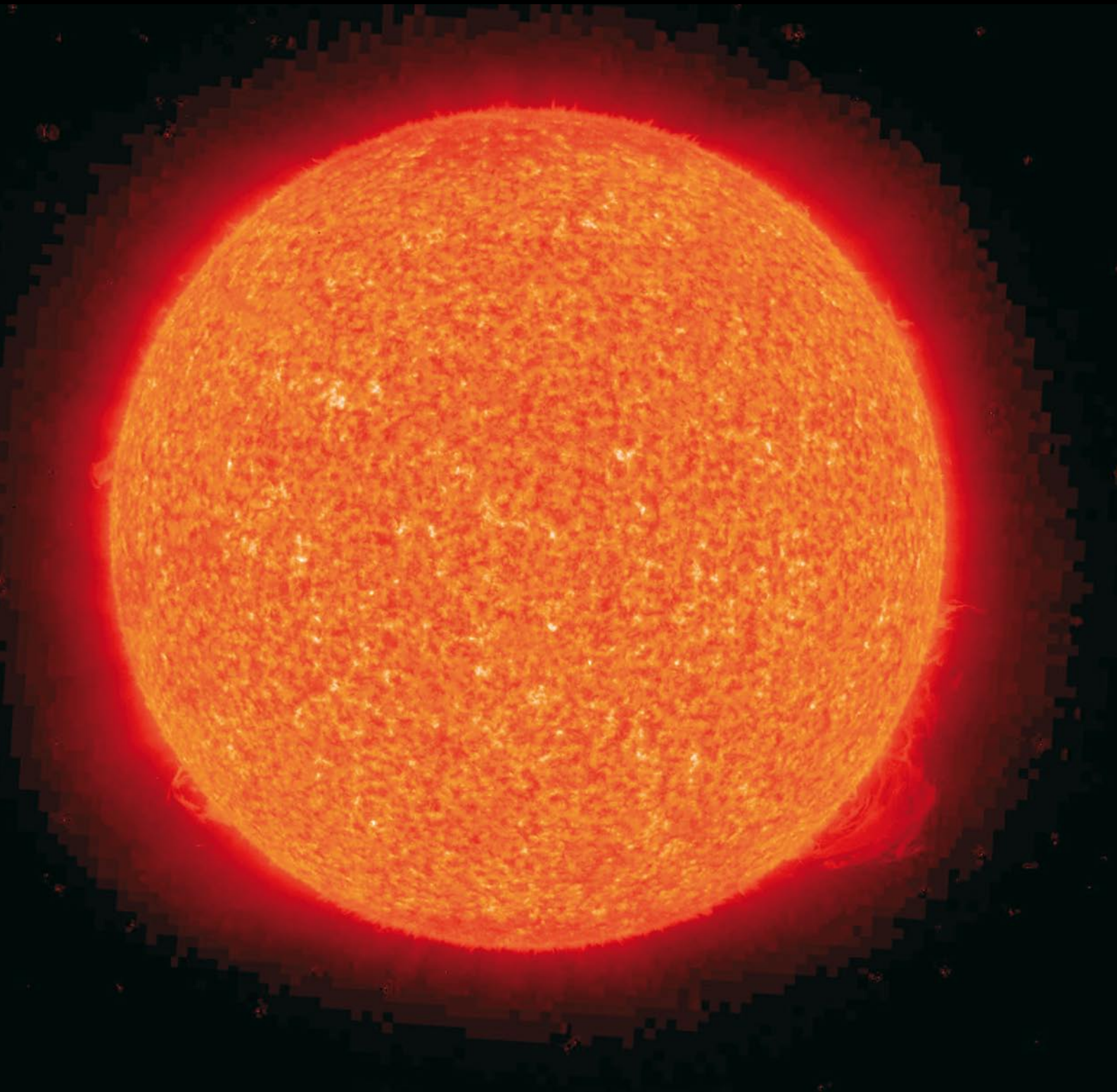




The front page image was acquired in extreme ultraviolet by the SOHO satellite on June 28 2000, when the sun was near the peak of its last 11-year activity cycle. It shows a very disturbed surface and two huge prominences - eruptions of energetic particles into space. By way of contrast this image (below), acquired on August 31 2008, shows the much quieter sun at the minimum in its current 11-year activity cycle.





Imperial ENGINEER

**NEW PRINCIPAL
MORE FUNDING
FOR ENGINEERING
POSTHUMOUS AWARD
CLIMATE DEBATE
CONTINUES**

ISSUE NINE: *AUTUMN 2008*

For members of

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

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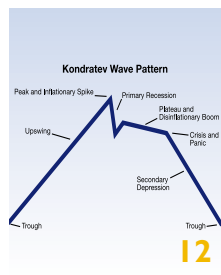
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COVER PICTURES: The sun on June 28 2000, when it was near the peak of its last 11-year activity cycle (front). The back cover shows it on August 31 2008 when it was much quieter.

Imperial ENGINEER

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

WHEN I joined Imperial College staff I knew little about City & Guilds. However, my first freshers' dinner quickly brought me up to speed! Now here I am, more than 30 years later, greeting you as president of CGCA! I hope my experience during those years as dean, and later as principal of the Engineering Faculty, will help me in making CGCA even more relevant to our alumni, and I am greatly honoured to have been elected. I've already enjoyed meeting some of you across the summer and I look forward to more interactions at our events during the year. A president has only one brief year (and already one third has passed) so continuity is vital.

I do want to congratulate my predecessor, Peter Garratt, on his successful year which I was able to observe at first hand for some of the time. His insistence on the importance of interacting with the departmental societies is, I am sure, the way to engage younger alumni. It is an action I shall push forward.

As the first female president of CGCA - just as I was the first (and so far only) female dean of C & G. I really am happy to note that there are now many more potential female candidates for these posts among our students, alumni and staff than when I arrived at Imperial. I hope I am just the first of a long line! To mark my President's Evening, I invited another female engineer - and a very distinguished one - Professor Wendy Hall. A vice-president of the Royal Academy of Engineering, she works as a computer scientist in Southampton University. She described the work she is doing with Tim Berners Lee (inventor of the worldwide web) on the next generation of web development and fascinated us all.

Our next big event is the Annual Dinner which will be held next February 19, in the Stationers' Hall. The guest speaker will be John Armit CBE FREng FICE, chair of the Olympic Delivery Authority. I hope to meet many of you there, at what I believe will be a splendid evening.



**Julia
Higgins**

PRESIDENTS REPORT



**Kurt
Budge**

THE RSM has lost several of its alumni since I last wrote. Alex Wright (Geology 2002) died in a tragic accident in early September; Bill Harman, a loyal servant to the RSM for over 40 years, passed away in August and more recently Dick Potts (Min 66) and Peter Flatley (Met 52) have been lost to us. There may be others I don't know of, but all will be remembered at this year's Annual Dinner, when we offer a minute's silence in their memory, and toast 'absent friends'.

After the AGM in the summer, John Sharpley, RSMA president 1986-7, gave me a copy of his president's message from the annual journal of that year. Surprisingly, very little has changed in 20-years, and John's call back then for alumni to join the Association and engage with it, is the call that I make today. I'm pretty optimistic that we are moving in the right direction, as we had an overwhelming response to our recent survey, with over 850 RSM alumni (not all members) making the effort to give us their thoughts.

More details of the survey are covered in an article on pages 10 and 11 of this *Imperial Engineer*; but the most telling fact was that alumni told us that they don't know the purpose of the RSMA. When I read this I went straight back to the RSMA constitution which, despite all the changes that have impacted on the RSM in recent years, has stood the test of time and should resonate with all RSM alumni:

- To endeavour to maintain the identity of the RSM and its distinctive diploma.
- To foster an enduring link between members of the Association and with the staff and students of the RSM, thereby promoting comradeship and a source of mutual help and advice.
- To provide members with a forum for assisting, both financially and in other ways, students in particular and the RSM in general.
- To present views of RSM men and women.

It's clear that the RSMA committee has fallen short in communicating with alumni about how it works towards the constitution's objectives and how it stays relevant to alumni, and the undergraduates who still join the RSM and still graduate ARSM. This we intend to change with your engagement and financial support, enabling the committee to harness the resources it needs to serve RSMA members and students, and to act upon the findings of our recent survey.

The RSMA committee has awarded Jack Sandy, honorary membership of the RSMA. Jack had decided to let his membership lapse because of poor health and increasing difficulty in staying connected to the Association. However, he has been a member for many years, during which time he has never failed to sponsor students at RSMA events. For these reasons we would not want to lose him as a member and are pleased to report that he has accepted the award.

Finally, the committee sends its best wishes to all RSM alumni who may be affected by the ensuing turmoil in global markets.

IN BRIEF**Newcomers join CGCA committee**

SUPPORTING Professor Dame Julia Higgins as this year's president of the CGCA, Chris Lumb continues as hon sec and Peter Chase as hon treasurer.

Two newcomers to the committee are John Loughhead (Mech Eng 67-75) as senior vice-president, and Susie Nounhan (née Newson, Comp 80) as a group representative.

Continuity on RSMA's committee

FOLLOWING the RSMAAGM in June, Kurt Budge continues as president, Coen Louwarts as senior vice-president and Leah Glass junior vice-president. They are supported by past-president, Roger Clegg, Paul Holmes hon sec, Rup Banerjee hon treasurer and a committee of 12 others.

Yet another volunteer, Fiona Cassidy, was applauded when she stood down after many years on the committee. She is remaining on the RSMA Trust board led by Prof Rees Rawlings.

Top commendation

IMPERIAL College is ranked third in the *Times Good University Guide 2009*. Oxford is first and Cambridge at number two. In the subject league tables, Imperial is ranked third for medicine, fourth for mathematics and fifth for chemistry. The College is ranked first for its spending on facilities at £3,218 a student and second for staff/student ratios. It is ranked sixth among universi-

Online reading

Once again, high levels of contributions mean that some articles have had to be abbreviated. Where specified go to www.imperial.ac.uk/engineering/about/alumni/imperialengineer to read them in full.

New Engineering principal

THE NEW academic year has started with Professor Stephen Richardson (right) being appointed principal of the Engineering Faculty. Professor John Wood, principal for the last year, has become the first international relations advisor.

Professor Richardson was previously head of Chemical Engineering and Chemical Technology. He completed his PhD at Imperial in 1975 and, after research at Cambridge, returned to lecture in Chemical Engineering in 1978. He was appointed professor of Chemical Engineering in 1994 and became head of department in 2001.

Stephen's research focuses on improving safety in the oil and gas industry. Achievements include developing a computer program to simulate and predict events when high pressure systems become rapidly depressurised.

**Research potential recognised**

DURING May's largest-ever graduation day for post-graduates, Professor Anthony Evans, a leading researcher in materials science, joined the Fellowship of Imperial College.

In addition, four Research Excellence Awards were announced, recognising research with significant future potential. Engineering teams supported this year are working on developing and applying ultrasound

wave theory for non-destructive evaluation, led by Professor Peter Cowley (Mech Eng), and imaging nanostructured materials to improve materials performance. It is led by Professor Sergei Kasaria (Chem Eng).

Two more developments teams are predicting the effects of global warming on biodiversity and extending the capability of the high power fibre laser.

RAEng honours fellows

THE ROYAL Academy of Engineer has honoured six Imperial researchers with fellowships for their outstanding contributions to engineering.

They are Professor Nigel Brandon (Earth Science and Engineering), Professor Jeff Kramer (Computing, dean of the Engineering Faculty and trustee of CGCA's Old Centralians' Trust), Professor Christofer Toumazou (Institute of Biomedical Engi-

neering) and John Loughhead (UK Energy Research Centre and CGCA vice-president). Professor Sir Gordon Conway (Centre for Environmental Policy) and Professor Lord Robert Winston (Humanities) received honorary fellowships.

RIGHT FROM TOP: John Loughhead, Jeff Kramer, Nigel Brandon and Chris Toumazou.

Research stored centrally

FOLLOWING the launch of Spiral, an easy procedure by which Imperial's academics can upload work for wider use, the College is taking part in a project to safeguard UK's research journals and provide a central access point.

With £9.84 million from The Higher Education Funding

Council for England (HEFCE), Imperial and the British Library will enable the creation of the UK Research Reserve (UKRR).

Deborah Shorley, director of Imperial Library Services, said: 'The UKRR addresses problems of libraries with duplicate copies of low-use periodicals'.

Alumnus becomes 14th rector

PROFESSOR Sir Roy Anderson has become the 14th rector of Imperial following four years on secondment to the Defence Ministry, where he was chief scientific advisor.

Sir Roy, a distinguished infectious disease epidemiologist, started a 40-year association with Imperial when he joined to study zoology in 1965. He completed his PhD in parasitology in 1971, became one of its youngest professors in 1982 aged 35 and department head at 37.



FOLLOWING a successful engineering careers fair, which brought 60 companies to Imperial College and was visited by 1,500 students, the Engineering Chapter hosted a networking reception for engineering alumni and students.

This event, generously sponsored by Npower and the CGCA, aimed to give students the opportunity to learn from alumni careers' experiences, make valuable networks, and to allow alums to connect with the current student body.

