The newspaper of the physics community

April 2005

interactions

Institute of Physics

Science goes to the ballot box

Ayala Ochert reports on what politicians are saying to try to win over the science vote.

On 1 March the main political parties in the UK outlined their policies on science at a standing-room-only meeting in the House of Commons. The event, entitled Science and the General Election, was organised by the Royal Society of Chemistry (RSC) on behalf of the science community in advance of the general election, which is expected to take place on 5 May.

Speaking at the meeting, science minister Lord Sainsbury said that, if re-elected, his government would continue its strong record on investment in science. Funding has doubled since Labour came to power eight years ago, he said. Under its 10 year investment framework for science and innovation announced last year, this would increase still further, and public spending on R&D would rise from 1.9% of GDP to 2.5% by 2014.

Sainsbury added that innovation was a key objective for his government and that money would go both towards creating a "dynamic science base" and to applied science. "The science community is very entrepreneurial. Scientists can do brilliant basic research and set up companies," he said. He claimed that "there is now a much clearer distinction between the parties on science than ever before" and challenged the other parties to commit to Labour's 10 year plan for science.

Robert Key MP, shadow minister for science, said that the Conservatives would match the government's spending on science. He acknowledged Labour's increased spending but he claimed that the extra money has gone on salaries rather than on increasing the volume of research.

Key also said that it is not the role of government to decide which areas of science should be funded and that his party would consider scrapping the research councils, which operate as "fiefdoms". Instead they would set up a single independent body, modelled on the US National Science Foundation, that would be "free from day-to-day political interference".

Representing the Liberal Democrats was Evan Harris MP, a member of the Science and Technology Select Committee of the House of Commons. He pledged that, if elected, his party would abolish tuition fees for undergraduates, thus helping to increase the number of students choosing to study science at university.

The Liberal Democrats also plan to move the Office of Science and Technology from the Department of Trade and Industry to the newly named Department for Education and Science (currently Education and Skills). Harris promised that more money would be made available to universities through this new department.

Stone: Joe Cornish

Scientific organisations are demanding that the next parliament should place science higher up its agenda.

Labour challenged the other parties to commit to its 10 year plan for investment in science.

The politicians also answered questions about some of the big issues in science today: department closures, the Research Assessment Exercise (RAE), the "crisis" in science teaching in schools and the shortage of students studying science at university.

Sainsbury admitted that the RAE was an administrative burden and said that his government was reviewing it, but the RAE 2008 would still go ahead. Harris countered that enough reviews had taken place and that, if elected, the Liberal Democrats would act on the recommendations of those reviews. He said that it was not about "new solutions, but implementing solutions". He said that his party would also pay the full costs of teaching science subjects at university.

On the subject of closures, Sainsbury said that there are enough physics and chemistry departments – there just aren't enough students who want to study those subjects. "We need to communicate the excitement of science and show that the physical sciences offer just as exciting a future as the life sciences and IT," he said.

Key said that the Conservatives would tackle the problem by "sharpening up boring science curricula". "Up to age 10 all children are enthused by space and dinosaurs, but by 11 they've gone on to other things," he said, adding that these policies might take up to 15 years to filter through.

On the morning of the event, representatives from the RSC turned up at 10 Downing Street to deliver a set of documents from more than a dozen scientific and engineering organisations – including the Institute – entitled "Policies for the next parliament". In its submission, the Institute said that science teaching in schools and universities must be the highest priority for the next parliament.

It also endorsed the idea that there should be funding for business-relevant research, but argued that this must not come at the expense of funding for blue-skies research. "There are things going on today in physics research that might only be important on a 20-, 50- or 100-year timescale, but that have the capacity to revolutionise the world," said Peter Main, the Institute's director of education and science. "If you have too heavy an emphasis on immediate applications, you kill all that."

einstein year
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www.einsteinyear.org

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HIGHLIGHTS

The poetry of the universe

Poets of all ages met the challenge of writing a poem on the themes of time, space and energy for the Universe Poetry Competition held by the British Association for the Advancement of Science. The winning entry in the adult category was "I once saw Einstein on a train" by Gordon Judge, with runners-up prizes going to Simon Cook for "Centennial: to Einstein", Noel Duffy for "The moons" and Roger Caldwell for "Einstein's cosmic hangover". The winners of the other age groups were Victoria Ellis (16–18) with "Don't you just hate gravity?", Simon Arch (12–15) with "Time" and Emily Birch (8–11) with "A chilly mistake". Joint winners of the 4–7 category were James Lockyer and Hugo Small from Freegrounds Junior School Southampton, and Rory Shaw from Carlops in Peebleshire. The results were announced to coincide with National Science Week in March and winners received telescopes suitable to their age group.
www.the-ba.net/universe

Spaced out across the UK

The world's largest model of the Solar System – on a scale encompassing the whole of the UK – is being built as part of the celebrations for Einstein Year. The finished model, entitled Space Out, will comprise 18 artistic installations representing objects in the solar system, including the planets, Halley's Comet and some asteroids and Kuiper Belt objects. These will be dotted around the UK on a scale of 1 to 15 million, located on school grounds and at sites of astronomical interest. Nine installations have already been opened, starting with one representing the Sun, which went on show at Jodrell Bank on 11 March (left).

