the New Year.

'All the serious chat was about plans for our real 40th year anniversary in 2013, although this was our 40th meeting because we had two in 1974,' reports Martyn Hart.

'Alice Spain has done some digging and found that the decade reunion for us is in November 2013. In fact we believe it will be on November 30 as it's usually the last Saturday in the month.

'Peter Cheung has offered us a special 'event' in Elec Eng on that day and some help for accommodation for those staying over the Saturday night. However, so far, we haven't worked out the details. More ideas are welcome. Just send me an email (martyn.hart@blueyonder.co.uk)

'Meanwhile next year's re-union is at the George, of course, at 7pm on Friday January 4. Triodes be there!'

For individual news of those Triodes present, go to [www.imperial.ac.uk/engineering/alumni/](http://www.imperial.ac.uk/engineering/alumni/)

## Mid-life change wins in 80s

YEARS ON from when he rowed with the Imperial College Boat Club in 1952, David Willett (Civil 55) has won the 2012 World Indoor Rowing Championships' for 80 - 84 event, held in February in Boston, MA.

This follows him winning the 5000m indoor running record for over 80s in the Ontario Masters Association meeting. David writes: 'Then recently, my eldest son (I have a rather athletic family I'm try-

ing to keep up with) encouraged me to enter the Canadian Indoor Track Championships in Toronto, and I was fortunate to set a new Canadian Indoor record for 5000 metres for the age group 80+.'

'I got my start in rowing in the City and Guilds "maiden-eight" crew and we won the inter-college race (against RSM and RCS) in 1953.

'However, I actually only rowed for one year, and was told I was not heavy enough

at 145lb (I'm now 150lb), and spent the next two years coxing and coaching.

'I never rowed again until last year, when I thought I'd have another go and joined a local social rowing club. They were kind enough to let me row in a male and female eight.

'In January, I entered the Canadian Indoor Rowing Championships, held in Toronto, using Concept2 rowing machines - these are the world standard for training indoors.

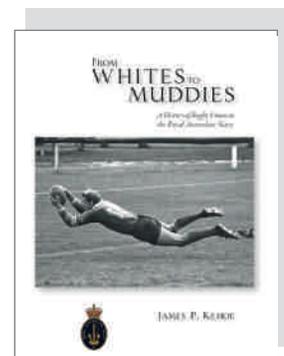
'In this event, my time was good enough to qualify me to enter the world event held a couple of weeks later. The rest, as they say, is history. If you would like to find some more info about this event, go to [www.concept2.us/racing/crashb2012](http://www.concept2.us/racing/crashb2012)

'In the intervening years, since giving up rowing in 1955, I was getting married, coming to Canada and growing a family. I took up road-running in 1978 (mid-life crisis?) and have been running ever since, including a few marathons and lots of local races.

[willgray@vaxxine.com](mailto:willgray@vaxxine.com)



DAVID pulls his weight in Ontario.



## Rugby captain goes to press

THIS book, written by Jim Kehoe (MechEng 62), about the development of rugby union in the Australian navy, is nearing publication. To read more about it, see the next issue when we hope to review it.

Jim, now an IT specialist and historian in NSW, was captain of Imperial's first rugby XV back in 1962.

## Andy succumbs to creative itch

YOU COULDN'T get much further away from his day job as IT consultant, but Andy Clark (EEE 94) decided he wanted to manufacture a chariot to be pulled by a flea. He was inspired while at Imperial when he visited a flea circus that didn't have fleas!

'The overview is that I built the chariot using techniques like those Victorians would have used, and finished it in 2009. In February, it was exhibited at the Portico Library and Gallery in Manchester as part of a contemporary art exhibit.'

Andy learnt his metal work while with an aerospace company and has also made a draughts set for a board only 5mm by 5mm.

In comparison the chariot is



bigger, having wheels 5mm in diameter. This means doing a lot of the work under a magnifying glass.

The flea is harnessed with copper wire and the whole thing is mounted on a coin about the same size as a 2p.

And when Andy wants to



acquire a flea for his chariot? Well, he goes to a wholesaler who imports from the USA, of course!

(Pictures Keith Clarke)

LAST July, Ted (Ed in Canada, Min Eng 52) Whitlock competed in the Masters' World Track and Field Championships in Sacramento.