After a brief address about recent changes in the Faculty, given by principal Stephen Richardson, around 30 alumni had a chance to enjoy a glass of wine and the opportunity to network with each other before being joined by over 100 students. Feedback from both students and alumni was very positive, although students would have liked to meet even more alumni!

Alumni contribute to networking



Action now for climate change

CLIMATE change is never out of the news these days and Professor Sir Brian Hoskins fuelled the debate still further in May with his first annual Grantham Lecture.

This world-leading meteorologist, and director of Imperial's Grantham Institute for Climate Change, spoke about extreme floods, droughts and heatwaves, and how researchers at Imperial are battling to deal with effects of a rapidly-warming planet.

Sir Brian outlined three things – how rising temperatures are threatening to reduce biodiversity and damage important agricultural land; how rising sea levels could threaten the supply of fresh drinking water in some developing countries,

and how changing temperatures could mean tropical diseases like malaria take hold in previously unaffected areas

Sir Brian said: 'When people talk about climate change, they often assume that changes will be slow and steady. However, some evidence suggests that, as the climate changes, we will see extreme events, like the very hot British summer of 2003 and the contrasting summer floods in England in 2007, occurring more often'.

Sir Brian also joined other climatologists, at a summit during the summer, when they called for massive investment in computer and research resources to help scientists predict the future effects of climate change. They argued that



many questions about how severe the effects of global warming will be, and which regions will be hit in what ways, are beyond the capabilities of current climate science. Professor Hoskins said: 'We need a revolution as it has got to be done extremely quickly'.

Research fellowships launched

IMPERIAL is committing £3.6 million to establishing 60 junior research fellowships over the first three years. They will start in 2009. It is expected that those who win places after applications close on November 30, will have three years free from teaching and administration, plus a competitive salary and laboratory support costs.

Professor Maggie Dallman, who is spearheading the scheme, explains: 'We're looking for the best scientists from across the world, so that the science base we all rely on is strengthened internationally. This will enable them to develop their own scientific path and make the difficult leap from post-doctoral researcher to lecturer.'

CLEAN car technology was on display at Imperial when Nissan unveiled its new hydrogen-powered, fuel cell vehicle in the College's main entrance. The cross-faculty Energy Futures Lab showcased the cutting edge research that supports it.

Hydrogen-powered fuel cells emit nothing but clean water, offering the prospect of pollution-free motoring.

Chosen as the venue because it is in the forefront of fuel technology, Imperial is developing the next generation of vehicle power, be it hybrid, electric or fuel cell.

Sustainable driving future?



Engineers help Henry Moore

HENRY Moore's *The Arch*, dismantled 12 years ago due to safety concerns, could be re-erected at its original site on the banks of the Serpentine, thanks to experts from Imperial.

One of the team, Dr John Harrison (Earth Science and Engineering) said: 'Rock engineering techniques are usually used to stabilise tunnels and rock slopes, but the basic concepts of understanding how rock behaves when it is subjected to loads are immediately applicable to stone sculptures'.

DEVELOPMENTS AROUND THE ENGINEERING FACULTY

Understanding of plants is key

RESEARCH into increasing the yield of crops, and assessing how plants respond to climate change, has received a boost with the official opening of £2.7 million plant science labs at Imperial.

Understanding plant biology is the key to solving one of the biggest challenges faced by the world today – how to provide enough food for the planet’s population and develop new green energy sources.

Middle Eastern promise for research

A RESEARCH collaboration that will focus on understanding carbonate reservoirs and CO₂ storage has been launched between Qatar Petroleum, the Qatar Science & Technology Park, Shell and Imperial.

The first three will contribute up to \$70 million over a 10-year period to provide the foundation for new CO₂ storage technologies that can be applied in Qatar and beyond. The collaboration builds on the on-going Grand Challenge Programme agreed between Shell and Imperial in 2006.

At the ceremony at Imperial were Qatar’s deputy pre-

mier and minister of energy and industry, His Excellency Abdullah Bin Hamad Al-Attiyah, Linda Cook, executive director of Royal Dutch Shell, and Dr Tidu Maini, executive chairman of Qatar Science & Technology Park (QSTP).

The agreement will see Imperial’s Chemical and Earth Science and Engineering departments recruit new academic staff, 20 PhD students and 20 post-doctoral researchers to push forward research in the UK and in Qatar. It will also provide critical expertise for Qatar and Shell as they seek to develop hydrocarbon

resources in a sustainable way.

Developing existing knowledge, researchers will be able to propose new CO₂ management processes and identify suitable carbonate rock formations to potentially store CO₂.

Minister Al-Attiyah remarked: ‘In a time of rising demand for oil and gas, Qatar is keenly aware of the need to balance the energy security concerns of customers with the need to preserve the environment. My country is committed to developing and implementing technologies that will allow us to take on this challenge responsibly’.

Wine future’s bad forecast

INCREASING summer temperatures could mean some parts of southern England will be too hot to grow vines for making wine by 2080, according to a new book launched by Professor Dick Selley (Earth Science and Engineering).

Dick also says that, if the climate changes in line with predictions by the Met Office’s Hadley Centre, areas of the UK including Yorkshire and Lancashire, will be able to grow vines like Merlot and Cabernet Sauvignon. These are currently only cultivated in

warmer climates like southern France and Chile.

‘With models suggesting the average annual summer temperature in the south of England could increase by up to five degrees centigrade by 2080, I’ve been able to map how British viticulture could change beyond recognition in the coming years,’ he explains.

This may seem an improvement, but vines currently thriving in south east England could become limited to the cooler slopes of Snowdonia and the Peak District. At the same time, present wine growing areas will become too arid!

Cosmic dust specks hold key to Big Bang

TREKKING across the globe collecting cosmic dust has led ESE’s Dr Mathew Genge to conclude that his research holds exciting possibilities for the deeper understanding of the solar system.

‘There are hundreds of billions of extra-terrestrial dust particles falling through our skies’, he says. ‘This abundant resource is important since these tiny particles of dust allow us to study distant objects without the multi-billion dollar price tag of space missions’.

The origin of cosmic dust has always been unclear. Scientists thought that analysing the chemical and mineral content of individual dust particles was the key to tracing their origin. But this study suggests that a comparison of multiple particles give better results.

‘This could answer so many important questions such as why we are here and alone in the universe’, says Mathew.

For more about his research go to the *Imperial Engineer* website.

COSTING £11 million and taking two years, renovations to Imperial’s Central Library were completed for the beginning of term. It now offers 150 new individual study spaces, 90 new computers, group study areas, a 30-seat training room to support the

The source of some of these articles comes from Reporter, newspaper of Imperial College, and press releases.

library’s delivery of information skills courses for students, and the Library Café.

A significant collection of over 50 modern abstracts adorn the ground floor walls, having been donated by Sussex artist Bob Brighton. Design features include a glass stairway in the main entrance, walnut joinery in the café and semi-transparent think tank areas for group study.

Consultation was a key feature of the refurbishment. The Library team conducted a stu-

dent survey to find out about their needs and researched how other libraries have been changing. In particular, computer connections throughout the area reflect the increasing use of laptops by students and reliance on the internet.

It is a modern 21st century library, designed to reflect the changing way 21st century students work. All members of the College community can come to the Library and work independently or in groups with this new versatile space.

Prestige European award for Amrit

IMPERIAL postgraduate Amrit Sharma has won the prestigious Young European Arena of Research Award for his work on improving motorcycle dynamics.

Amrit, from EEE, won the gold medal for his mathematical models used to improve the design of a racing motorcycle for the manufacturer ECOSSE Spirit. Professor David Limebeer (EEE) praised Amrit for his efforts.

DEVELOPMENTS AROUND THE ENGINEERING FACULTY

Rio Tinto backs research for mine of the future

MINING company Rio Tinto, with Imperial, is developing advanced techniques to extract increasingly hard to find minerals from deep within the earth while minimising environmental impacts.

The Rio Tinto Centre for Advanced Mineral Recovery will develop a range of mining technologies like block caving. This exploits natural fractures in rocks so they break under gravity rather than by using explosives, making the mining process cheaper and safer.

Researchers will also design new sensing technology for use in block caving to measure the underground area containing minerals and the size and shape of these deposits. This would increase the efficiency of this mining process.

New ways of mining minerals, which use acids to dissolve metals in rocks below the earth's surface, will also be explored. These dissolved metals could then be pumped above ground and extracted from the acids.

Researchers believe this method will use less energy and remove the need to disturb land in open cut mines and be safer for miners who would not need to venture deep underground.

Scientists will also work on reducing energy needs and increase efficiency for froth flotation technology which separates valuable minerals from waste rock.

Lead scientist, Professor Jan Cilliers, Rio Tinto Chair in Mineral Processing at Imperial's Department of Earth Sci-

ence and Engineering, says: 'If we found copper close to a major city tomorrow, the associated environmental and social concerns would make it impossible for us to mine this resource. However, our research could make this a reality without any adverse impacts to the environment'.

The £6 million fund will be used over a five-year period and will see six post-doctorates and 12 researchers employed in Earth Science and Engineering.

Vodafone backs new scholarships

UNDERGRADUATES in the Engineering Faculty are to benefit from a new, prestigious scholarship scheme thanks to a generous donation from the Vodafone Group Foundation.

Individual engineering departments will each nominate a UK/EU and overseas undergraduate on the basis of outstanding academic merit. A committee comprising admissions' tutors, senior academics and a Vodafone representative will then select the winners of the Vodafone Group Foundation Technology Scholarships.

Those selected will receive tuition fees and maintenance for the entirety of their time studying.

The scholarships are not only aimed at

rewarding excellence, but also at levelling the playing field for engineering study at Imperial, by enabling the most talented undergraduates to attend the College regardless of means.

Through the Vodafone Group Foundation Technology Scholarships, the foundation is making a tangible contribution to the engineering talent pool, which will ultimately benefit the engineering sector as a whole.

The Vodafone Group Foundation has invested over £115 million in projects since its creation in 2002, concentrating on disaster relief, helping disadvantaged young people via sport and music and projects through 24 foundations worldwide.

Pedestrians and traffic to mix

BY 2012, Exhibition Road will be redesigned using the 'naked street' concept. It could have a defining influence on city centre planning everywhere. However, there are a lot of unknowns with this project in which pedestrians and drivers will share a road stripped of road signs, markings, and traffic lights. The aim is to make both aware of their environment and other road users.

Professor Michael Bell (Civil and Environmental Engineering) says: 'We'll be monitoring traffic speed, the interaction between vehicles and pedestrians, and the willingness of people to share this new space with vehicles'.

New ways with depression

EATING sushi and seaweed, drinking smoothies and smiling more could help fight depression, argues a new book by Professor Janet Plant (Earth Science and Engineering).

In *Beating Stress, Anxiety and Depression*, she challenges many conventions in the treatment of mental illness with co-author Janet Stephenson. 'We don't agree with the usual advice to "keep taking your medication and eventually all will be well, because doctor knows best".'

Self-healing cracks could help environment

MATERIALS that can stop a crack and then self-heal have been brought a step closer to reality thanks to an Imperial

College-University of Bristol joint project.

The Crack Arrest and Self-Healing in Composite Struc-

tures (CRASHCOMPS) project is developing tailor-made composite materials that arrest the development of cracks and heal themselves and could be used to build lightweight, safe, damage-resistant components for more fuel-efficient aircraft, trains, cars and ships.

'Because engineers are worried about cracks forming in composites, they currently build aircraft parts much stronger, and therefore heavier, than may be necessary', explains Dr Emile Greenhalge (Aeronautics).

'This means more fuel is needed to get off the ground and fly to their destinations. This is far from ideal, in terms of aviation's impact on the environment.'

Mars mission will dig deep

PREPARATIONS are underway for the most in-depth probe of the Red Planet ever undertaken, with the help of Imperial.

The European Space Agency's ExoMars mission in 2013 will search for evidence that life may exist on Mars; investigate the Martian upper atmosphere, and analyse the physical characteristics and properties of the planet's surface and interior.

Researchers from Imperial are amongst those developing

and testing the instruments and technologies for the mission.

Dr Tom Pike (Electrical and Electronic Engineering) said: 'As well as investigating the potential for life, ExoMars will be the first lander to look deep within the planet. The mission I'm currently working on, Phoenix, has literally just scraped the surface of Mars.'

'We hope that, with the Imperial microseismometer being used, ExoMars will be able to look much deeper, right down to the core of the planet.'

DIARY DATES

2008

Friday November 21

RSMA Annual Dinner, Ballroom, Polish Club Ognisko, 55 Exhibition Road, 7 for 7.30pm
Booking form on reverse of address carrier

Saturday November 22

CGCA 'Decade plus One' Reunion Luncheon, Polish Club Ognisko, 55 Exhibition Road, 12 for 12.30pm.
Booking form on reverse of address carrier

Thursday December 11

CGCA Christmas Lunchtime Seminar, 170 Queen's Gate, 12 for 12.30pm. Booking form on reverse of address carrier

2009

Thursday February 19

CGCA Annual Dinner, Stationers' Hall, 6.45 to 10.45pm
Booking form inside this magazine

Wednesday May 20

CGCA AGM & President's Evening
Venue: tbc

Thursday June 25

RSMA AGM and Final Year Barbecue. Venue: tbc

For more information and booking for any of these events, contact the Chapter Office (as page two) or phone 020 7594 1184

ON LAND

THE FORMULA Zero Championship in Rotterdam was a huge success for Imperial's Racing Green student team, whose vehicle came in third. The hydrogen-powered fuel cell, hybrid, zero emission go-kart ran almost perfectly with a number of minor electronic and mechanical issues being solved by the team who knew the vehicle systems inside out.