The project was dreamed up by Nigel Marshall, a science teacher at Lancaster Girls' Grammar School and chief examiner for astronomy GCSE. His idea was backed by a group of friends and colleagues. Public and private sponsors, including the Institute's Lancashire & Cumbria Branch, have supported the scheme.
www.spacedout-uk.com

Search for gravitational waves comes home

An initiative to use the power of PCs across the world to search for gravitational waves – the Einstein@Home project – was launched in February. It is based on the same concept as the SETI@home project, getting individuals to download a screensaver that uses their computer's idle time to process data. In this case the data come from three observatories, each employing laser interferometry to detect gravitational waves from sources such as asymmetrical compact stars. Gravitational waves are ripples in space–time predicted by Einstein's general theory of relativity. They have never been detected directly although their influence on binary pulsars has been measured.
www.physics2005.org

Einstein Year receives Irish stamp of approval

The Irish postal service, An Post, issued three commemorative stamps on 14 March, which is Einstein's birthday. The 65c stamp depicts Albert Einstein, the 60c stamp celebrates World Year of Physics and the 48c stamp marks the bicentenary of the birth of Irish physicist William Rowan Hamilton. In addition to being Einstein Year, 2005 is Hamilton Year in the Republic of Ireland.

Football teams up with physics

By Dianne Stilwell

Physics and football joined forces for National Science Week at Ipswich Town Football Club on 17 March when 400 children from schools across Suffolk joined in a physics-themed sports day to celebrate Albert Einstein's birthday.

The children were joined by Jason De Vos and Richard Naylor, both players from the club, as they took part in workshops designed to show them how an understanding of physics can help their performance in the game.

The physical sciences workshop employed photoelectric timing devices to measure how fast the children could complete a 10 m sprint. The budding Beckhams also had the speed of their kicks measured using inflatable radar speed cages. The BATAK Reaction Board, which allowed the children to test their reaction times, was particularly popular.

Another workshop involved the students in exploring the concept of centre of gravity by measuring their flexibility, balance and strength. Meanwhile, another group competed to see whose balloon-powered rocket could fly the farthest while another group of children took part in an interactive lecture-demonstration on the physics of sport.

Verdicts on the day were positive. Students from Northgate Grammar School described the events as "cool", "fun" and "lots better than Thursday afternoons in school" and all agreed that the day had made them see physics and science in a different light.

Ipswich Town's involvement in science education is not a one-off – the day was used to launch their own science-based education project, called Town QUEST. The Portman Road stadium has a dedicated science laboratory, where schools can take part in a range of activities that are based on football, health and exercise.

BT, whose research centre is at nearby Martlesham, sponsored the physics-themed sports day. Its director of research and venturing, Mike Carr, said: "This event will give the young people attending the opportunity to explore many exciting scientific topics that they might not have encountered previously."

The Institute hopes that the format of this successful event can be copied by other football clubs across the country to promote the involvement of physics in sport. Caitlin Watson, programme manager for Einstein Year, said: "Einstein Year is all about discovering the physics in the world around us, and sport has plenty of physics to explore. Working with football clubs means that we can reach some kids who wouldn't normally be interested in physics and we've been able to show them that there's more to the subject than they thought."

Ipswich Town Football Club

Let's get physical: children from across Suffolk take part in science and sport at Ipswich Town Football Club.

Einstein Year exhibition opens

One of the highlights of Einstein Year promises to be the national tour of Move Over Einstein: the Next Generation is Here! This exhibition will showcase cutting-edge research in physics to 11- to 14-year-olds. Seven venues across the country will play host to the exhibition, which will open first at the Science Museum in London on 16 April.

Move Over Einstein was produced by the Institute in collaboration with the Particle Physics and Astronomy Research Council and the Engineering and Physical Sciences Research Council. It aims to switch young people on to some of the exciting ideas that are coming out of modern research in physics. In keeping with the aims of Einstein Year, the exhibition celebrates the great physicist's 1905 contributions but concentrates on the work being done by his modern-day successors.

"It was a brave decision to target 11- to 14-year-olds," commented Graham Farmelo, former director of exhibitions at the Science Museum. "That's one of the hardest audiences to reach. Most people at that age have their minds on other things and take a lot of persuading to engage with a science exhibition." Farmelo is chair of the exhibition's steering group, which has worked with the National Museum of Science and Industry to produce Move Over Einstein.

"The result is an interactive exhibition of a kind never seen before in this country," said Farmelo. "It's unstuffy and punchy, and covers an extraordinary range of subjects." It includes sections on quantum cryptography, nanorobots, the electronic "supernose" and the continuing searches for dark matter, the Higgs particle and extraterrestrial life. At its core, the exhibition features a visually stunning interactive "Einstein's bike", which invites visitors to "get inside Einstein's head" by asking them to consider some of his famous thought experiments. "We hope that every visitor will be inspired by the excitement of physics research and by Einstein's amazing legacy," said Caitlin Watson, Einstein Year's programme manager.

The exhibition is being previewed at the Observatory in Herstmonceux. After showing at the Science Museum it will tour the country, visiting the Royal Museum of Scotland, the Lakeside Shopping Centre in Essex, the Harvey Centre in Harlow and W5 in Belfast. All of the venues will organise school visits and offer a specially designed package of educational materials produced by ECSITE-UK.

Einstein was apparently never very keen on exhibitions, but the organisers believe that he would have approved of this one's central aim: to show the value of pursuing curiosity-driven research.
www.moveovereinstein.org

Physics is a matter of choice

This year's Schools Lecture employs an innovative format to engage with students.

The Institute's Schools Lecture for Einstein Year 2005 began its nine-month tour of the country with a bang last month. The lecture, called "Our planet – our future", included dozens of exciting demonstrations, including setting a hydrogen balloon alight, to dramatic effect. It will visit nearly 40 venues and be seen by around 10 000 11- to 16-year-olds.

The lecture's theme is sustainability – the impact that humans have had on the planet and the ways in which science and technology can help to create a sustainable future. This year's lecturers are Karen Bultitude and Laura Grant, both of whom work at Graphic Science, a communication company based at the University of the West of England.

The pair were chosen because of their innovative "choose your own lecture" format. The Institute's Schools Lecture traditionally includes demonstrations but, in addition to these, Bultitude and Grant also use an electronic voting system that allows students to choose which topics they want to hear about. "The theme of choice runs throughout the lecture. Not only do the students get to choose between the topics, but we also talk about the choices they will have to make as citizens that will determine the future of our planet," said Grant.