He won the 1500, 5000, and 10000 metre races in the over-80s. And he won ridiculously

## Octagenarian breaks records

easily, writes his friend Tony Greenfield (Mech Eng 52)

Although, on this occasion, he didn't run in the marathon, Ed did so earlier in 2011, a few weeks after his 80th birthday,

setting yet another world record. He clocked 3:25:43, beating the previous 3:39:18. In October, he beat that with 3:15:54.

Ed's goal, as he told *Runners' World* early in 2011, is to get back to what he was doing in his early 70s. 'And I refuse to let age be an excuse', he says.

## Engineers gather in Oz

A MEETING down-under in November in Sydney was called an IC annual reunion but, in fact, there were 10 RSM and eight C&G alumni present, so it was more an engineers' reunion.

Organiser Ron Butler wrote: 'That was 20% of our local roll call, with many apologies for absence on account of work (and other) commitments.'

'We missed one of our

older alumni, Tony Bradshaw (Metallurgy 43) who was unable to join us due to a prior commitment to his croquet team. We hope they won't'

**BELOW: Marinus Stigter (Civil 63), Roy Cox (Min-Geo 61), Ray Dudgeon (MinProc 68), Jan Stigter (Civil PG 57) and Ron Butler (Metal 52).**



## Thanks 50 years on

'I'D NEVER thought about mining (as a career) until I heard your talk', John Fairfield (ESE 62) told Tony Brewis (ESE 52) when he met him at a reunion for Epsom College students last July. It's the sort of comment anyone would like to hear after speaking to children about the work they do.

As Tony says, he was back at the RSM for a post graduate course in mineral processing and gave the talk to 'a dozen or so boys in the maths sixth... about mining and what it entails. It was a short talk illustrated by chalk sketches on the blackboard and a few mineral specimens I passed round.'

It had the desired affect and now, over 50 years later, John has been retired two years. But the tradition is being kept up by his son, who is COO of St Barbara Mines in Australia.

In that time John, and the wife he married while at RSM, has travelled the world, moving house 24 times in 38 years. He started with Consolidated Zinc Proprietary and stayed, the company finally being part of RTZ.

## WANTED

New members of the team to take *Imperial Engineer* into the future

### Possible roles include:

Editor/Sub editor

Production editor

Designer (with experience of using InDesign) and others capable of compiling a section of the magazine.

All will be supported by an existing editorial board.

Small honoraria are available.

Please contact current managing editor

Bill McAuley

01276 23020. [william.mcauley@talktalk.net](mailto:william.mcauley@talktalk.net)

18 Tekels Avenue, Camberley GU15 2LB

Imperial Engineer plays an important role for the CGCA and the RSMA keeping them in touch with their members and members in touch with each other.

## IN BRIEF

## Operatic reunion

TONY HOLT (Aero 55), now a councillor for the Royal Borough of Kensington and Chelsea is still living close to College 'You might like to mention a small group of us, contemporaries from the mid-50s, who still meet once year with wives at the Holland Park Opera. At a long dinner afterwards, we catch up with family news. [tonyholt@gmail.com](mailto:tonyholt@gmail.com)

## CBE missed

'THERE was no mention of the CBE award to John McDonough, who was an undergraduate of Mech Eng with me from 1970-73,' writes Peter Cramb. John has been CEO of Carillon for the last few years and is due to retire later this year.

## New 'stuckees'

CLARE AND Toby Gilsig, and Claudette Sergerie have thanked members of Imperial College Exiles North America East (ICEANE) for coming to Montreal to enjoy the result of their hard work. Now they've handed over to new 'stuckees' Pam and Richard Olley and Teresa and Tom Pugsley.

## Wine lesson

ADRIAN Patrick (RSM 73) drew our attention to Christopher May's (Aero 59) *Daily Telegraph* letter.

'As a shy applicant to Imperial, the first culture shock was in the lavatories, where there were rhymes in Latin. During the interview the technical inquisition on jet engines was followed by a discussion about Dostoyevski. I had read enough of *The Idiot* to know some Russians towns have boardwalks.

'...I went to dinner in Hall. Only once; the red wine gave me a stomach ache. I wouldn't have learnt that at Oxford.'

SINCE past president of CGCA Robby Robinson's annual excursion to South Africa included a stopover in Johannesburg, it provided the impetus for an *ad hoc* gathering of the local Guildsmen at one of our regular venues, the Johannesburg Country Club. After gathering at the Sports Bar, we moved to an upstairs private dining room where we were able to exchange stories and share experiences in total privacy, with splendid food and wines, and to stay well beyond regular closing time.