STUDENT POWER

It was generously supported with £3,000 from the Old Centralians Trust.

The reliability of the Imperial kart was impressive, showed remarkable consistency and was the only one to complete the full endurance distance without stopping on track.

Special mention must be made of Toby Schulz (Mech Eng) who was driver and responsible for programming the vehicle management unit.

The students designed, built, tested and raced the go-kart in a single year and fully expect to improve on their performance and results at the next Formula Zero event.

Preparations are also underway to build a fuel cell hybrid racing car for next year's Formula Student event at Silverstone. This has already won

a second place for its design on paper.

ON WATER

'AN ENCOURAGING display, given our tight budget and inexperience' (despite a £1,000 from the Old Centralians Trust) was the Imperial team's verdict on coming 14th in a field of 21 in the Frisian Solar Challenge – Europe's only solar-powered boat race.

The team was unlucky on the last day when the electronics failed 500m from the end of the 200km race, something recognised by the organisers when they awarded the 'Bad Luck Prize'!

They are now looking forward to getting together a new team of dedicated students to work on the project, ready for the 2010 race.



IN THE AIR

AIRBORNE above the Serpentine, Mech Eng's David Mulholland experienced a hubristic moment at the controls of glider Icarus. And even though he plummeted to earth, he declared it to be one of the highlights of his academic career. David and his team (right) came 23rd out of 40 in this year's Red Bull Flug Tug competition. Two more, being made this year from scratch, will fly in London or Bognor.



Medal awarded posthumously

THIS year's Peter Harding Memorial Award for 'demonstrating sustained commitment and outstanding contribution to The RSM and Imperial communities' has been made posthumously to Bill Harman. Bill, who was a technician in the Mining/Mineral Resources Engineering department for over 40 years, and a member of the Chaps Club, died in August. He was instantly recognisable in the RSM and a part of its fabric.

RSM was a major and significant part of Bill's life, as Barrie Holt (Mat 69) said during his eu-

logy at Bill's funeral. Bill had no family and the funeral congregation was basically RSM, – John Monhemius, Sevket Durucan, Rob Marsden, myself and others. Bill's commitment to the RSM and students made him so deserving of the award.

The RSMA committee has had a medal, engraved in recognition of the award to Bill, to be put on display within the RSM building. The prize cheque for £150 is to be donated to Great Ormond Street Children's Hospital in Bill's memory.

Kurt Budge

Friendly brewery adds to pleasure

A GREAT reprieve from RSMA supporters made an enjoyable evening for over 40 students (31 of whom were sponsored) when the traditional final year dinner became a barbecue in June. Also in attendance were 21 alumni and official guests and staff.

Completing the fun of the evening was beer supplied by RSM alum Eddie Gadd's Ramsgate Brewery. The barbecue will be repeated next year.

Dame first among equals

BRIGHT brown eyes, missing nothing, set in a pretty face and topped by a head of brown curly hair. Her manner is brisk but unhurried and there's always time to debate a point. Her charm helps the hesitant and disarms the belligerent. This is Julia Higgins, the new president, and first woman president, of CGCA.

Born during WWII, Julia can remember, just, the doodle-bugs buzzing overhead. Her parents, she told me, 'were highly-educated people: my sister did mathematics, my next brother was an architect and the next brother went to Oxford, like me, and read physics. So my parents bred essentially scientific offspring'.

First fellow

Being the 'first woman' isn't a new experience for Julia. She became the first woman dean of the C&G, from 1993 until 1998, and was the first woman to become a fellow of the Royal Society and the Royal Academy of Engineering.

'I always assumed when I started my career that there would be crowds of women following behind – but when I looked they weren't there! They needed a push.

'I discovered that people who championed women in science and engineering at the lower levels just didn't get very far. This was because they weren't speaking to people at senior levels – but I could, of course. I had enough influence to create an effect by talking to influential people like the Rector and others. It was quite fun. I think there's now much more consciousness about women's needs at the senior level.

'One of the problems for women trying to break through the glass ceiling is that universities and institutions have a certain promotion procedure where they wait for people to come along and

say "I want to be promoted". But women tend to be rather laid back and don't do this. I've also read through several job applications from women and they always say things like "I managed to"... never "I did". I'd like to encourage them to write in a more positive manner.

'I try to take on things I really want to do. This means

ing – one of the UK's largest.

'I'm not doing as much as I was now I'm retired. I spend more time on young colleagues, vetting their PhDs, and also with colleagues overseas – more at a "hands on" level but still *thinking*. Running a big research group is extremely pressurizing but now I enjoy the luxury of just thinking.



Colleen Richardson talks to Professor Dame Julia Higgins, DBE FRS FCGI, (above) following her appointment as president of CGCA for 2008-09

not resenting having to do it.'

This is why Dame Julia became chair of the Athena Project. This was set up in 1999 and aims to increase the number of women recruited to top posts in science, engineering and technology.

'Being a woman in science and engineering is an advantage', she told me. 'If you're at all competent, people remember and ask for you.'

In June 2006, Dame Julia was appointed principal of Imperial's Faculty of Engineer-

'In my group, we study the behaviour of complex materials and particular polymers. One of our specialities is the application of neutron scattering techniques to problems.'

Fun stimulation

Fundamentally, Dame Julia says, she's probably a materials scientist but after 30 years in a chemical engineering department, she doesn't actually think like other scientists

do – 'I've gone native! But what I find great fun is sitting around talking research with someone who is on the same wavelength. It's hugely intellectually stimulating. A lot of people in research need a collaborator who can reflect things back, so an idea returns from a different direction.'

Young focus

On the topic of her new role in the CGCA, Dame Julia said, 'I feel we must get more people into the Association. We must try and promote things that younger people like to do – not just the things older people like to do. I think the present Faculty structure will help the CGCA to survive, so long as we have a pool of active engineers. Getting the Engineering Chapter, Guilds and the School of Mines together is a very good move.

'I believe the efforts of Peter Garratt, the previous president of CGCA, in trying to involve the departmental societies in the Association, was excellent in increasing younger membership.

First line

'Another idea to help the Association to survive is to offer some retiring heads of departments a main office when they become vacant, like hon secretary and treasurer.'

A couple of years ago, Dame Julia suggested that women members of the CGCA could be offered a brooch to wear instead of a tie. This was done in the Royal Academy of Engineering. She also suggested that College links with CGCA were likely to become increasingly important now it's broken away from London University. The College might well wish to strengthen its links, not only with the Institute, but also with the livery companies.

Already, Dame Julia appears to be bringing a stream of fresh ideas into the slightly dated CGCA and she is much welcomed.

RSMA survey shows way forward

THIS YEAR the RSMA committee has continued to focus on the challenge of increasing its relevance to its 'key stakeholders' – students, alumni, the Engineering Faculty and Imperial College.

Sustainability

'We also decided to tackle the question of the Association's sustainability and engaged with the wider RSM alumni community as well as RSMA members', reports RSMA president Kurt Budge. They did this by means of a survey which was distributed electronically during the summer.

While not expert in drafting surveys – a fact noted by some respondents! – they wanted to ask some key questions, which would help them determine the future direction of the RSMA.

Kurt continues: 'We also wanted to gain a clearer idea of how best to serve the RSMA membership and whether or not we can rely on RSMA members' active support of the Association as well as only paying subscriptions'.

The response was overwhelming, with over 850 completed surveys and large numbers of comments returned. These came from around the globe, reflecting the diverse range of places RSM alumni have settled – 267 in Europe, 82 in Australia, 59 in the USA, and significant numbers in Canada, South America, Asia Pacific and Africa.

The long-standing attachment to RSM was also highlighted with responses from alumni who graduated as far back as 1944.

'Although we received a few negative responses, they were in the minority, and the support for our initiative has been tremendous', says Kurt. 'The biggest shock was that many alumni don't know the purpose of the RSMA.'

Now the work begins. The committee is going through specific queries raised and will respond to them personally. With the data generated from the survey, they can also update

the database with new contact details and get communications working properly to keep members informed. 'We're also considering some new developments suggested by respondents, such as producing an accessible membership directory, for members to stay connected, and an endowment fund for providing RSM scholarships.'

'We've ascertained the depth of the hole we're in, but there's light at the end of the tunnel – forgive the mixed mining metaphors – and we have the foundations upon which to build and to re-engage with many RSM alumni who have lost touch', says Kurt. 'We intend to make the RSMA a more proactive and meaningful association for its members.'

Worth every penny

'We have a purpose, embedded in the RSMA's constitution (printed left). For any RSM alumnus, we believe this set of objectives is worth supporting, as the RSMA has done since its inception in 1913. And our membership offers what we believe is worth every penny of the £15 we ask members to pay annually.'

'However, the one theme that came through very clearly in the survey's answers and comments was a lack of understanding of the mission of the RSMA.'

'There may have been peaks and troughs in terms of engagement with members, but the facts are that the RSM is still here, the students are in College and the RSMA Committee is seeking to serve its membership and stakeholders as best it can.'

**RSMA
CONSTITUTION**

- To endeavour to maintain the identity of the RSM and its distinctive diploma.
- To foster an enduring link between members of the Association and with the staff and students of the RSM thereby promoting comradeship and a source of mutual help and advice.
- To provide members with a forum for assisting, both financially and in other ways, students in particular and the RSM in general.
- To present views of RSM men and women.
- In support of these objectives the Committee shall, amongst other things, provide news of members, the RSM, its staff and students by means of a regular newsletter and shall promote comradeship through the medium of regular social functions.

Question	Number of responses	YES	NO
Do you know the RSM still exists?	864	89%	11%
Do you know the purpose of the RSMA?	862	74%	26%
Are you a RSMA member?	790	39%	61%
Do you pay a subscription?	430	22%	78%
Would you be prepared to increase your subscription to £15?	503	47%	53%
Would you like to receive the <i>Imperial Engineer</i> ?	648	66%	34%
Do you prefer email as a means of communication ?	720	85%	15%
Are you likely to attend a UK-based RSMA event?	541	45%	55%
Would you like to be connected to other RSM alumni?	665	54%	46%
Would you like to be kept informed of RSMA events?	696	81%	19%

Why RSMA is worth paying a £15 annual subscription

- *It helps fund RSM students in times of financial hardship.*
- *Assists with tight financing of student events – Freshers' Dinner, Christmas Ball, Bottle Match Weekend and Bar Nights – by contributing £1,200 this year.*
- *Funds sponsorship for students at RSMA events – Annual Dinner, Final Year BBQ – for graduating RSM students.*
- *Funds special student projects.*
- *Provides a copy of Imperial Engineer, published twice a year.*
- *Allows for quarterly updates and breaking news emails to keep members informed.*
- *Provides membership of the New Cavendish Club in London.*

Early stage thinking is looking to

- *create an accessible database/directory for RSMA members to stay connected.*
- *setting up an endowment fund to support RSM student scholarships/bursaries.*

The RSMA committee's first actions will be to

- *update the contact database;*
- *reconnect with the global network, building stronger ties with the regional RSM alumni groups that are already active;*
- *aim to cater for the different needs of globally dispersed membership;*
- *cater for older alumni and those unable to attend events;*
- *improve communications with RSMA members and reduce response times to membership and RSM alumni queries;*
- *keep members well informed of RSMA/RSM events well in advance of them taking place;*
- *offer RSMA regalia;*
- *promote the www.Linkedin.com RSM alumni group as a means of getting us all connected straightaway.*

WHAT ALUMNI WROTE

There were a few negative comments but RSMA now knows it has support from alumni.

The RSM was one of the best things that ever happened in my life! Planning to work/travel in the UK in 2010 and looking forward to making a contribution to the RSM 'family'. Keep up the good work.

Am in the process of updating my annual subscription standing order to £15...

Really appreciate your efforts in taking the RSMA forward.

I'm looking forward to participating in events – promoting and giving back to the RSMA.

Shall be interested to know percentage response to this questionnaire!

Keeps the spirit of RSM going!

I love the idea about the mining song CD. Please print the words too!

Please try to have some events on Friday nights so that people travelling can attend, otherwise I have to take the day off work to come down for a Thursday night event.

Would like to see a RSMA endowment large enough to make a significant contribution to student funding and to keep alive the School.

A consulting / recruitment database - RSM alums post CVs & Companies post open job vacancies online.

Would be interested if an online membership database, updated by individual members, was openly available to the membership, to facilitate with networking etc. I suspect that this would be beneficial to the events planning of the association. Thanks for asking.

Would love to have contact with the RSM!

I am glad to know that you are gathering RSM alumni.