During each lecture the audience chooses three topics out of a possible six – "Energy from the atom", "Waste not, want not", "Futuristic travel", "Green machines", "Extreme weather" and "Restless Earth". These cover an impressive range of subjects, including nuclear fusion and fission, energy from waste, recyclable plastics, cars powered by hydrogen or biodiesel, and earthquakes.

The topics were chosen after consulting focus groups of young people. "We've tried to include the things they said they found interesting, like 'wow' science, futuristic technology and live demonstrations," said Grant.

Even the hardest-to-please students are thrilled by the hydrogen balloon explosion, and their natural tendency to make a mess is harnessed in the explanation of nuclear chain reactions – represented by paper balls that they throw around the room. The fast-paced format is designed to keep the young minds engaged throughout the 60 minute lecture.

Bultitude and Grant manage to include plenty of basic science in their lecture – the radio-frequency handsets for the voting system are used to describe the electromagnetic spectrum, and the discussion of hydrogen fuel cells involves a description of the process of electrolysis. But they also describe cutting-edge science and technology, such as microbial fuel cells, the latest fusion research, and cloud-seeding as a means of reducing the damage done by hurricanes.

The electronic voting system is also used to ask students their opinions on such questions as: "Which electrical device could you not live without?" and "Who can make the biggest contribution to sustainability – individuals, politicians, scientists or engineers?" This helps to give the students a sense of ownership of the lecture, says Grant. "Students told us that they are sick of being 'preached at' about sustainability – for example, being told to turn out the lights – so we were looking for a different approach."

Evidence so far suggests that the electronic voting is going down well with students. "I liked the way they got everyone involved and I liked having a choice," said Ruth Allen, a 14-year-old from South Wolds Community School in Keyworth, Nottinghamshire. Her physics teacher, Paula Mills, was also impressed. "The students were still buzzing about the exploding hydrogen two days later, and the lecture also seemed to enthuse a few of the less scientifically minded pupils," she said.

http://teachingphysics.iop.org

John Sumpter

Fired with enthusiasm: Karen Bultitude lights a hydrogen balloon in front of a young crowd in Nottingham.

IN BRIEF

● The government has committed itself to addressing the issue of **poor uptake of physics among girls** and will work with the Institute to look at the reasons why more girls do not study the subject.

This undertaking was outlined in the White Paper issued by the Department for Education and Skills (DfES) in February in response to the Tomlinson report on 14–19 education. This said that, working in partnership with the Institute and the Department of Trade and Industry, the DfES would "commission research into why girls do not do physics, what can be done in the classroom to change this, and the role that Science Learning Centres will play".

The pledge was immediately welcomed by the Institute's director of education and science, Peter Main, who noted that only 23% of A-level physics students this year are female.

The Institute has been working on two research reports on girls and physics, which are due to be published in the near future. One is a review of the extensive research into girls in physics. The other examines schools that have been successful in recruiting girls into studying physics post-16 and endeavours to draw out good practice.

The Institute's manager for education in schools and colleges, Daniel Sandford-Smith, says that the two reports will be used to inform the work that the Institute will do next, but will also be shared more widely within the science education community. He said: "We are pleased to see the prominence given to science in the White Paper and particularly that the government has recognised our work on girls in physics."

NEWSMAKERS

Leading space scientist **Keith Mason** has been appointed as the new chief executive of the Particle Physics and Astronomy Research Council (PPARC). He will be taking over from Ian Halliday, who is retiring, on 1 August for a period of four years.

Michael Finnis of Queens University, Belfast, is the winner of the 2005 Born medal and prize, awarded jointly by the Institute and the German Physical Society, for his contributions to materials physics, in particular the structure and thermodynamics of interfaces.

Philippe Monod of the Ecole Superiéure de Physique et de Chimie Industrielles in Paris is the winner of the 2005 Holweck medal and prize, awarded jointly by the Institute and the French Physical Society, for his outstanding contributions to the understanding of highly correlated electrons in condensed matter.

Looking for advice on career breaks?

Following its survey on career breaks last year, the Institute has published a guide to best practice in managing such breaks. The survey found that few people planned them in advance.

The guide calls a career a "precious commodity" and suggests investing time in managing a career break. It offers advice for those about to embark on a break, whether to look after children, relocate or for any other reason.

It recommends, for example, keeping up to date with membership of professional institutions (many offer reduced rates), finding a mentor and joining a university library. It also recommends going to occasional scientific meetings as a way of maintaining contact with your profession and to reduce the feeling of isolation often experienced by those on career breaks.

http://diversity.iop.org

Science aids transport problem

In the not-too-distant future we could all be riding around town in "automatic personal taxis" on networks of guideways. This was one of the predictions made at Science and Transport: Finding Solutions for the Future, a seminar at the Institute on 15 March.

With 22 million cars in the UK, producing one-fifth of the country's carbon dioxide emissions, and numbers set to increase by 1–2% per year, the seminar explored ways in which science and technology are providing solutions to the transport problem. The meeting, jointly organised by the Institute, the Royal Society of Chemistry and the Institute of Biology, was chaired by Gwyneth Dunwoody MP.

The ULTra (Urban Light Transport) "personal rapid transit" system was described by Advanced Transport Systems' Martin Lowson. It involves small electric vehicles, each operating at just 1.8 kW, that run along light interconnecting guideways. He called it the "ideal transport system" as it uses between a third and a quarter of the energy that cars and trains use, costs half to a third of light rail and is three times as quick. "It offers the benefits of a car without the problems," he said.