The current president of the South African branch of the CGCA, Eric Arnot, himself an active octogenarian, said he felt young, yet humbled, by nonagenarian Robby's enthusiasm and energy. Robby had a game of golf scheduled, before flying down to Durban to visit family members.

One peculiarity of the South African branch is that

## Who's next for South African hospitality?



**At the lunch for Robby (above, second left). Others attending were Eric, Mapundi, Colin Batchelor, Joe Collins, John Godwin, Charles Lewis, Roger Loveland, Ivan Schwartz, Andrew Smith, Peter Watermeyer, Tony Williams and myself – Richard Gundersen.**

since Colin Batchelor arrived in 1981, we've only had one new member, Mapundi Banda, in the past 30 years! However, we

still meet once a quarter for a lunchtime drink and our reputation for hospitality for visitors is legendary. So who's next?

## London Walks support Guide Dogs

ORGANISER of the regular London Walks, John Backhurst (Chem Eng 62), is captivated by the stories behind the bridges, buildings and open spaces and the social development which

has taken us to where we are today in London and The City.

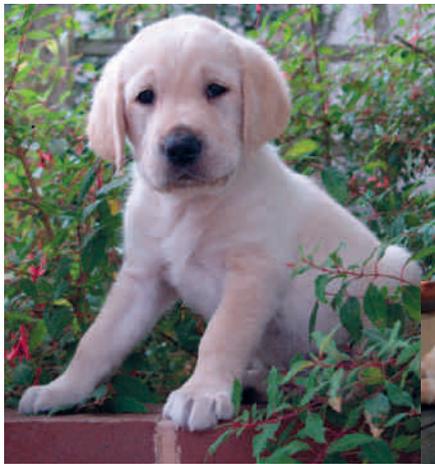
'For example, do you know that the Pearly King was the elected head of one of the first mutual insurance societies? Or how the Knights Templar provided secure foreign currency exchange?

'Our Blue Guide doesn't take a fee, but all we raise, net of a drink at the end of

the walk, goes to his designated charity. Previously it was Cardiac Arrest in the Young (CRY). For two years it's been Guide Dogs for the Blind. The two dogs (left) were supported by the £400 we raised last year.

'David Hattersley initiated the walks 12 years ago to introduce Guildsmen to the 16 City livery companies, instrumental in founding our college.

'Now open to present and past students and their accompanying friends, each walk is limited to 20. The booking forms can be found on the CGCA website and by a link from Events on the IC website. The cost is a modest £9-£12 per person. The two-hour walks take place on Saturday mornings and end about 1 pm with usually four walks per academic year.



Jess (above) and Ted (right).

## Ruben leads generator programme

**RUBEN FAIR (EEE 85) reports that since he joined General Electric's Global Research Center in Niskayuna, New York State in 2010, Covert team, the company he left, has also joined GE. He has been working on superconducting machines for wind energy. Now GE has received major funding**

**from the Department of Energy to work on a 10MW wind turbine generator using low temperature superconductors. Ruben is leading the team for this programme. Ruben's wife and son have now followed him while his daughter is studying at London University.**



Ruben Fair

## Ed plans IChemE's new strategy

SHELL senior executive Ed Daniels has been elected to the post of technical vice president of the Council of the Institution of Chemical Engineers (IChemE).

Ed, who graduated with a master's in Chem Eng in 1988, works closely with IChemE spe-



cial interest groups and leads a review of its technical strategy. This seeks to address some of the key challenges facing humanity today - specifically the chemical engineering profession.

A new technical strategy is due to be published in May leading to a refreshed IChemE roadmap for 21st Century chemical engineering.

'The human desire to "consume" presents many sustainability challenges in areas as diverse as energy, water, food, nutrition and health and well-

being,' commented Ed. 'Chemical engineering principles lie beneath each of these. We need to consider how we can form potential solutions.'

On graduating, Ed joined Shell's refining business and worked across a number of its divisions. Since July 2009, he's been executive vice president with overall responsibility for the downstream technology portfolio (including fuels and lubricants technology, catalyst technology and refining and petrochemicals process technology) in Projects & Technology.



## Barry appointed to IET position

PAST CGCA president Barry Brooks (EEE 71) has been appointed deputy president of the Institution of Engineering and Technology (IET). It's expected that he will become president in October next year.