As a former treasurer of the RSM, I applaud your efforts and if I have any ideas I'll be happy to pass them on.

Good initiative! Can you make the membership

directory accessible online, protected with a password for members only? This way we can keep our contact details up to date and find friends.

Keep up the good work. I'm living in Africa and it's difficult to network with people in the UK. Can we get some help in setting up RSMA chapters in Africa?

Keep up the good work of promoting the RSM /RSMA message.

...sign me up for the 15 pounds. Kurt needs his few beers at the end of the week I suppose...

Good idea to do this type of survey every few years (say five).

Now that broadband and photos/video clips are frequently used, would it be possible to send these as attachments to your quarterly issues. I am thinking of events, in particular – for overseas members.

I like to read about events and progress at IC and the RSM (or whatever it's called now) but I probably wouldn't attend events unless someone I know was also attending.

Negative views included:

I might want to pay a £15 subscription fee if I knew what it would include. Also, I have no idea if I'm a member or not still! More likely to buy regalia than a CD!

Other College alum associations are far more aggressive in keeping the spirit of their organisations going.

I lost interest when IC closed down the mining engineering program. I have little interest in the facade of the RSM these days.

I no longer feel much affinity to IC since the RSM was absorbed into the Engineering area. Geologists are not engineers!

I guess I've never been that into old boy networks...

In this issue of *Imperial Engineer*, a number of the following articles, by alumni and others, continue the debate on fuels for the future and sustainability

PART OF being a successful, and hopefully prosperous, international engineer is to have a good working model in your mind of how the world works. Leaving aside major catastrophes, such as wars, the model I am most personally comfortable with is of a relatively steady upward trend in global economic growth, offset to an extent by productivity improvements, with occasional technology step jumps like the internet.

This is overlain by fluctuations due to the economic and political behaviour of people. These last events give rise to the idea of economic cycles or waves. Economists claim to be able to predict them with some accuracy. The cycle most relevant to mining is called the 'Kondratev' Cycle (the Long Wave) and this article looks at this cycle, or wave, and considers its relevance to the present and to career decisions.

Inconvenient view

First what is the 'long wave'? Nikolai Kondratev was a professor at the Business Research Institute in Moscow in the early 1900s. While there he developed what he called his 'Long Wave Theory'. He argued that one cycle lasted between 50 and 60 years. He presented his results to his Communist bosses at a politically inconvenient time and reaped his (unjust?) reward - a one-way ticket to a gulag. His bosses are long since gone and forgotten: Kondratiev's ideas live on.

The essence of his argument was that one of his cycles (an economic up-and-down) consisted of three distinct phases:

- Phase A** - Around 20 years of growth and prosperity, ending with high inflation (Upswing),
- Phase B** - Around 10 years while a battle between inflation and deflation takes place (Primary Recession, Plateau and Disinflationary Boom),
- Phase C** - Around 20 years of deflation with rising political and social conflict (Secondary Depression).

This is described in the diagram (right). The time between successive

The long wave and the global economy

This article, written by Bill Bradford in early 2008, is the distillation of nearly 40 years' involvement in the international mining industry. The ideas it embodies were originally produced while working as an economics consultant for the Open University in the late 1990s, in connection with the development of a new earth science course.

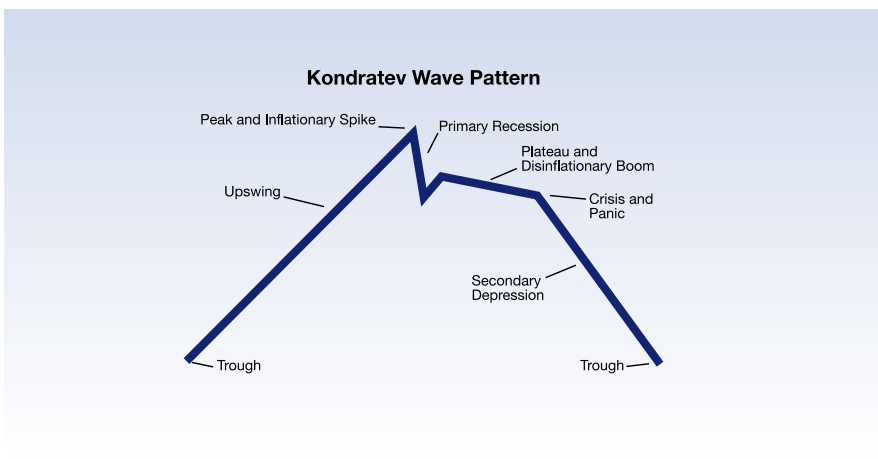
The original 2008 text is largely unchanged, except where it seemed necessary to adjust it to reflect the current realities. As he says: 'I make a comment about history "rhyming not repeating". Fortunately, our lords and masters seem to have learnt something from the depression of the 1930s which will hopefully soften the consequences seen in that dreadful era. What we are facing is an extended period of low economic growth around the North Atlantic basin, while the South Pacific basin roars ahead. We, our children, grandchildren and great-grandchildren will feel the consequences over the rest of the 21st century'.

troughs has historically been between 50 and 60 years.

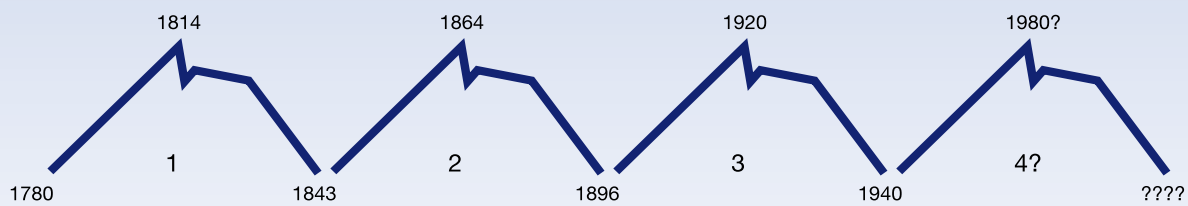
Having given a 'shape' to the long wave, we now need to put it in a time frame. (See diagram on opposite page).

Waves 1, 2 and 3 have been well documented in a variety of different ways and correspond to the economic

rise of the countries around the North Atlantic Basin (North America and Europe). This area of the world can now reasonably be described as economically mature. Many, if not most primary industry projects (mining, agriculture, fishing) have been identified and implemented. Large-scale manu-



Please note that the vertical scale is exaggerated for illustrative purposes.



Idealised Kondratev Wave
(not to scale)

The 'wave' is a reflection of US wholesale prices

facturing has peaked and services are in the ascendant. Wave 4 is where we are now and is too close in time to define its dates with any precision. All I can do is to suggest that the model will continue to work. We may have the interesting situation where the wave works around the South Pacific Basin but does not work around the North Atlantic Basin. One of Mark Twain's less helpful sayings is that 'history does not repeat itself; it rhymes'.

Changing elephant

What is happening is that a potentially very large (economically and politically) young elephant is intruding on our mature party. It is growing around the Pacific Basin and has its feet in south and east Asia. It was initially welcomed, but is now beginning to flex its muscles. The nature of our party is changing; the elephant is getting past the child stage and moving rapidly towards a rumbustious teenage.

One of its most worrying characteristics to us around the North Atlantic Basin is the elephant's hunger. It is growing very rapidly and although still small, needs large quantities of raw materials: what we loosely describe as commodities. This includes soft commodities (wheat and pork for example) and hard commodities (such as copper and iron).

Supply awareness

The lag between demand and supply depends on the particular commodity. Those of you familiar with farming know that farmers are intensely aware of shortages, real or perceived. Subject to the nature of their land and their personal skills, they will produce whatever they believe will give them the best return. Their time-frame is

relatively short. Witness the rapid switch to biofuel feedstock production in many areas of the world. This has had a knock-on effect for food supplies with rising prices in many human food staples.

With hard commodities, the time scale is relatively long: you need to think in terms of decades. The basic philosophy is the same as farming. Mining venture capitalists look for shortages. They operate in areas where they are technically and financially comfortable. However, because of the extended time-scale and the sheer size of investment, they lead much riskier lives than farmers. The rewards are commensurate; farmers survive but miners tend to either boom or bust.

I speak about the above with some feeling. I come from a West Country farming family, but ended up graduating from the Royal School of Mines.

I started out working on tin production in Nigeria and Bolivia in the early to middle 1960s, but by a strange twist of fate ended up working on a number of large copper mine development projects from the late 1960s to the early 1980s, mainly in Asia and Latin America. I became increasingly aware of the pat-

terns and influences that control successful implementation. Some of those projects that I was involved with in the 1970s are only just moving towards serious production.

In a tightly controlled totalitarian world, Kondratev's ideas made some sense, but in a loosely controlled capitalist world they look at times a little wishful. Nonetheless, his ideas have triggered a lot of other researchers to look for similar patterns on a wider stage. There are claims that the cycle is related to a number of human factors, including the length of a human generation. We can all expect (on average) to see one complete cycle in our lifetime, which is a shame since we cannot make use of that experience second time round. An interesting thought is, 'Will increasing life expectancy lengthen the notional cycle?' With the current wave looking to trough in the 2010s, perhaps an 80-year cycle is shaping up.

Pole reversal

More recently I've begun to overlay an even broader pattern on the long wave. I spent a very significant amount of my working life with the mining industry in the southern hemisphere and around the Pacific Basin. I've steadily become aware that the world now needs to be looked at with very different eyes. We have all grown up with atlases and globes that show the North Pole at the top and the South Pole at the bottom.

A 'joke' map produced about 30 years ago, showed Australia at the top and emphasised the Pacific Basin. It's no longer a joke.

The idea has been reinforced by

(Continued on page 16)

Bill Bradford (MinTech 57) has worked for a number of employers, including GEC, Federal Nigerian Government, UNDP, Selection Trust, Seltrust Engineering, Mitchell Cotts, and Matthew Hall. He was also a flying officer in the RAF and a consultant and tutor for the Open University. He is a governor of two local schools and active in Rotary.





Joanna Haigh is professor of Atmospheric Physics and head of the Imperial College Space and Atmospheric Physics Group. In 2004, she received the Institute of Physics Charles Chree Medal and Prize for her work on the effects of solar variability on climate.

Professor Joanna Haigh argues for human blame

COULD there be natural causes of climate change? The general answer to this question is obviously 'Yes': there's no denying that ice sheets expanded and receded long before humans existed on earth, and temperatures have been higher than at present in the distant past. But could natural factors be responsible for the global warming experienced over the past 150 years or so?

To answer this question we need to assess the impacts of all the potential natural and human climate forcing factors. Furthermore, and importantly, we need to do this whilst being aware of intrinsic (unforced) natural changes in the climate: a hugely complex non-linear system which exhibits variability on a wide range of space and time scales.

As an example: 1998 was globally the warmest year on record but this cannot be taken to imply any particular trend (eg that overall global warming has reversed since that date), it just reflects that there was a large warming in the tropical Pacific Ocean that year associated with the El Niño-Southern Oscillation (ENSO) - a natural oscillation of the coupled atmosphere-ocean system.

Natural climate forcing factors include volcanic eruptions and changes in the sun. Volcanoes eject particles which can remain aloft in the atmosphere for several years and which tend to cool the climate by reflect-

Climate change - are

ing solar radiation back to space. Signals of such cooling are clearly evident in the global surface temperature record and also in measurements of radiation made from satellites. That there happened to be a lot more explosive volcanic eruptions during the second half of the 20th century, compared with the first half, probably acted to oppose the warming trend over that period.

Do changes in the sun affect the earth's climate? Variations in sun-earth geometry clearly have a major effect, controlling diurnal and seasonal cycles as well as the onset of ice ages, but what about the impact on climate of intrinsic variability within the sun? Observations of sunspots date back to at least the second century BC, and so have speculations that sunspot numbers are related to weather. In 1801, for example, William Herschel (who made the first sighting of the planet Uranus and discovered infrared radiation) claimed to have found a relationship between solar activity and wheat prices on the London Stock Exchange. During the 19th century many other serious scientific attempts were made to establish such a link but when 'sunspottery' became popular, and was adopted by various astro-meteorologists who predicted the weather based on the sun and the planets, the embryonic UK Met Office established a distance between itself and such supposed quackery which remained until around the 1980s.

Unfortunately, a lot of pseudo-science remains in this area. One example was

...none of our work suggests solar variability could be responsible for all warming...

shown during a TV broadcast in March (Channel 4's *The Great Global Warming Swindle*) whose description of the processes of cloud formation (as the action of solar-modulated cosmic rays on water vapour in the atmosphere) would have been laughable had it not been such an unashamed attempt to manipulate the audience.

Undeterred, in the Imperial Physics Department we have been studying the effects of variations in solar irradiance on the atmosphere. We have found, from meteorological records, that the mid-latitude storms tracks are positioned slightly further towards the poles when the sun is more active and that the response in tem-

This Imperial Engineer's from and solar flares. The back, captured apparently the most 'quiet' it has scientific views regarding the effective 'Pro' claims these emissions are balanced. The 'anti' camp accepts that the rise is minimal and is greatly overshadowed and little-understood global climate government-led initiatives to reduce summarise

perature is not the warming concentrated in the tropics that might be anticipated as a response to a higher input of solar energy, but is concentrated in mid-latitudes.