Alan Scragg of the University of the West of England talked about the potential of biofuels to replace petrol. While bioethanol and biodiesel are both carbon neutral and can be used in cars with little modification, in the UK they could only supply up to 15% of transport fuel needs because of the limited agricultural land available.

John Hollis of BMW gave an upbeat view of the potential for hydrogen cars to become commonplace over the next 50 years. There is a consensus in the car industry that hydrogen from renewable sources is the fuel of the future, he said, but to meet the goal of a 60% reduction in carbon emissions by 2050 we must start building the infrastructure now.

Technology is also helping to cut congestion, said Peter Sykes, an independent transport planner. Microsimulation, which models thousands of individual vehicles and the decisions of their drivers, represents traffic flow extremely well and is helping to reduce traffic and pollution.

Chris Wright, a transport expert at Middlesex University, said that attitudes to transport must change. If we simply make transport faster, demand will increase to meet supply. "We need slow, safe, reliable transport that is not fast and exciting, otherwise we'll end up just as we are today," he concluded.

FameLab seeks top presenters

Craig Strong Photography

Seeking fame: science communicators Trevor Cox (left) and Andrew Bebb.

Two physicists are the winners of the first heat of FameLab, a competition to find the UK's best new talent in science communication. They beat 50 other hopefuls at the auditions in Manchester on 16 March. Together with 10 other finalists, they will compete at the Cheltenham Science Festival in June for the national title.

The competition, in which contestants have just three minutes to present an "entertaining, engaging and informative talk for a non-scientific audience", has been called the *Pop Idol* of the science world. The judges include fertility expert and BBC presenter Robert Winston; physicist and writer Simon Singh; science editor of the *Daily Telegraph*, Roger Highfield; and Channel 4's head of science and education, Simon Andreae. The winner will be given broadcasting time on Channel 4, a UK tour of speaking events and £2000 prize money.

Trevor Cox, a professor of acoustic engineering at the University of Salford, demonstrated the similarities between a loudspeaker and a gin bottle to explain resonance. He kept the judges entertained by mixing gin and tonics. He returned in the afternoon to talk about psychophysics, showing how to get the best sound from a whoopee cushion. Cox, who studied physics at Birmingham, says that he gives science talks at schools, which helped him to make his talk entertaining.

Andrew Bebb used balloons and a giant toy magnet to explain the Invar effect, in which alloys display near-zero thermal expansion across a wide range of temperatures. Bebb studied the Invar effect (using high-energy synchrotron radiation rather than toy magnets) as part of his PhD in physics at the University of Warwick. In his second presentation he spoke about complexity and used a pot of giant edible ants to keep the judges' interest.

The remaining regional heats are scheduled for March and April.

www.famelab.org

Female physicists are edging forward

One in four university physicists are professors, but only one in 10 are women. Female physicists are also just a sixth as likely to be professors as their male counterparts.

These statistics form part of a snapshot of the academic physics community obtained by the Institute. All 48 physics departments in the UK responded to a 2004 survey, which asked about the make-up of their permanent staff. Overall, 1767 people are engaged in physics research and teaching in this country, a number that has barely changed since the survey was last conducted in 1999.

Overall, 24% of university physicists are professors, 24% are readers or senior lecturers, 23% are lecturers and 13% are research fellows. The remaining 16% are teaching fellows, experimental officers and others. Postdocs, postgraduates and technical/administrative staff were not included.

The survey shows that, in 2004, just 4% of women in physics departments held professorships, compared with 26% of men, but this proportion had doubled since 1999, when just 2% of women were professors. There were other signs of improvement for women. Of the 286 staff who left physics departments in the last five years, men outnumbered women by 14 to one; but of the 301 staff who arrived in that time, men outnumbered women by just five to one. Retiring physicists made up half of those leaving their departments; 31% left to take up academic posts elsewhere.

Physics departments were also asked to classify the research done by their staff. Top of the list were astronomy, astrophysics, cosmology and space physics, with 19% of physicists working in these areas. Next most popular were high-energy and particle physics (11%), closely followed by optics and laser physics (9%). Nearly three-quarters were experimentalists; the rest were theoreticians.

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Careers service gets moving

By Heather Pinnell

A service offering one-to-one careers advice to Institute members near their homes has been touring the country.

The Institute's first careers adviser, Vishanti Lall, began seeing members individually at London headquarters last July but, following consultation with members through an online questionnaire, a mobile careers surgery was launched.

"The majority of our members are not London based, and it is difficult for them to justify the time that's involved in travelling to London, particularly if they have never used the service," said Lall.

The new service is coordinated by the Institute's branch network and has been proving popular. John Bradshaw, branch support officer for the north-west branches, said: "It's a good idea to try and bring some of the Institute's services out to the members wherever possible."

The 45 minute sessions are scheduled from noon till 9.00 p.m. to fit round members' work commitments. Many people want to discuss a career change into or out of physics-related careers or into different areas of physics. Others simply seek career ideas or inspiration, or help with interview techniques, updating their CV or advice on starting a business.

"There are also people on masters or PhD programmes, those coming up to retirement and researchers who are on long-term contracts but are planning ahead before the contract ends. There has been particular interest in moving from academia to industry, and vice versa," said Lall.

Rosemary Bailey, who works in traffic management for Derby City Council, took advantage of the service when Lall visited Nottingham in February. "One of the main reasons I used the service was its accessibility. If someone is offering a session in London it means taking a whole day and organising childcare, when you don't know what you're going to get out of it," she said.

Lall stresses the confidentiality and anonymity of the service. "I would encourage anyone to use the service. Career development can happen at any stage but occasionally people are apprehensive about making a transition. Careers advice may help people to make that initial move."

http://careers.iop.org

Birmingham spawns new stars

Adrian Burrows

Bubbles for Paperclip Physics: Sarah Cull and Isabel Urquhart of King Edward VI School for Girls, Birmingham.