IET, the largest by far of some 36 engineering institutions in the UK, has 153,000 members in 127 countries and about 100 local networks.

'It publishes technical journals as well as organising conferences and seminars and providing advice to government. It is an educational charity and Barry is one of 16 trustees.

'We undertake professional development and registration of engineers and technicians (chartered and incorporated engineer, engineering technician and ICT technician).

'Between the local networks and the central events team, we attract over 750,000 people to lectures. [bpsbrooks@gmail.com](mailto:bpsbrooks@gmail.com)

**WILLIAM Penn graduated in Geophysics in October 2011. Pictured with him are his proud parents. Austin graduated in Chem Eng in 1982 ('seems like yesterday!') and Jenny (née Crompton) graduated in Mech Eng in 1984. Austin now works for Sulzer Engineering as a product development manager, and Jenny is a C of E vicar. [j.penn3@homecall.co.uk](mailto:j.penn3@homecall.co.uk)**



Nigel Fitzpatrick (Materials 65) looks back through a changing world

## Half a century on from 1962

LEAVING the Union on Friday October 26 1962, after watching the progress of the Cuban Missile Crisis on the TV, one did not expect to reach the next Monday, let alone have the luck to be still in the technical game almost 50 years later.

From RSM, I joined Alcan in 1968 where projects included the then revolutionary development of can recycling technology now used by Novelis at, for example, Latchford Locks.

Leaving Alcan after what seemed a long quarter century I moved with the family to British Columbia and there at 56—the age Caesar's career was ended by assassination—became the founding CEO of Azure Dynamics Corporation. This company has delivered Ford Transit Connect Electrics across Europe

and North America.

To relax, Joan and I bought a quarter share of an apartment in the Legends, Whistler. There we met another owner who was reducing the energy costs of the property with novel techniques. This relationship led recently to my joining the advisory board of Enbala Power Networks.

From its first project at Legends, Enbala is balancing the grid and has revenue in the US as well as Canada.

I still help Azure on their patent and trademark portfolio and am particularly thrilled to be a member of their team for 10th time in 10K Vancouver Sun Run (thankfully walking is allowed!)

Chaotic though it seems 2012 does show more promise

of stability than did October 1962. But there is much to do to bring down carbon use.

As mitigation co-chair at the third Climate Change Technology Conference (CCTC 2013), I draw everyone's attention to the call for papers at <http://cctc2013.ca/CallPapers/CallPapers.html> [n\\_p\\_fitzpatrick@yahoo.ca](mailto:n_p_fitzpatrick@yahoo.ca)

## WE NEED YOUR NEWS

**Let us know your news and stories.  
Or have you an idea for a feature?  
Editorial assistance is available!  
Contact is Teresa Sergot  
(address on page two).**

**STORY IDEAS FOR NEXT ISSUE: AUGUST 13  
FINAL COPY DEADLINE: SEPTEMBER 28**

Graham Harris's latest work looks at the possibility that the inhabitants of Sodom (that iniquitous city) were the first chemical engineers.

## Sodom's fate result of surrounding minerals?

DURING the third millennium BC, the Dead Sea valley was a source of bitumen, a mainstay of Canaanite exports to Egypt. The bitumen was much prized having a variety of commercial applications.

Then, as now, resources of hydrocarbons were of strategic importance, and the history of the region records numerous conquests and wars being waged in order to control the bitumen harvest. The evidence points to Dead Sea production having been centred at Sodom, in the Vale of Siddim, the legendary city of sin which, according to Genesis, was destroyed by a wrathful God.

However, rational analysis suggests Sodom and her satellite cities were doomed by geography rather than dammed, the scientific evidence pointing to its destruction as a consequence of earthquake-induced liquefaction followed by a tsunami event.

But apart from bitumen, what other products could the imaginative engineers of Sodom have produced aided by the acknowledged proficiency of their main trading partners, the Ancient Egyptians? With such assistance there is good reason to believe the ancient inhabit-

ants of the region might have been some of the world's first chemical engineers, though their art would have been considerably cruder than that of today.

The Dead Sea valley is a hot, unpleasant place, probably as hot and unpleasant now as it was over 4000 years ago. No doubt it was a cruel, harsh existence, not only for the Sodomites themselves, but for those forced to labour beneath them. And they would have needed much manpower. The life of such labourers would have been short.