Thus solar activity plays a significant role in climate in some geographical

...not able to simulate...global warming without including...greenhouse gases introduced by humans

regions more than others. We have used computer models to investigate how these responses arise and we have found that an important factor is the absorption of solar UV radiation in the stratosphere. Our current research is concerned with the mechanisms whereby these effects take place and our studies are leading to a new understanding of climate variability in general.

In terms of the global surface temperature record, however, none of our work suggests that solar variability could have been responsible for all the warming seen over the past century. We do not have measures of the sun's energetic output back in time but we do have indicators of solar activity in isotope records and we can calibrate these 'proxy' measures to derive a solar radiation dataset dating back hundreds of years. Using this, together with information on volcanic activity, our computer models are successful in reproducing the gross variations in global mean temperature over the thousand years before the industrial era. We are not able, however, to simulate recent global warming without including the effects of greenhouse gases introduced by human activities. It might reasonably be argued that we have

Are humans or nature to blame?

front cover, from 2000, shows a sun active with sunspots captured this August 31, shows a dramatically different image – has been for almost a century. This symbolises the two differing effect of human-generated CO₂ emissions on the global climate. The sun is having an accelerating and potentially disastrous warming effect. The rise in atmospheric CO₂ concentration is having an effect, but this is shadowed by other variables, such as solar activity, in a very complex climate system. Given the huge economic and social consequences of not to reduce CO₂ generation, we asked two serious investigators to compare their differing views on the subject.

missed some (as of yet unidentified) process and thus underestimated the effect of the sun on the climate over the past 50 years or so, but if this were the case it would then be necessary to explain why it did not have a much larger impact in the past.

Increasing solar activity over the first half of the 20th century might have contributed up to 25% of the observed rise in global temperatures but the evidence for human-induced warming over the past 50 years is now incontrovertible.

Lord Monckton questions IPCC and scare figures

PROPOSALS to mitigate imagined 'global warming' will have no more effect on the climate than King Canute's command to the tide not to wet the royal feet.

EVEN IF global temperature has risen, it has done so linearly and naturally for 300 years as the sun recovered from the Maunder Minimum, beginning long before we could have had any influence. (Akasofu, 2008).

EVEN IF temperature change had accelerated, the sun might be the reason. It was more active in the past 70 years than in the previous 11,400. (Usoskin et al, 2003; Hathaway et al, 2004; IAU, 2004; Solanki et al, 2005).

EVEN IF the Sun were blameless, the International Panel for Climate Change (IPCC) has not shown that humanity is to blame. CO₂ occupies only one-ten-thousandth more of the atmosphere today than in 1750. (Keeling & Whorf, 2004).



Christopher Monckton – Lord Monckton of Brenchley – read Classics at Cambridge and was a journalist before joining Margaret Thatcher as a policy advisor on major technical and scientific issues. He has recently dealt successfully with a long-term illness and completed a second degree in mathematics, applying this to studying climate change.

EVEN IF CO₂ were to blame, there has been no 'global warming' since 1998. For seven years, temperatures have fallen. The Jan 2007–Jan 2008 fall was the steepest since records began in 1880. (Hadley, GISS, UAH, NCDC).

...if the earth were not cooling, the rate of warming...is too small to cause harm.

EVEN IF earth were not cooling, the rate of warming is far less than the IPCC imagines, and too small to cause harm. There may be no new warming until 2015. (Keenlyside et al, 2008).

EVEN IF the warming rate were harmful, humankind's contribution is miniscule. The IPCC exaggerates our impact. (Chylek et al, 2007; Lindzen, 2008; Wentz et al, 2007;

Spencer, 2007, Douglass & Christy, 2008).

EVEN IF we are affecting climate, the UN's projected human fingerprint – the tropical upper troposphere warming at thrice the surface rate – is absent. (Douglass & Knox, 2006; Douglass et al, 2007; Lindzen, 2008).

EVEN IF the human fingerprint were present, climate models cannot forecast the future of the chaotic climate unless we know its initial state to an unattainable precision. (Lorenz, 1963; Lightbill, 1998; Giorgi, 2005).

EVEN IF computer models worked, they cannot predict future warming rates. Temperature response to atmospheric greenhouse-gas enrichment is an input to the computers, not an output from them. (Akasofu, 2008).

...the 'Armageddon scenario' depicted by Al Gore 'is not based on any scientific view'.

EVEN IF the UN's guesswork about climate sensitivity were right, disaster would not follow. The peer-reviewed literature is near-unanimous in not predicting climate catastrophe. (Schulte, 2008).

EVEN IF some harm might happen, the 'Armageddon scenario' depicted by Al Gore 'is not based on any scientific view'. (R v S of S Education ex parte Dimmock, Oct. 2007).

EVEN IF catastrophe loomed, taking scientifically-unsound precautions, 'just in case', is starving millions as biofuels gobble millions of acres of agricultural land, doubling cereal prices in a year. (UNFAO, 2008).

EVEN IF taking precautions might work, the strategic harm done to humanity by killing the world's poor and destroying the world's economic prosperity outweighs any benefit. (UNFAO, 2008).

EVEN IF the climatic benefits of mitigation could outweigh the societal harm, adaptation if necessary would be far more cost-effective and less harmful than mitigation. (Henderson, 2007; all economists except Stern, 2006).

SUMMARY

We must get the science right or we shall get the policy wrong. There is no 'climate crisis'. It is a non-problem. The correct approach to a non-problem is to have the courage to do nothing.

The long wave

(Continued from page 13)

PWC (formerly Price Waterhouse Coopers), the international accounting firm. It recently produced a set of economic projections called 'World in 2050'.

It focuses on what it calls the E7 group of countries; China, India, Brazil, Russia, Indonesia, Mexico and Turkey. With the exception of Turkey and Brazil, they all have a window on the Pacific.

Growth areas

These countries are projected to grow much faster than the big-economy countries around the North Atlantic, although their economies are currently much smaller than the current world leaders (USA, Japan, Germany, UK, France). India (estimated 8.5% pa economic growth rate) and China (estimated 6.8% pa economic growth rate) are the probable leaders and it's worth noting that the Chinese economy is now approximately one quarter the size of the US economy. Countries peripheral to the E7, like North Vietnam, will also be pulled into the growth projected for their neighbours.

I see the UK in the 21st century as a largely services-based economy. Engineering design linked with finance will be a significant part of the high skills section of the economy and help generate the exports that will be needed to finance imports. Production goes up and down; design and finance are generally steady employers.

Where do you gain those skills? The traditional route has been via a first degree followed possibly by a postgraduate MBA (Master of Business Administration) or similar qualification.

If you think mining is your thing, then you will need to look radically at your prospective education. For all practical purposes there are now no undergraduate mining courses offered in the UK and Europe.

Those who have survived have moved towards applying their earth science skills to environmental subjects. The suppliers of traditional postgraduate business skills have recently been under heavy fire as being part of the current North Atlantic Basin problem. Even Harvard, granddaddy of all business schools,

is having to rethink its approach.

Assuming you like the idea of a mining-based topic for a first degree then you must look outside Europe. Countries with good mineral endowments and burgeoning mining industries are the places to find them. A little gentle Googling will identify the mining schools and colleges seeking talented school leavers.

Some are offering scholarship support. The USA looks to offer good possibilities. If you then follow the MBA or similar route, go for the most prestigious you can find. Your qualifications will then serve you well for probably at least 20 years of steady gainful employment and an attractive CV for what follows. After that who knows in our rapidly changing world?

As a postscript, it's worth looking at our current situation. The world is experiencing one of the periodic economic/political upheavals I mentioned earlier, this time as the result of unwise banking practices, mainly around the North Atlantic Basin. This time it's worse than usual and will be extremely uncomfortable for all.

However uncomfortable this can be personally in the short term, it's unlikely to be more than a passing phase for the UK. What it does imply, however, is that what are generally described as 'sovereign funds' will become increasingly involved in the control of northern hemisphere financial service companies, including major UK and US banks. These sovereign funds have grown and developed because of persistent large trade imbalances.

On the move

Since these sovereign funds are located in major oil-producing countries, and increasingly around the South Pacific, the economic centre of gravity of the world will progressively move south and east. A strategy for the ambitious needs to take this into account.

Finally, please remember, mining is often regarded as counter-cyclical. What this means is that when the general economy is doing badly, mining does well (and vice-versa). Phase A of the next Kondratev cycle beckons!



SKANSKA UK has entered the final stages of installing an innovative 5.4MW ground source cooling system for a new hospital after approval to proceed with the installation of a renewable ground source heat pump system, at Kings Mill Hospital, Mansfield, was granted. The system can also provide supplementary low-grade heating to the gas-fired boiler installation when the cooling demand is low. Coventry-based Geothermal International, a market-leading company in this field, has been employed by Skanska as partners to develop and deliver the scheme.

Ground-sourced cooling and heating technology will reduce carbon emissions as well as result in significant running cost savings. It is also setting a benchmark for the NHS, changing the way hospitals are cooled and heated in the future.

The scheme is not only a landmark installation for the NHS but also for Skanska and Geothermal. It will be the largest geothermal lake loop installed in Europe.

The system, which has been used to great effect in America and widely adopted in northern Europe, will use a network of heat exchangers submerged in neighbouring Kings Mill Reservoir. The heat exchangers are connected via pipes to the hospital where heat pumps extract or reject heat from the reservoir to provide either cooling or heating to the new hospital.

When the water flows back through the heat exchanger plates in the reservoir, the temperature imbalance is partly restored by the reservoir without contamination because the system is a closed-loop system and no reservoir water is used directly.

This heat exchange is much more efficient than other available renewable

TOP OF COLUMN: Heat pumps for Kings Mill Hospital.

TOP RIGHT: Heat exchangers prepared for installation.

RIGHT: Heat exchangers submerged on the reservoir.

Ground heat saves hospital money and reduces carbon footprint

Following the installation of an 'energy pile' scheme in Paddington - just one of over a 100 such projects in the UK and overseas, Karl Drage recounts how Geothermal International installed a ground source heat pump system for a new hospital.

energy technology or conventional gas, oil or bio-fuel heating.

For every 1kw of energy used, 4 to 7kw are produced by the system, which means that not only are CO₂ savings anticipated compared with more traditional systems, but energy bills will also be significantly reduced. The life expectancy of the heat pumps will also far exceed that of traditional plant.

The project design teams consulted

extensively with the local council and Friends of Kings Mill Reservoir, a local preservation group, to assure them

that the environmental impact of the system would be extremely low and, in some cases, would benefit the lake's ecology.

Gerry McNabb of Skanska UK, said: 'The technology we and Geothermal

International offers makes sense to homeowners and businesses, especially with government emission

FACT FILE

Cooling and heating for Kings Mill Hospital, Mansfield uses

- 65,000m² lake
- 140 slim-jim units to give
- 5,400kW cooling
- Up to 5,000kW heating (significant proportion of heating)
- 42 EKWI30 heat pumps



reduction and renewable energy targets on the horizon.

'Together we are able to offer a cooling and heating system that is both ecologically sound and cost-effective.

'We have no doubt the hospital will reap the full range of benefits from this ground source heat pump system'.

Karl Drage, operations director of Geothermal International, said: 'The possibilities this technology offers are getting more and more attention and we are delighted to be involved with a project of this size.

'Renewable ground source heat pump systems have been used very successfully throughout Europe and North America for decades and now the UK and Ireland are taking notice.

'We are, therefore, pleased to be working with Sherwood Forest Hospitals NHS Foundation Trust and Skanska on such a ground-breaking project. It will provide a truly valuable, cost-effective and efficient service to the people this hospital will serve and will have measurable benefits.'

Geothermal International has worked with Skanska UK on numerous projects and become strategic partners in geothermal operations.

The two companies have jointly pioneered cost-effective methods for installing geothermal pipes within energy piles and have a number of patented components and techniques involved in the process.



KARL DRAGE
(Mech Eng 95)
left Imperial to work as an operations manager with Unilever. After a good five



years he joined a small technology company. Geothermal International followed in 2004, where he is now operations director. He has been the chairman of the Ground Source Heat Pump Association (the trade association) for the last two years.

FEATURES

DURING a recent visit to England, I was impressed by the extent to which the British government, public and press (unlike their Australian counterparts) have come to terms with the need for nuclear power. However, it is not yet a *fait accompli* and there are clearly still many people who fear the nuclear renaissance. Although such fears may be understandable, they are misplaced.

It would be unfortunate if electricity generation policies were to be predicated upon misconceptions about the radiological safety and environmental impact of nuclear power, as they are in Australia. It is not just a case of the benefits outweighing the risks. The risks are simply not what they are generally believed to be. I am particularly concerned that correct information should be available on the following six points.