By Sally Fairclough

A team of students from Altrincham Girls' Grammar School in Manchester became the winners of this year's Paperclip Physics Competition by explaining how stars are born. Organised by the Institute, the grand final was held at Thinktank in Birmingham and brought together 13 regional finalists from the UK and Ireland.

Paperclip Physics challenges students aged 15 to 17 to explain a concept of physics, using everyday objects, to a panel of judges that includes a non-scientist. The Manchester team of Catherine Brown, Bekky Kennedy, Caroline Young and Victoria Young won with its dramatic performance of the process of star-birth. In a sketch involving hula hoops, giant ropes and specially designed hats and costumes, the team acted out the roles of Miss Gravity and Miss Strong Force, who struggle against electrostatic repulsion to bring together two positive charges inside a star.

The 13 teams had each won their regional heat, organised by the branches of the Institute. More than 1500 children took part overall. The competition aims to measure their ingenuity, understanding of physics, teamwork and, most important, ability to communicate their understanding. In a maximum of five minutes, each team was asked to make a presentation to the three judges – physics teacher Lisa Clarke, physicist Colin Gough and non-scientist Nick Owen, presenter of BBC's *Midlands Today*.

The runners-up, from Plymouth College, looked at the pros and cons of nuclear radiation, using ping-pong balls to explain radioactive decay and to show how radiation can be harnessed in essential medical treatments.

An interesting offering came from Emmanuel College in Gateshead, Tyne and Wear, in which students acted out an argument between James Bond and a film director. They explained that 007 would be forced backwards by air resistance if he jumped on the roof of a moving train.

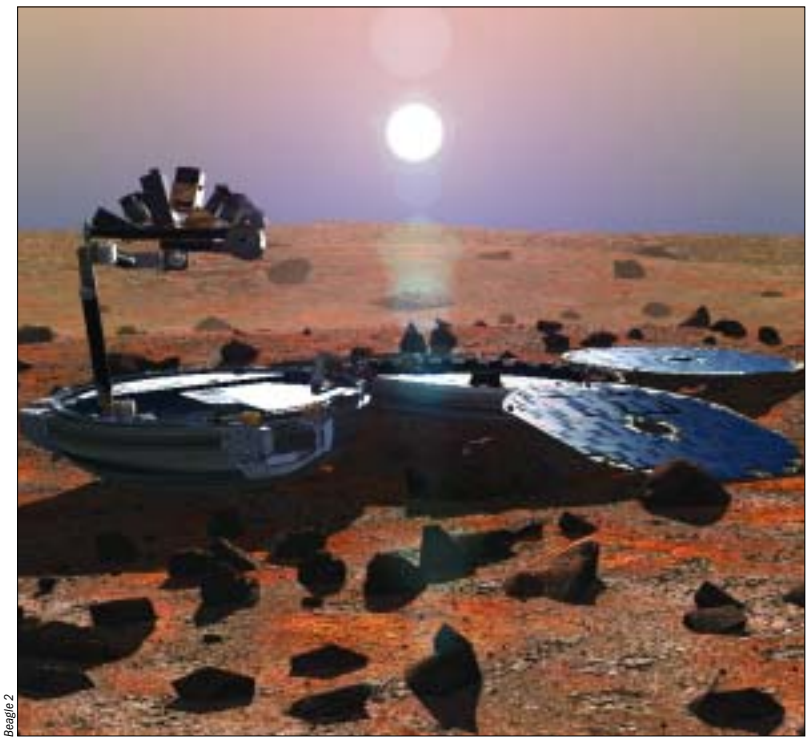
"I thoroughly enjoyed my day with all the budding young scientists," said Owen. "As a non-physicist, I approached the event with some trepidation, but I actually found all the demonstrations interesting and illuminating. I genuinely learned a lot and I was hugely impressed with all their hard work and enthusiasm."

The winners will receive a free trip to a summer science camp, donated by sponsors Aventure Scientifique. For the first time in the competition they were also awarded a trophy in the shape of a giant paperclip.

viewpoint: Martin Ince

Make space for humility

Beagle 3's designers could learn from the social sciences.



Beagle 2

How *Beagle 2* would have looked if it had landed successfully on Mars.

Can 919 000 people be wrong? That is the number who visited the European Space Agency's (ESA's) website to see images of Titan when the ESA spacecraft *Huygens* landed there on 14 January. Millions more saw the pictures on TV and in print. Many even heard the sound of Titan's winds on the radio. *Huygens* has upstaged *Giotto*'s 1986 visit to Halley's Comet as Europe's biggest space success.

Supporters of a bigger European space presence may also be hoping that 14 January has displaced Christmas Day 2003 from our memories. That was when *Beagle 2* arrived on Mars, probably with a loud crash after its parachute system went wrong.

Most spacecraft sent to Mars, whether by Europe, the US, Japan or the Soviet Union, have never been heard from again. But among these missions *Beagle 2* stood out. Its originator, Colin Pillinger, is a one-off English character. The sums of money were comparatively small, at just less than £40 million, and the question it was meant to answer was big enough for anyone: is there life on Mars?

Beagle 2 wasn't able to answer this question, but it has told us something interesting about life on Earth. Immediately its failure became apparent, its makers asked for the money for a new one. So far, they've got what they asked for – the UK government has already agreed to pay £5 million to reserve a launch slot for *Beagle 2: Evolution*, as *Beagle 3* is called.

A look at the proposal shows much engineering ingenuity but rather less humility. Despite a few nods to better landing equipment, more efficient solar panels and more up-to-date communications technology, the new spacecraft is more *Beagle 2.1* than *Beagle 3*. Given what we know about the strength of Martian air defences, this is probably a mistake.

Absent from the Beagle team's thinking, it seems, is that their idea might have been faulty in the first place, and they appear to have begun work on the second mission before learning what went wrong with the first.