Today the South Basin of the Dead Sea is one vast industrial complex, producing a wide variety of chemical products. These chemicals include not only fertilisers such as potash, but bromine and magnesium, the latter produced by the electrolysis of magnesium chloride. The engineers of Sodom would have truly marvelled at present-day technology!

This article has been written in the hope it will attract comment adding to knowledge of Egyptian-Canaanite practice in chemical engineering during Antiquity.

To read the rest of Graham's (Civil 61,63) thought-provoking ideas go to the web address printed on page 2.



In this picture from the Nuremberg Chronicle, Lot's wife is already turned to a pillar of saly.

## OBITUARIES

# Colleagues mourn unexpected loss

WILLIAM (BILL) MACMILLAN (Chem Eng PhD 62) died on March 13, in Sydney, just 50 years after some of the most treasured days of his life – his four years at IC.

Born and brought up in Sydney, Bill took his first degree at the NSW University of Technology, before joining Permutit. The wider world beckoned and Bill left in 1958 to take up a research offer at IC, under Roger Sargent.

He was one of the first recipients of a Commonwealth



Scholarship and was honoured by a reception at Buckingham Palace. He was Imperial swimming captain, led the Guilds' water polo team on the 1962 tour of the Netherlands and played in the College A rugby team.

After his doctorate, Bill returned home, joining the CSR organisation, initially in their hardboard division, before joining their Gove Aluminium business. He retired in 1997.

Bill was a keen surfer all his life and, with wife Heather, an enthusiastic theatregoer.

For many years, Bill has been convenor for IC alumni in NSW and responsible for many reunion dinners. Perhaps the most memorable was in 2000 when guest of honour was the Rector, Lord Oxburgh. Four Olympic gold medal rowers (three IC alumni), fresh from their victory, were also entertained!

\*There will be a more complete obituary on the web.

## Sailing hobby was taught to descendants and others

SOUTH Londoner James William Richards Twyman (Civil 43), lived most of his life of 85 years, in Petts Wood. While studying at City & Guilds, he manned an anti-aircraft gun in Thornet Wood. After graduating, he went to work for The Bristol Aeroplane Company, and was seconded to Vickers, preparing analysis on airframes.

In 1946, Jim was able to start pursuing his love of sailing and in 1949 married Jean. Then, in 1950, Jim became a lecturer at the Northampton Polytechnic (which later became the City University). His speciality was fluid dynamics.

Shortly after retirement Jim took up a part-time job with the Engineering Council, helping implement new accreditation standards for chartered engineers.

Both Jim and Jean had a great love of sailing, which they

passed on to their three children and then grandchildren.

Jim was a natural teacher and latterly taught shore-based seamanship courses (Day Skipper and Yachtmaster), only hanging up his board pens a few years before his death.

Outside sailing, Jim had wide-ranging interests including classical music, matters aeronautical and wartime history. He had a strong practical streak, enjoying some aspects of boat maintenance and repair, as well as, with Jean, doing much of the improvement and maintenance on their house.

Jim had enjoyed good health all his life, until he suffered from bowel cancer a few years ago. This was treated successfully at the time. However Jim was taken into hospital just before Christmas 2011 and ultimately passed away late on February 20 with family at his side.

# 'Summer will never be the same without David'

David King's niece Emma Watson was speaking at the conclusion to her eulogy. Our words are taken from it. To read it complete, go to the web address on page two.

'I SHOULD like to interview King. He seems quite a useful fellow.' They were the words of the department head when he came up in 1950 to read civil engineering.

'University was followed by national service in the Royal Engineers. At the end of that David's senior instructor wrote:

"A keen, capable young man who has made the maximum use of his service to the army. He is technically of a very high

standard. He has a very pleasant personality, a good sense of humour and is intensely loyal. A smart soldier at all times who is not afraid of using his initiative. He has been a very real asset and he will be missed when he leaves us. He should go far.

'He also added "He is a keen and useful oarsman."

'To try and convey the immense nature of David's abilities and his mastery of science is hard, but perhaps the best way

is just to tell you about some of his engineering projects, as they really speak for themselves.

'They included the Rathbone Place extension for the Post Office Railway tunnel; sewer construction for Wembley borough council; the design of marine terminals at Fawley and Milford Haven and in Thessaloniki for Esso.