✓ **ROUTINE OPERATIONS OF THE NUCLEAR INDUSTRY DO NOT EXPOSE WORKERS OR PUBLIC TO DANGEROUS LEVELS OF RADIATION.**

Exposure of workers in the nuclear industry is controlled to levels which are demonstrably safe. Although there

Nuclear fears understandable but misplaced

have been accidents affecting workers, it is one of the safest industries in which to work. Public exposures due to radiation and radioactive materials that are released from a nuclear plant or from any other nuclear installation or activity, in normal operation, are very small compared with natural background radiation. Anything more would be unacceptable. (Natural radiation itself varies widely around the world - up to at least 100 times the average level - without causing any discernible adverse effect on health.)

✓ **MODERN NUCLEAR PLANTS IN PROPER CONTAINMENT STRUCTURES**

PRESENT ESSENTIALLY NO RISK TO THE PUBLIC, EITHER FROM ACCIDENTS OR FROM TERRORIST ATTACK.

There have been two major reactor accidents involving core-melting during the 50-year history of nuclear power generation. The accident at Chernobyl, Ukraine, in 1986, was the worst that could happen - a full core meltdown with no containment. About 50 people have died due to radiation exposure from Chernobyl and it has been realistically predicted that several thousand more will eventually die from cancer due to the massive release of radioactive material.

Most of the consequences of the Chernobyl accident would have been prevented if the reactor had had a containment structure. This was clearly demonstrated by the other core-melt accident, which occurred at Three Mile Island (TMI) in the USA, in 1979, in a reactor that was equipped with a proper containment. The TMI accident did not cause any radiation injuries or result in a significant radioactive release to the environment. Apart from Chernobyl, there has never been a death recorded due to accidental exposure to radiation from any commercial nuclear power reactor.

Engineers learn from experience so that:

- modern designs of reactor are far less prone to a risk of accidents than the TMI design;
- no-one will ever again build a reactor of the Chernobyl type; and
- containment buildings, which are massive steel-reinforced concrete structures, are designed to withstand the impact of the largest credible external events.

✓ **APART FROM BEING EXTREMELY SAFE, NUCLEAR POWER PLANTS HAVE LESS ENVIRONMENTAL IMPACT THAN OTHER TYPES OF POWER STATION.**



ABOVE: Dungeness B viewed from across the flower-filled gravel shore in Kent. OPPOSITE PAGE: An aerial shot of Sizewell B, Suffolk.

*As the UK commits to building more nuclear plants,
Don Higson puts the case for nuclear safety and, one by one, deals with the usual
arguments against it.*

Nuclear power stations need far less space per megawatt than solar or wind farms. They have no coal or slag heaps, no smoke stacks and no turbine blades whirling around on towers. They do not emit smoke or fly-ash containing radioactivity. They do not need to be sited near a coal mine or any other primary source of energy. This allows the option of coastal siting so that sea water can be used for condenser cooling – so that cooling towers are not needed either. I would not want to live next door to any power station but, if I had to, give me nuclear every time.

✓ **THE NUCLEAR INDUSTRY GENERATES MINIMAL EMISSIONS OF GREENHOUSE GASES.**

The operation of nuclear plants generates no greenhouse gases and they can provide the electrical power needed to drive other fuel cycle plants such as uranium upgrading and enrichment. Mining inevitably generates greenhouse gas emissions somewhere in the world.

However, when mining for materials of construction, manufacture of equipment and all other relevant factors are taken into account, renewable energy technologies have environmental impacts (including greenhouse gas emissions) which are comparable to, though different from, nuclear power. Mining for uranium ore, per unit of the energy contained, has a minor impact compared with fossil fuels.

✓ **NUCLEAR REACTORS AND OTHER NUCLEAR FUEL CYCLE PLANTS IN A COMMERCIAL NUCLEAR POWER PROGRAMME WOULD NOT USE, HANDLE OR PRODUCE MATERIAL**

SUITABLE FOR MAKING ATOMIC BOMBS.

The material that can be used easily to make an atomic bomb is uranium-235. Natural uranium contains 0.7% uranium-235 and 99.3% non-fissile uranium-238. Weapons-grade uranium must be enriched to more than 90% uranium-235. The fuel for current designs of nuclear power station is enriched to no more than about 5%. Plutonium produced in commercial



operations of nuclear power stations contains more than 30% non-fissile plutonium-240.

The highest concentration of this isotope ever present in plutonium successfully exploded in a bomb was about 10%. This explosion required the highest level of bomb-making expertise in the US.

We may have concerns about supposedly commercial reactors and uranium enrichment plants in some other countries being misused to make weapons-grade materials, but I am talking about domestic industries. Governments of rogue states might decide to sponsor such activities but they would be totally outside the scope of com-

mercial operations – they would cost far too much.

✓ **THE SAFE DISPOSAL OF RADIOACTIVE WASTE IS READILY ACHIEVABLE TECHNICALLY.**

Plutonium-240, when irradiated in a reactor, generates fissile plutonium-241. Therefore, industrial plutonium (240 as well as 239) is a valuable fuel for recycling back into nuclear power stations and there is an economic

incentive to recover it. Take the plutonium out of the waste and waste disposal becomes a lot more manageable. If plutonium and other trans-uranic elements (“minor actinides”) are removed from spent fuel by reprocessing, and burnt in a nuclear reactor, the radioactivity in the remaining waste would decay below the level of radioactivity in natural uranium ore in less than 300 years, not the hundreds of thousands of years often quoted for the spent fuel itself.

Developing nuclear submarine propulsion for Rolls-Royce followed a degree and PhD in chemical engineering at Imperial (57) for Don Higson. He joined the Australian Atomic Energy Commission in 1964, specialising in reactor safety assessment, and has been a consultant to the International Atomic Energy Agency. He is a fellow of the Institution of Engineers, Australia; a Fellow of the Australasian Radiation Protection Society; former editor of the ARPS Newsletter and a member of the Publications Commission of the International Radiation Protection Association (IRPA). higsond@bigpond.net.au



Thai biogas leads to worldwide applications

IN LINE with its policy of environmental responsibility and driven by the recent high energy prices, in May 2006 Corn Products International, commissioned Global Water Engineering (GWE)

to design and build for its production facility in Thailand, what is expected to be Corn Products' first in a long line of anaerobic waste water treatment plants with biogas utilisation.

GWE, a global leader in wastewater treatment and green energy solutions. It was chosen because of more than 20 years' unmatched track record in efficient design, installation and commissioning of wastewater treatment plants, combining aerobic and anaerobic treatment technology in more than 300 plants worldwide, with expert biogas handling expertise to produce green heat and/or electricity.

The facility chosen for this milestone project, was the 600t starch per day factory for Corn Products Amardass (Thailand) Co. Ltd. It is situated in Sikkhiu, in Nakhon Ratchasima province of north east Thailand. The factory produces modified starch using the tapioca (cassava) root as a feed stock.

High flare

Construction for this turnkey project started in earnest in the late summer of 2006 and the first biogas was fittingly flared off at the plant on July 4 2007, USA's Independence Day.

Following a successful biological start-up of the anaerobic reactors and subsequent 'guarantee test run', performed by GWE and Corn Products' staff, GWE's guarantee of 90% chemi-

by *Simon Denye*
managing director
of Corn Products,
South East Asia.

cal oxygen demand (COD) removal efficiency was achieved and comfortably exceeded. This resulted in average biogas production of 527 Nm³/1,000 kg of COD load, at an average methane (CH₄) content in the biogas of 63%.

All the biogas produced is used as fuel in the two factory boilers that generate steam required for starch drying. Since the start of steady operations to date, this has resulted in a more than 50% reduction of fuel used of ca 12 l/ton (litres of heavy fuel oil per ton of tapioca roots processed).

From an environmental standpoint, this project also qualifies for carbon emission reductions under the CDM (Clean Development Mechanism), a UN initiative from the Kyoto Protocol. Certified Emission Reductions (CERs as they are commonly known) are awarded to the project as GWE's anaerobic reactors trap and use the CH₄. Previously, this would have gone into the atmosphere, through the standard open lagooning treatment. As the trapped

methane is burnt into the factory boilers it converts to CO₂ which, while still a greenhouse gas, is 22 x less harmful than CH₄ to the planet. So for every ton of methane destroyed, 21 tons of CO₂ emission reductions are awarded. This is a win-win situation for customer, technology provider and our planet!

It is easy to see why Corn Products are currently planning to apply anaerobic digestion technology to the rest of their facilities worldwide.

For more information please visit www.cornproducts.com and www.globalwe.com.

ADDITIONAL INFORMATION

GWE's turnkey biogas project is composed mainly of pre-treatment units - three high-rate ANUBIX-Ba™ reactors (GWE's sixth generation design of the long-standing UASB - Upflow Anaerobic Sludge Blanket) equipped with a two-step neutralisation process - and a biogas handling and reuse system. This plant is the biggest so far in GWE's record for native and modified starch producing factories on a global basis. It is designed, based on maximum expected factory production, for a staggering organic load of 150,000kg COD/day with a maximum hydraulic load of 6,000m³/day of waste water at an average COD concentration of 25,000mg/l.

WHAT IS CORN PRODUCTS?

Corn Products International Inc, with headquarters in the Chicago suburbs, is one of the world's largest corn refining and ingredient companies. One of the first listed on Wall Street, it was recently acquired by Bunge Ltd, a US agro industry giant.

It is a leading supplier of starches, sweeteners and other ingredients to customers in more than 60 industries. It is the world's largest producer of dextrose and a leading regional manufacturer of starches, syrups and glucose with 27 production facilities worldwide.





Plant start-up was completed in August 2007 with lower than expected factory wastewater output since then, culminating in a maximum organic loading of just over 100,000kg COD/d – more or less two-thirds of the design COD capacity of the reactors. COD removal efficiency has been as high as 95% on the average. This efficiency delivered by GWE technology is unmatched in the industry.

Alternative firing

Since steady operation, all the biogas has been utilised as fuel in two existing



steam boilers with four burners, and in any combination. Each of these burners may selectively be fired in either three modes: 100% biogas firing, dual firing, *ie* biogas and fuel oil and fuel oil only. The daily modes of burner firing depend largely on the amount of biogas produced (which is also dependent on the amount of organic waste produced from the factory) and the fuel firing system has been automated for operational flexibility and to give biogas preference. Any biogas in excess is being burned at

the centralised safety flare situated on the biogas reactors.

PROCESS DESCRIPTION

The wastewater comes from the factory by gravity sewer. The influent first flows through sand/grit traps for removal of settleable solids, mainly earth (sand, mud from the roots washing) and some floating materials and scum. From the sand traps, the wastewater passes through screen extractors, in order to remove coarse particles (roots pulp, peels), which is very important as they can cause anaerobic bacterial sludge in the methane reactors to float and escape.

After the screen, the wastewater flows into an equalisation lagoon where biological hydrolysis/acidification processes take place, resulting in the formation of organic acids. This causes a serious pH drop (down to 4 – 4.5).

From the equalisation basin, the pre-acidified wastewater is pumped up into a degasifying tank and from there to the methane reactors. The acidic wastewater has to be neutralised with caustic soda. This neutralisation is particularly important in the start-up phase and initial months of operation. Afterwards it is mainly stand-by. The pH in the feed line is measured and is controlled to be above a pre-set value (neutral to slightly acid, depending on the progress of plant start-up) by addition of NaOH in-line, followed by an in-line mixer.

The wastewater is then pumped into the methane reactors through an influent distribution system at the bottom of the reactor.

Out of the GWE range of methane reactors the ANUBIX-B™ reactor was selected, which is of the UASB (Up-flow Anaerobic Sludge Blanket) type, with a special ‘three phase separator’ device at the top of the reactor which results in a separation of the mixed liquor into clarified wastewater, biogas and sludge.

Constant

Part of the methane reactor effluent is recycled to keep a constant flow velocity in the reactor’s influent distribution system.

Excess sludge can eventually be withdrawn from the bottom of the reactor if necessary.

The effluent of the anaerobic treatment is further treated in some of the existing lagoons, receiving around only 2-5% of the original load.



Simon Denye (Chem Eng 87) joined ICI in the Catalysts and Technology Licensing business, and subsequently worked in its petrochemical business and the engineering department, before relocating to the US in 1999 to work in its National Starch business. In 2003, he relocated to Thailand to run the two tapioca factories of National Starch and, in 2007 joined Corn Products International as the managing director of South East Asia. Simon is married to Maoliosa, also a Chem Eng graduate, who works for Chem Systems, a marketing consultancy, at its Thailand office. simon@cornproducts.co.th

Will renewables be cheap enough to fix climate

Jon Gibbins *and his wife*, Diane Barnett, *discuss the question.*

WITH OIL at \$100 a barrel and talk of production peaking, isn't renewable energy an obvious replacement? Civilization can be saved from an energy crisis and climate change, while money revitalises industries instead of filling OPEC's coffers.

From a millennium away, 21st century history might look like this - if we're lucky. The problem is that we have perhaps five or 10 times more fossil fuel carbon available than the atmosphere can safely take. And if we don't come up with ways to stop that carbon getting into the atmosphere, then a significant part of the CO₂, and the heat it traps, will still be around in a millennium.