Contrast this approach with that in the world of the social sciences, arts and humanities. There, it is possible to think small. A historian can always start work on a project in the hope of a grant later on. The UK Arts and Humanities Research Council, which funds history, says that many active researchers never apply for a grant because all they need is a library. Try suggesting this approach to a fusion scientist. A space mission or particle accelerator that has its budget cut in half ceases to exist.

In my own professional life, I work as media adviser to the Teaching and Learning Research Programme, which is finding out how people learn in school, why some companies develop professional skills better than others and even how to make science education more successful. It is the biggest-ever UK research programme on education, yet its total cost is only about £30 million, less than *Beagle 2* – not per year, but over its entire lifetime from 2000 to 2008. But in the social sciences it causes palpitations on the grounds of its size.

Perhaps the problem for the social sciences is that their very affordability may sap their assertiveness. Indeed, there is an internal discussion in education research called the "Warrant Debate" in which the participants worry about the validity and applicability of their findings.

Their lengthy discussions about whether they have the right to make the claims that they do are to their credit, but they are certainly not thought necessary in the physical or life sciences, let alone in technology. Here, the findings are their own warrant and it is "obvious" that producing more of them is the best possible use of taxpayers' money.

"Absent from the Beagle team's thinking is that their idea might have been faulty in the first place."

One lesson is that researchers in fields such as education ought to be a bit pushier. They might model themselves on the economists, much the sharpest-elbowed members of the social sciences family. But perhaps there is something in their approach that anyone dependent on UK state funding for their research could learn from.

The government's proudest boast about British science is that it is the most productive in the world. In other words, our researchers produce more top papers than anyone else despite having less money. The claim that a line of research should be supported simply because it might answer the next big question could prove less supportable in this new era of spending reviews and strategic plans.

The enormous public response to the *Huygens* landing shows how everyone will get behind these ambitious interplanetary missions – when they are successful. But Pillinger and his team should be aware that another failed mission – especially a failed mission to Mars – is likely to be greeted with a little less understanding than last time.

Freelance journalist **Martin Ince** has written several books on space and astronomy, including, most recently, Bloomsbury's *Dictionary of Astronomy* (2001).

OBSERVATIONS

Physics teacher Justin Clements recounts his experience of becoming a student again last December at the Institute's Physics Update course in Oxford.

Friday

I'm glad the Institute of Physics chose Oxford as the venue for this course for teachers because this was where I did my training. But it does mean a long journey for me as I work at the Sir Henderson British School in Milan. The course begins at lunch, where we all compare schools, departments, budgets and the different courses we're teaching at A-level. A lot of teachers have been praising the modern Advancing Physics A-level course developed by the Institute.

The first lecture is on materials science and is fascinating. With examples of cutting-edge technology, such as polymer LEDs and special plastics on satellites that react to light by becoming opaque, it's just the kind of thing my A-level students would have enjoyed. Most of my students would struggle to answer the question "What does a materials scientist do?", but now I'll be able to tell them. The next lecture, "Cosmology in wonderland", is a fascinating topic, but unfortunately is aimed well over my head. The evening lecture, "Polar explorations in light", is much more my kind of thing, presenting original ideas on how to teach polarisation using a selection of everyday items. Reports the next day that all of the local shops had sold out of jam-jar covers remain unconfirmed.

After dinner at St Anne's College I went to bed wishing I had brought a different book with me. Bill Bryson's *A Short History of Nearly Everything* is just a little bit too much science for one day.

Saturday

If I was "physics-ed out" after half a day, how was I going to feel after 10 hours of lectures and practical sessions, I wondered? Luckily, the sessions I chose were useful, informative and even entertaining. In "Puzzles and misconceptions" we covered a range of topics and questions that students – and sometimes teachers – often get wrong, which sparked off some animated discussions. This was followed by a fun-filled session on physics toys and an interesting workshop showcasing software for modelling particle collisions.

A highlight for me was a talk on the long-term effects of the Chernobyl disaster. It gave us plenty of useful anecdotes for the classroom, particularly about the inaccurate reporting of the episode in the media. (One report stated that if Russian guidelines for evacuation were adopted here, half of Cornwall would have to move out because of the radon levels.)

One of the best presentations was by Holger Babinsky from Cambridge University, who suggested that we've all been teaching the physics of flight incorrectly. He included dramatic video footage of a passenger jet deliberately being stalled – I'm sure it would amaze my students. His alternative explanation was convincing, if a little complex.

By mid-afternoon we were pretty weary, but "Challenges of the deep" proved infinitely more absorbing than one might imagine a lecture on rope technology would be. It included stories of "vertical buses" in South African gold mines that travel at 50 mph on the end of 3.5 km long ropes stretching 8 m on each journey. Definitely one for my class.

Sunday

The day began with a workshop on classroom astronomy, showing how school pupils can "take pictures" using the Internet to control a powerful robotic telescope in the Canary Islands. But my favourite presentation of the weekend had to be David Richardson's "Physics on stage" – a variety act of highly entertaining demonstrations, like how to produce standing waves on a cheese-topped tortilla. This was my first Physics Update course, but hopefully not my last. For me, it struck just the right balance between new concepts in science and innovative teaching ideas, and it was exactly the kind of in-service training that teachers like me are after.

To contribute to **OBSERVATIONS**, e-mail your idea to interactions@iop.org.

Institute of Physics

interactions

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The wrong Voice

I must protest vigorously at Eric Voice's obituary (p6, March). It states that in 1956 he became the "first scientist at Dounreay" and "pioneered the development of their fast-breeder reactor programme". He did no such thing. He played only a small, but no doubt worthwhile, role. I know this because I was appointed head of R&D at Dounreay in autumn 1955. I admired Voice for his tenacity and great energy in matters that concerned him, but he does not fill the role portrayed in this obituary.