'In particular he was instrumental in a project at Immingham in the Humber estuary

for the British Transport Docks Board. For this pioneering work and subsequent academic paper, David received the prestigious Telford medal.

'Impressive though David's career certainly was, he still found time to enjoy an active rowing career with Thames Rowing Club.

But perhaps his most enduring service to rowing lies in his activities computerising the Head of the River Race.\*

A past colleague pays tribute to Ken Wright, who graduated from RSM in 1945. He died last summer.

## Man of stature

'I HAVE many memories of Ken from the time he was my boss during the commissioning and early operation of the lead/zinc concentrator at Silvermines in Eire. I learnt a lot from him,

'He had a huge physical presence, as well as great strength. Once, to avoid a complete shut down, he blocked the underflow from a cyclone with his hands for a good five minutes while a temporary repair was made.

'I've no doubt that Ken's claim to have held the RSM record for drinking the yard was true.' *Henry Brout, ex-Dome* \*

## The centre of oil folklore

BRENDAN McKEOWN, who died on November 16 aged 86, was written into oil industry folklore when he borrowed a pickle jar to transport a sample of the UK's North Sea oil to his boss's desk. A small quantity was poured into a glass ashtray and set alight. It was indeed oil.

Brendan's first job was as a civil engineer in the Stormont Ministry of Health, but by 1949 he had joined the Kuwait Oil Company (KOC).

Back in Kuwait, after a post-graduate course in oil technology at Imperial, he was attached to KOC's drilling office and learnt the nitty-gritty of the oil business from the drill floor.

He rose through the ranks to superintendent of operations and worked alongside famous oilfield firefighter Red Adair.

Brendan joined Amoco after

two years in Tehran as operations manager for the Iranian Offshore Petroleum Company.

After Amoco struck oil in the North Sea, Brendan went on to become operations manager at the Bacton gas terminal and division operations manager for Amoco UK gas fields.

In 1985, he was named Great Yarmouth's first Oil Baron of the Year by the town's Society of Petroleum Engineers. He was also made an OBE, for services to the oil industry, in 1986, the year he retired. He was also an associate member of the Institution of Civil Engineers, a founder of Lions International in Wroxham (in the Norfolk Broads, where he lived for 45 years), a keen golfer and true family man. He and wife Sue celebrated their 60th wedding anniversary last September.\*

## Drove sports car to end

JOE KNEVETT (Mech Eng 38), an active member of the RC St Vincent de Paul Society, died on Ash Wednesday, a few weeks after his 95th birthday. He served a number of years in the RAF during and after World War II, becoming a wing commander.

He joined the SVP in his late 80s with the express purpose of being secretary. He was a true gentleman with wonderful sense of humour, say his colleagues there. Joe loved life and still drove a powerful sports car until a few weeks before his death.

## Grandchildren's cool 'grumpa'

PAUL CHIPMAN FARISH (Mech Eng 50) died on November 13 after a very busy week, out visiting friends and family.

Writing in the *Daily Telegraph* announcement, his daughter Penny described him as 'adored husband of 58 years of Elizabeth, much-loved father of Penny, Susie and Tim and cool 'grumpa' of William, Kate, Tori and James. An amazing man who enjoyed life to the fullest and who will be sorely missed by all who knew him'.

## Peter Adams

PETER ADAMS, MICE, (Civil 45) died on Christmas Day 2010, at the University Hospital of Wales aged 85.

## Councillordies

JOHN KLASHKA (Chem Eng 62) died suddenly on October 26. His technical knowledge made him an asset as county councillor for the Kesgrave & Rushmere St Andrew Division and district councillor for Kesgrave East, in Suffolk

**More complete versions of obituaries, marked with an asterisk \*, can be found on the website address published on page two.**

## Long working life

PETER Hugh Hutchinson, 88, (Elec 41) died on October 31.

On leaving Imperial, the Joint Recruiting Board told Peter to volunteer for the Royal Air Force where, in a new rank of electrical engineer officer, he would receive a commission. After a variety of roles, such as signals officer and an attachment to Aeronautical Inspection, Peter was posted to India.

Returning home to Hampton-upon-Thames, he took up

an offer made to him earlier, to go into partnership in Budd Radio and Electrical. The business steadily grew, he became managing director and remained for the rest of his working life. He continued to work part-time until over 80, only retiring to care for his wife so she could remain at home.

Peter was a hard-working man who loved his family and who took a great interest in knowledge of all kinds.\*