But surely, as oil price rises, dragging gas and coal prices with it, fossil fuels will be driven out of the market by cheaper renewables (and nuclear)? Well, yes and no. Renewables can compete successfully with expensive fossil energy, but if they do, the demand for fossil fuels will fall and fossil suppliers will reduce prices. And fossil fuel prices can be reduced a lot. As most oil supplies are still from sources that pumped oil for the \$20/barrel of the mid-80s to the late-90s. If they had to, these suppliers would still produce at that price. This can be said for gas and coal suppliers.

Until non-fossil sources are cheaper and better than fossil for virtually all applications, competition from them probably won't keep fossil fuel carbon permanently in the ground.

But surely this neglects carbon pricing - the cost for allowances to emit fossil fuel CO₂ to the atmosphere? Well, there are two problems here. One is that a carbon price of even \$100/tonne CO₂ emitted is equivalent to only an extra \$40/barrel on the cost of oil. This won't be enough to stop its use. The cost of carbon for gas, which emits less carbon per unit of energy, is even lower.

The second problem is that carbon pricing is an artificial construct. It lasts only as long as people agree to it and as long as fossil fuels are desirable without carbon pricing.

Now, we would probably expect that most people will continue to

do the right thing and agree to price carbon as necessary to make sure fossil fuels don't get used. This means they must always be able to persuade, bribe or otherwise induce everyone else in the world to do the same.

So the only really reliable way of tackling climate change with non-fossil energy is for it to be very cheap, cheaper than the basic cost of almost all fossil fuel energy. But this win-win solution isn't there yet. It may get there with learning but learning is also taking place in fossil fuel production. Government support for related

won't still continue to benefit from general technological improvements.

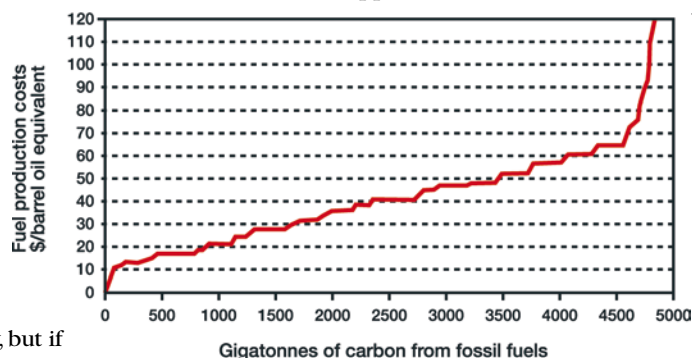
Carbon capture and storage (CCS), where the fossil CO₂ is captured and sealed beneath impermeable rocks a kilometre or more underground, is another solution. In properly selected sites, the CO₂ should stay isolated for many thousands of years. But CCS must always be more expensive than cost-free venting of CO₂ to atmosphere, and uses more fossil fuel for the same amount of delivered energy.

So is CCS also uncertain as a long-term solution? Well, a difference between CCS and renewables

is that, with CCS, the fossil carbon is left in the ground as CO₂. Money has been spent to obtain low-carbon energy in both, but CCS permanently puts some fossil carbon beyond use. Since using fossil fuels drives up prices, CCS will help get us to the point where renewables become genuinely cheaper. It's hard to say

whether CCS would be more effective than spending money on renewables - it's probably safer to do both!

For Europe, with its climate change leadership aspirations, spending money on CCS, rather than on expensive renewables, would, however, definitely be a more effective way of getting China and India to agree to limit emissions from their large coal reserves by implementing CCS themselves. China and India will use as much renewable (and nuclear) energy as they can get. But this won't dissuade them from also using their coal unless and until renewables are demonstrated to be even cheaper.



This graph shows estimated fossil energy production costs against cumulative carbon released, assuming the cheapest energy sources are used first. We have emitted about 500 GtC since the start of the Industrial Revolution and could perhaps 'safely' emit another 500 to 1000 GtC if the climate response turns out to be not very severe. By using up cheapest fossil fuels with CCS, we might safely reach the point where production costs for the remaining fossil fuel would be \$30/bbl oil equivalent or higher. This would have the same effect, compared to current production costs of around \$15/bbl, as halving the cost of renewable energy when it comes to achieving reliable, long-term displacement of fossil by renewables. (Data from H-H. Rogner, An assessment of world hydrocarbon resources, Annual Review of Energy and the Environment 1997, adjusted from 1990 to 2006 dollars.)

research, for example for underground coal gasification and methane hydrate production, may be stopped eventually, when the obvious climate implications are thought through. But it's hard to imagine that fossil fuel production

Jon Gibbins (Mech 75) (j.gibbins@imperial.ac.uk) is a senior lecturer in Imperial's Energy Technology for Sustainable Development



Group and principal investigator for the UK CCS Consortium (www.ukccsc.co.uk).



Diane Barnett is a graduate of the London School of Economics with an ongoing interest in climate change policy.

Meteorology at Imperial College

RECOGNISING the urgency of gaining expertise in aspects of meteorology relevant to the rapid developments in aviation, in 1920 the Air Ministry and Imperial recommended including facilities and staff in the new Aeronautics Department, then housed at 1 Lowther Gardens.

Sir Napier Shaw, retiring director of the Meteorological Office, was appointed to a part-time professorship – the first professorial appointment in the subject in the UK. Space being hard to find, accommodation and facilities were made available in the South Kensington section of the Met Office. The first post graduate course opened in October 1920, staffed by Sir Napier Shaw and his technical assistant Miss E Austin, and visiting lecturers Mr D Brunt from the Met and Mr C T R Wilson from Cambridge.

By 1923, increasing pressure on space led to an advisory Committee being set later in the year to advise on the whole matter of Meteorology at IC, particularly the problems of space and finance. It recommended that teaching and research should be maintained, at a total annual expenditure of £1,250 (something like £100K today!).

The report also implied that Meteorology should become a sub-department of Physics, but space could not be found there and it moved into the old RCS building (then known as the Huxley Building), still under the wing of Aeronautics.

In October 1924, Sir Gilbert Walker, who was retiring from a distinguished career in the Indian Meteorological Service, was appointed the new part-time head of Meteorology. With one administrative assistant (but no academic assistance), he ran the sub-department, teaching a comprehensive course to students from Physics, Aeronautics, and the Meteorological Offices of the UK and India. With help from some students, Walker continued work started in India on the problem of the Indian Monsoon, extending its scope to the subject of world weather. He also initiated experimental investigations into the problems of convection in a fluid heated gently from below and the effects of vertical shear-matters. Later this was of great importance in the interpretation of the evolution of natural clouds.

Walker retired in 1934 and a full-time meteorology professor, Mr D Brunt (later Prof Sir David Brunt) was appointed and the sub-department was placed under the wing of Physics, though still housed in the Huxley Building. Academically, Meteorology remained a single-handed enterprise

until 1939, when, as war approached, funds from London University allowed the appointment of a reader, Mr P A Sheppard from the Met Office. At the beginning of the 1938-39 session, Meteorology had finally become an independent department.

A small experimental hut was erected at the Harlington Sports Ground for field investigations of the turbulent transfer of heat, momentum and water vapour from the ground to the atmosphere.

At the same time, the university and the Royal Meteorological Society, with the support of the Air Ministry, made a case to the University Grants Committee for funds to foster the development of meteorology at IC. UGC increased its allocation by £1,250 pa for research fellowships and technical assistance from 1939-40, with a non-recurrent grant of £10,000 for a meteorological laboratory.

*Ken Bignell looks back
at the changing fortunes
of the one-time department.
Now a visiting lecturer,
he was lecturer in
meteorology 1963 to 1995.*

These plans were suspended until after the war. Brunt and Sheppard were seconded to the Air Ministry in September 1939. Brunt returned to College in June 1940, but Sheppard served until 1945, organising a large programme of upper-air observations.

Courses resumed in 1945, with Brunt and Sheppard teaching the most comprehensive syllabus yet offered for the DIC and MSc programmes. More room became available in Huxley, giving space for laboratories and a Library.

In October 1947, Mr E G Jennings was appointed chief technician to develop workshops to support current and planned experimental programmes. M K Miles (lecturer, October 1946) brought his war-time expertise in synoptic meteorology; E T Eady, an eminent theoretical dynamical meteorologist, became lecturer in April 1948 (and later reader) while B J Mason taught experimental cloud physics.

In October 1949, Miles was replaced by Dr R S Scorer, an outstanding dynamical meteorologist. From October 1949, Mr F H Ludlam, a distinguished cloud physicist, on leave from the Met Office, was a Leverhulme Research Fellow and became lecturer in October 1951.

In 1952, Prof Sir David Brunt retired and Prof P A Sheppard took over as department

head, heralding in a period of rapid expansion. In 1954, Dr R M Goody was appointed reader in meteorology, initiating studies of atmospheric radiation. Greatly expanded new facilities at the Silwood Field Station provided a base for infra-red atmospheric spectroscopy and for radar investigations of precipitation from convective storms led by Ludlam.

In 1958, Dr J S A Green was appointed assistant lecturer and then lecturer. With Eady and their research students, he tackled problems of the amplification of various instabilities in atmospheric motion systems.

In the late 50s it was becoming clear that, for a month or more ahead, it would be essential to correctly represent sea-surface temperatures in any future seasonal forecasting efforts, so it was appropriate that Meteorology should have expertise in oceanographic matters. Accordingly, Dr H Charnock was briefly reader in physical oceanography in 1958. These problems were taken up again by Green and his colleagues in the 70s and 80s, by which time much more had been discovered about the vastly complicated dynamics of the oceans.

In the 60s, the Met Dept enjoyed its most buoyant period. Mr J R Probert Jones joined the staff, bringing expertise in radar sounding of precipitation. About the same time, Dr R P Pearce was appointed reader, specialising in theory and numerical modelling of organised convection. A succession of visits by the world's most eminent meteorologists provided valuable stimulus to the visitors and the department alike.

In the mid-70s, the College faced a predicament. College was about to vacate the Huxley Building, so the Mathematics and Meteorology Departments would be competing for space in the new W2 Building with the Physics and Computing Departments. At that time small meteorology initiatives were springing up in several universities, one being the new department at Reading. Advice from the Met Office was that there was not room for two major meteorology departments in the UK. It was argued that the Reading department, being close to the Met Office in Bracknell and the European Centre for Medium range Forecasts at nearby Shinfield Park, should be the one to survive. Accordingly, IC decided that on Sheppard's retirement, the Meteorology Department would cease to exist. It was re-united with the Physics Department, with the new name 'Atmospheric Physics Group'. So 1975 marked the end of the pursuit of classical meteorology as an independent subject in Imperial College.

HEARTY greetings and gasps of amazement were heard in abundance on September 27, when chemical engineers staged a 40-year reunion at Imperial.

The Class of '68 (1968-71) met in the Chemical Engineering department to acknowledge long-standing friendships, reacquaint themselves and generally enjoy being together again on old turf. For many this was their first visit back to IC since graduating.

'Of the 65 students who began the course 40 years ago, 53 were found,' said Terry Knott, who, along with colleagues Martin Braithwaite, Martin Davies, Rob Holton, Roger Wiltshire and Tony Wragg, organised the event.

'We couldn't have achieved this success rate without being able to search the internet and follow up with email – unheard of when we began college.'

Coming from around the world, including New Zealand, Australia, South Africa, USA and France, 36 of the class took part – adding in partners and also lecturers from the time,

ALUMNI NEWS & VIEWS

Four pages of who's doing what and where

Mixing chemicals 40 years on

the party numbered 60 in all, and included Stephen Richardson, until recently head of the Chemical Engineering

CHEM ENG 1971

department and now head of the Engineering Faculty at IC. Following an afternoon in the department and a champagne reception, the group adjourned to the Polish Club in Exhibition

Road for a merry and lengthy dinner.

While many of the throng still practise as chemical engineers – all of them high achievers – and others have already retired. The spread of careers across the Class of '68 is worthy of note, including distinguished academics, accountants, authors, doctors, photographers, stock-brokers and even a knight of the realm. **Terry Knott**



Chem Eng mixes it in one of their old haunts, Lecture Theatre 1.

IN BRIEF

Down-under dinner

DAVID BISHOP (Mech 64) has written to say that the annual CGCA dinner was held on October 13 at Vivace in Brighton, Australia. db@numerousbenefits.com

RSMA gathering

NOVEMBER 16 saw a dinner, in Sydney for RSMA members, at which the guests of honour were Prof Sir Peter Knight and Dr Joe Herbertson. Peter was involved in the establishment of Imperial's Institute for Climate Change. Joe gained his PhD in the RSM in the 60s.

Australian honour

JOE HERBERTSON (Civil 77) who is working in Australia, has been awarded an AM (Member of the Order of Australia) for 'services to the environment through the development and promotion of sustainable resource processing technologies'.

Top team

GEOTHERMAL International has a strong Imperial board. Chris Davidson (Physics 94) is technical director and James Cooper and Karl Drage (Mech Eng 95) are commercial director and operations director respectively.

Eco lecture

FOLLOWING his article in the last *Imperial Engineer*, Peter Head is speaking about Dongtan, the eco-city on which his company, Arup, is working. The lecture, in the Skempton Building, will be at 7pm on November 19. For more information email admin@friendsofimperial.org.uk

CAN YOU HELP?