Charles Tottle
Devizes, Wiltshire

Bigger is better

I would urge physicists to take an interest in renewable energy and particularly in wind power. But they must ignore the small wind turbines you show on lattice towers (p3, March). The last serious wind generator I can recall in the UK with a lattice tower was built 30 years ago at Boroughbridge, Yorkshire. The 1200 or so built since then have all been on tubular towers. Wind farms now have megawatt-sized machines, reaching as high as the London Eye. Anything smaller is uneconomic.

Donald Swift-Hook
Woking, Surrey

Journey of the mind

I didn't see Jim Al-Khalili's Channel 4 documentary on Einstein's brain (p8, March), but I am surprised he doesn't mention in this piece the journey made by the journalist Michael Pateriniti in the late 1970s. He tracked down Dr Harvey and drove with him and parts of the brain across America to San Francisco, where he met Einstein's granddaughter Evelyn. Pateriniti wrote a book about the trip, *Driving Mr Albert*, which was published in 2000. It's an interesting read, containing some details of Einstein's life and achievements, and also the eccentric behaviour of Dr Harvey during the drive.

Guy Hill
Faversham, Kent

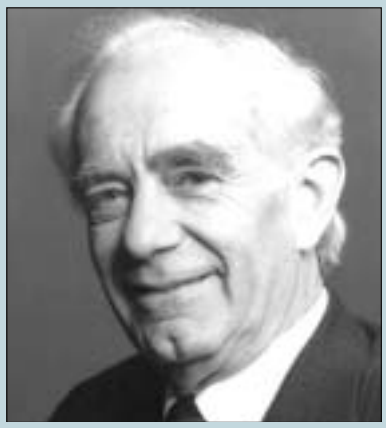
Correction

"New honorary fellows welcomed" (p2, March) stated incorrectly that the Institute has just three honorary fellows. There are in fact 30.

Write to interactions@iop.org or the address above. Letters may be edited for space.

OBITUARY

Peter Farago (1918–2004)



Peter Farago: inspiring teacher.

The last day of 2004 saw the death of one of Scotland's most charismatic physicists, Peter Farago.

He studied physics at the University of Budapest and Eötvös College, where he was influenced by distinguished physicist Zoltan Bay, who became a lifelong friend. In 1946 he joined Tungsraum Research Laboratory. He was then made professor of physics at Eötvös College and reader in physics at the University of Budapest. He later became head of section at the Central Research Institute of the Hungarian Academy of Sciences.

In 1957, following the Soviet invasion, Farago escaped to the West. He went to Leipzig to lecture, to East Berlin under the auspices of the Hungarian Academy, and finally to London, where he was reunited with his family. Farago's invitation to lecture at Imperial College was his ticket into the country, but he soon left to become a senior lecturer at Edinburgh. There he set up an experiment to measure one of the important constants in atomic physics – the g factor of the free electron – to a degree of precision several orders of magnitude higher than achieved elsewhere.

Farago and his family settled in Edinburgh, with short sabbaticals in Munich, Ontario, Amsterdam and Perth in Western Australia. He was elected a fellow of the Royal Society of Edinburgh in 1961 and appointed to a personal chair at the University of Edinburgh in 1967. He was a valued member of the community of British physicists and became a fellow of the Institute of Physics in 1957, serving on various branch, group and division committees and as deputy editor of the *Journal of Physics B*. When asked how he felt about leaving his native Hungary, he said: "I can accept being a foreigner in a foreign country. But what I could not face was the thought of spending the rest of my life feeling like a foreigner in my own country."

Peter Farago was an exceptional physicist able to make imaginative leaps of understanding, based on his strong intuitive grasp of the subject. He was also an inspiring teacher and to the end of his life kept up a regular correspondence with former colleagues and students on issues from the philosophical roots of science to the inadequacy of most attempts to popularise modern physics. He is survived by his wife, Margaret, and his son Peter, the distinguished theatre director.

Remembered by **Richard Sillitto**.

notices

NEW BUSINESS PARTNER

Home Office Scientific Development Branch.

NEW MEMBERS

Lalith Abeydeera, Pascal Andre, Michael Audley, Colin Bashford, Charles Bird, David Bryce, Anthony Cannon, Paul Cartwright, Dominic Cernis, Clifford Cheesman, Anthony Clark, Alan Dalton, Michael Dean, Hugo De Luna, William Galbraith, Stephen Gaunt, Andrew Goodwin, Philip Green, Alan Haselden, Richard Hensley, Geoffrey Heywood, Parken Hovsepian, Adrian Huntley, John Hughes, Paul Hughes, Giovanni Imponente, Anne Johnson, Rolf Kaufmann, Ross Kimber, Digby Knight, Gregory Kouzmenko, Ronald Langan, Jason Marshall, Lorenzo Milazzo, Stuart Morrison, Ioan Notingher, Daryl Penny, Michael Poole, Richard Potter, Timothy Purcell, Carl Roberts, Gareth Roe, Gregory Smyth, Robin Strange, Mark Stubberfield, C Q Sun, David M Taylor, Natalie Vinci, Andrew Watkins, James Whitton, Phillip Wilson, James Wise, Donghui Zhao.

NEW FELLOWS

Paul Addison, Laurence Barron, Eric Brown, Janet Brown, Alison Bruce, Sinclair Gair, Ian Galbraith, Helen Gleeson, Daniel Gorman, David Hicklin, Alan Hood, Thomas Hosea, David Hutchings, Eryk Infield, Douglas Irish, Desmond Johnston, Robert Kirby Harris, Richard Lacey, Andrew Long, David Lurie, Pramod Patil, Tim Prestidge, A Roy, Heather Ruskin, Martin Tillin.

IN MEMORIAM

Ian Palmer, Bo Nystrom, Arthur Charlesby.