We're looking for advertising for Imperial Engineer, especially from companies which provide our members' employment base and would benefit from exposure in something read by people now working in their diverse industries.

Can YOU, our readers, approach your own organisations? The editors will be happy to follow up your lead if needed.

Please forward all ideas and contact details to the Chapter office (details page two).

Paff celebrates his 100th birthday

AFTER winning a Royal Scholarship to Imperial and an electrical degree in 1931, Wilfred Pafford (Paff to his friends) went on to be a leading light in the development of that familiar box in the corner. He was present at the birth of TV, working for the BBC at Alexandra Palace from 1935.

Paff was working at the BBC transmitter at the outbreak of war and was transferred straight back to Ally Pally. Here, as part of MI5, he led a team of RAF technicians in operation 'The Battle of Beams' which involved blocking German radio signals.

After retiring to Ferring, Sussex in 1972, Paff now lives in a retirement home in Rustington. He was still pursuing his favourite hobby, gardening, until early this year.



Paff celebrated his 100th birthday in June with daughters Sue and Margaret and son-in-law Terry. (Picture by Malcolm McCluskey, Littlehampton Gazette.)

Alan's writings add to Bo story – can you?

FOLLOWING last issue's article about CGCA's mascot, Boanerges, Alan Baker added to the story with his letter recounting how the car was first adopted. 'I was at Guilds (1934-37) when Bo – or at least

the 1902 James and Browne (note the e) arrived.'

Alan, who became an automotive journalist, vaguely remembers the preceding young Rover. That motorcar never acquired anything like the kudos or

affection of the present Bo. The name appears to be eponymous, since the James & Browne did not come to South Ken until 1934 and Eric Arnot indicated that the nomenclature dated back to the 1920s. Another

letter of Alan's, giving more history of Bo, was in the spring *The Automobile*. More about this next issue, plus an engineering drawing of Bo. If you can add to the story, contact Alan on clovacottage@gmail.com



LEFT: In the bar. BELOW: Jim 'Beat' Smith describes Imperial in 1958.



LEFT: Robbie Robinson (Mech 35) and Theo Marx (Mech 37).



Aussies make trip to Links Club dinner 50 years on

MEMBERS and their guests gathered at the New Cavendish Club for the 82nd annual Links Club dinner in June. Jim Smith, elected in 1958, gave a spirited account of life at Guilds at that time, his entanglements with the police then, and his subsequent appointment as an OBE 'for services to the police!'

Others attending included Robbie Robinson (elected 1937) and Theo Marx (1939). Spider Bruce (1958) and his wife travelled from Perth, 50 years after his election. Chong Wai Wong, captain of squash, received the Links Club Award (a cheque for £250) for the most outstanding sports person in College.

WE NEED YOUR NEWS

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

**COPY DEADLINE FOR NEXT ISSUE IS
February 2 2009.**

Any pieces not published in this issue
will be published next time.

Climate e-book on web

JOLYON Nove (CIVL 57) has written a spirited e-book that postulates survival post the apocalypse. Like many civil engineers, he combines pessimism with practicality. Starting from the premises that a) global warming is unavoidable and b) it's likely to be severe, he proposes a practical model for a sustainable human environment on the subcontinent of Australia post the worst case scenario. Jolyon believes that, within 50-100 years, Australian mean

temperatures will increase by 3-6°C and peak temperatures by twice that. He constructs a persuasive scenario that combines a sustainable environment with energy, food and other essentials being self-generated.

It's a good model but difficult to reconcile with the interdependent planet we have today.

Give it a read at the website (www.climatechange-ebook.com) I like a lot of the engineering!

Bill McAuley

Teaching innovator

PROFESSOR Milija Pavlovic was a polymath and a scholar. Even among academic engineers, he stood apart: he was good or fluent in nine languages and the possessor of PhDs in both medieval Spanish jurisprudence and structural mechanics. He joined Civil Engineering in 1978 to develop teaching and research into concrete shell structures.

Milija was well-known as a first class theoretician and researcher, but it should be noted that he was also an excellent teacher, constantly proposing innovative ways to encourage students to learn. His efforts, which won much acclaim from his students, were recognised by the award of a prestigious Teaching Fellowship in 2007.

Milija had been ill for a very short time, so his death on September 20 came as a severe shock. His friendship and humanity will be missed by his many students, scientific collaborators and others at Imperial.*

World-class scientist

IN HIS long and productive research career at Imperial, Bruce Sayers (Chem Eng 50) served as head of Electrical Engineering and, subsequently, as head of Computing. He was also dean of City and Guilds. Bruce, who died on May 12 aged 80, will be remembered as a leading, world-class, research scientist and someone who really cared about students and education.

In the mid 1960s, Bruce established the Engineering in Medicine Laboratory and was, arguably, the father of the field of biomedical signal processing, which today is central to many areas of diagnosis involving medical scanners and other electronic instruments. Laboratories established in the 1960s later became the Department of Bioengineering.

Bruce was a dedicated teacher and was held in deep affection by his students, devoting a large amount of his time to student and City and Guilds activities.*

'Ideal son' killed in a landslide

ALEX WRIGHT, 27, who graduated in geology in 2002 and was a soil engineer for Cotswold Geotech, was killed on September 5. He was taking samples from a site in Stroud, Gloucestershire, when a trench collapsed, probably due

to torrential rain, and buried him under tonnes of mud.

Speaking about their son, Alex's parents said he was an ideal son. 'He was really family orientated and couldn't do enough for his family and those around him.' He had been with

his partner for a year and they were going to get married.'

Alex had worked for consulting engineers Cotswold Geotech Ltd as a soil engineer for more than two years and was also an assistant scout leader.

Complete versions of the obituaries, marked at the end with an asterisk, can be found on the website published on page two,

Engineer with gentle sense of humour

ALEC SANDBERG (Civil 40), who led the transformation of his family-run consultancy Sandberg from rail specialists to testing specialists, died on August 1, aged 85.

Speaking about his father, managing partner Neil Sandberg, described how strong his father's commitment to engineering was, and his gentle sense of humour.



Alec in his year as president of CGCA.

'He was the third generation of Sandbergs to take control of the business and he realised that rail had become a mature sector and was moving from expansion towards maintenance, and our work would be squeezed', said Neil.

'He took us into materials testing, and developed a relationship with the then Department of Transport (DoT) for the construction of the new motorway network.

'His humour was never at the expense of anyone, which is what made it funny', he said.

Alec received an OBE for services to civil engineering both at home and abroad, and retired in 2000.*

'Unstuffy and decent'

PROFESSOR Dennis Anderson, a renowned environmental economist who founded Imperial's Centre for Energy Policy and Technology, was remembered in *The Times* in June. With a background in technology, economics and policy, his work influenced key policy decisions on energy and the environment, and he also contributed to the recent Stern Review and Intergovernmental

Panel on Climate Change. He died on April 20.

His colleague, Professor Peter Pearson (Centre for Environmental Policy) recalls: 'He was notable for his unstuffy manner and gentle humour, and his students and colleagues saw him as a model of decency, commitment and humility. He insisted that a brighter future for humankind was within reach.*

A great sense of fun, compassion and integrity

BRIAN LAST (EE 60) died peacefully on April 23 after a long battle against cancer. He was well-respected locally and ran his company, TEK Consultants, in Sheffield for many years.

Brian will be remembered for his work for disadvantaged

around South Yorkshire where he was deputy chairman of the South Yorkshire Community Foundation

'His sense of fun, compassion, sincerity and utmost integrity will be sadly missed by all who knew him', writes son John.

Dam expert and CGCA support

PROFESSOR Peter Vaughan (Civil 53) died on May 16, aged 73. He was an undergraduate, postgraduate and member of the academic staff at Imperial and worked in his early days at Balfour Beatty and Sandeman Kennard and Partners. During this time he made dams his speciality.

After his formal retirement from Civil Engineering in 1996, he was a member of several international advisory panels overlooking the design and construction of many embankment dams – Empingham and Roadford Dams in the UK, Mica Dam in Canada and the Cascade of Daugava in Latvia – to name but a few.

Peter was a strong supporter of the CGCA and the holder of a number of awards and medals from the Institution of Civil Engineers.*

A lovely man

FOR THE last eight years of his life, Dennis Eastland suffered with Parkinsons disease but, with his typical make-do attitude and wife Sheila's unflagging support, he bore it with dignity and courage. Dennis, who died on August 25, never lost his sense of humour. He felt that if repeatedly heading a football might have contributed to the disease, at least the slide tackling had taught him how to fall!

A phrase heard often after his death is that he was 'a lovely man'. He was also a clever one and completed six years at Imperial with a degree and PhD in chemical engineering (46, 49)

His work took him around the world, first to Sweden's paper industry and later with BOC, Davy and C-E Lummus among others.*

Steel in the blood

PETER FLATELEY (Metal 52) died on July, 21, aged 81, after a long battle with cancer. His father was a steel worker in Rotherham, Yorkshire, and Peter followed his father when he left high school to join Sheffield steelmakers, Steele Peach and Tozer, as a trainee.

Determined to better himself, Peter came to the RSM as a 22-year-old. Following graduation, he joined the secondary metals operation of McKechnie Brothers in Widnes, but for most of his working life, was employed by British Nuclear Fuels at the Springfields nuclear fuel fabrication plant, near Preston.*

Powerful career

BOB WEEKS, who died aged 82 on August 1, was a mature student who gained a scholarship from CEGB while a shift charge engineer at Huddersfield power station. He was a postgraduate student on the first nuclear power DIC course in 1958 and, after graduating, was appointed nuclear operations engineer for the CEGB.

After being station manager at Bradwell, one of the first nuclear power stations, he went on to be director of generation for the CEGB. **Brian Dean (Elect 57, Nuclear DIC 58).**

David Colbert

DAVID COLBERT (Civil 72), who had been living and working in Mauritius for the past 12 years or so, has died.

He had been diagnosed with bile duct cancer and had been having some treatment in France. He died suddenly, probably as a result of associated heart failure. **Paul Jowitt**

Ajitsingh Medtia

AJITSINGH MEDITIA ACGI (Civil 92), who was only 39, died on June 21 from spinal cancer.

Dick Potts

An obituary of Dick Potts, who died on September 28, has just been received. It will be included in the next issue and on the web.

Plain sailing for Hong Kong party

HERE in Hong Kong we held our 2007 'biennial-and-a-bit' general meeting on April 18, in the opulent surroundings of the Gun Room at the Royal Hong Kong Yacht Club. There was an excellent turnout of 11 members and one visiting alumnus for the meeting, during which the retiring committee, comprising chairman – Barry Adcock, vice-chairman – Peter Pun, secretary – David Sorton, treasurer – Leo Leung and members Joseph Schembri and Richard Lau was re-elected for a further two-year term.

Following the meeting, the members were joined by seven partners for the custom-



ary post-BGM dinner party, during which a toast to the College was made and the traditional *Boomalacka* was chanted – at least by some!

David Sorton (Civil 71) dsorton@mtr.com.hk

Pictured, John Ackers, Michael Chalmers, John Latter, Leslie Swann, Peter Y S Pun, Ian Livingston, Barry Adcock, David Sorton, Noel Preston, Joseph Schembri, Thomas Tam and Richard Lau.

UK exiles meet in Adirondacks

TWENTY-ONE alumni (including your editor) and guests, spouses and partners gathered at the sylvan resort of Lake Placid in the Adirondack Mountains of New York State on September 27 for the annual exiles' reunion.

The weather, whilst variable, escaped the worst of Hurricane Ike as he barrelled his way up the Gulf of Maine to New Brunswick. We were thus able to gather the answers to the organisers' quiz/treasure hunt without worrying

about downpours. At the end it wasn't quite clear who the winners were but a good time was had by all.

At the Saturday dinner Sandy Eames' guest, Christine Havelock, shared thoughts on the problems of extended longevity, an issue increasingly import to our ageing gathering! On this subject, despite a steady stream of young alumni immigrants, a limited number are finding their way to this gathering. Perhaps increased publicity via the OAD can help!



BRIAN LAUNDER (Mech Eng 61) right received an honorary degree (*Docteur honoris causa*) over the summer from the Paul Cézanne University in Aix-en-Provence, for his contributions to modelling turbulence for the calculation of engineering and environmental flows. Brian is a professor in Manchester University's School of MACE

RICHARD HUDSON's (ESE 82) request for a new Imperial scarf has led us to look into why the stripes are the colour they are. See explanation in the next issue.

Code review called for

SECRETARY of the International Marine Minerals Society (IMMS), Philomène Verlaan (PhD Earth Sciences 2003) has called for reviews and comments on the IMMS Environmental Code. The website is www.immsoc.org.

The Code provides a framework for environmental programmes for marine exploration sites and a means for environmental evaluation of proposed applications. The Code's five year review is now due.

The review of the Code is part of Dr Verlaan's presentation to the Underwater Mining Institute at the annual IMMS Conference in November. Details of the conference may be obtained from IMMS Administrative (karynnem@hawaii.edu or by phone 001 808 956 6036), to whom comments on the Code can also be sent.