MEMBER NEWS

● **New book for children** Peter Wright would like members to know about his book, *Mr Chip and the Antimatter Affair* – an adventure peppered with science aimed at children aged 10 and over. Published by Big Pen, it is available through Amazon, Fetchbooks and UK bookshops (ISBN: 0755210018).

MEMBER OFFER

Online subscriptions prize draw Timothy Benseman of Cambridge is January's prize draw winner and Andrew Skeats of Whitland is Feburary's winner. Both are now proud owners of a 512 MB USB data stick. For your chance to win, pay your membership subscription online at http://members.iop.org when you receive your subscription notice.

Visit **whatson.iop.org** for the Institute's full online calendar for the physics community or **www.einsteinyear.org** for Einstein Year public outreach events (indicated in **blue**).

APRIL 05

Edinburgh International Science Festival
Edinburgh, UK
2–12 April
www.sciencefestival.co.uk

Einstein's Century
Birmingham Central Library, UK
2–30 April
E-mail: Stephen_Morley@birmingham.gov.uk

Modelling, Simulation and Design of Dielectrics
IOP Dielectrics Group, Homerton College, UK
6–8 April
http://conferences.iop.org/MSD

METROMEET 2005
Innovalia Association, Bilbao, Spain
7–8 April
www.metromeet.org

25th Anniversary of Condensed-Matter Theory at ISIS and the Rutherford Appleton Laboratory
Rutherford Appleton Laboratory, Didcot, UK
8 April
www.isis.rl.ac.uk/conferences/theory25

Boffins, Bangs and Bazookas
Royal Armouries, Fareham, UK
9–10 April
www.armouries.org.uk

Physics: a Century After Einstein
IOP, University of Warwick, UK
10–14 April
www.physics2005.iop.org

Albert Einstein: His Life and Times
Astronomy Ireland/IOP in Ireland, Dublin City University, Ireland
11 April
www.astronomy.ie/lecture0504.html

ONE-DAY MEETING

Polymer Tribology
University of Birmingham, UK
23 June
Review of the science and engineering of polymer tribology. Organised by the Tribology Group and the Polymer Physics Group of the Institute of Physics.
http://conferences.iop.org/PTG

Advances in Online Instrumentation for Materials Characterisation in the Metals Industry
IOM Communications Ltd, London, UK
11–12 April
www.iom3.org

14th International Conference on Microscopy of Semiconducting Materials
Royal Microscopial Society, Oxford, UK
11–14 April
www.rms.org.uk/MSMXIV

Energy: Security of Supply
Institution of Mechanical Engineers, London, UK
13 April
www.imeche.org.uk

Fuels for the Future
IOP Combustion Physics Group, Cardiff University, UK
14 April
http://conferences.iop.org/FUF

Einstein Year Exhibition: Solar and Wind Applications
Doon Valley Museum, Dalmellinton, Ayr, UK
14 April – 2 July
E-mail: mark.klimek@physics.org

Einstein and the 21st century
Birmingham Library Services, UK
16 April
E-mail: Stephen_Morley@birmingham.gov.uk

Stars at Stockwood
Luton Museum Services, UK
17 April
E-mail: jarrett@luton.gov.uk

Commercialising Research for Bio-technologies
IOP Industry & Business, London, UK
19 April
http://industry.iop.org/bpn/Events

The Heart of Building Acoustics: What Makes It Tick?
Institute of Acoustics, Oxford, UK
19–20 April
www.ioa.org.uk

Fourth CCM International Conference on Pressure Metrology
CCM/NPL, London, UK
19–21 April
http://conferences.iop.org/ICPM

First IEE Seminar on Quantum Information Processing
IEE, Oxford, UK
20 April
www.iee.org

Protecting and Exploiting Intellectual Property
IOP Merseyside, Daresbury Laboratory, UK
21 April
E-mail: davidm@liv.ac.uk

Computer Languages for Scientific Computing
IOP Computational Physics Group, London, UK
22 April
http://conferences.iop.org/COL

Wear of Materials 2005
Elsevier, San Diego, USA
24–28 April
www.wom-conference.elsevier.com

IEE Seminar and Exhibition on MEMS Sensor Technologies
IEE, London, UK
25 April
www.iee.org/events/mems.cfm

Nanotechnology: Issues for Business
EU Conferences, Brussels, Belgium
25–26 April
E-mail: graeme.francis@euconferences.com

Cosmic Collisions
The National School, Hucknall, Nottinghamshire, UK
26 April
Dave Taylor 0115 9635 667

Ferroelectrics UK 2005
University of Paisley, Renfrew, Glasgow, UK
26–27 April
www.paisley.ac.uk/ferroelectrics

Phenomenonal Forces
INTECH, Winchester, UK
27 April
www.intech-uk.com

CONFERENCE

EMAG-NANO 2005 Imaging, Analysis and Fabrication on the Nanoscale
University of Leeds, UK
31 August – 2 September
Members £275
Non-members £330
Students/Concessions £130
Registration includes conference dinner and proceedings.
http://conferences.iop.org/EMNA

Microscopy of Catalysts
IOP Electron Microscopy and Analysis Group, London, UK
27 April
http://conferences.iop.org/EMC

Bridging the Gap: a One-day Seminar on Hybrid and Inverse Methods in Experimental Mechanics
IOP Stress and Vibration Group, Derby, UK
27 April
http://groups.iop.org/SV/HTSA/index.html

Healthcare Technology Forum: the Future of Medical Imaging and Radiotherapy
PPARC KITE Club, London, UK
28 April
www.pparc.ac.uk/in/htf-invite.asp

MAY 05

Twyford Waterworks Gala Open Day
Twyford Waterworks Trust, Twyford, UK
1 May
www.hants.gov.uk/twt

Scanning the Human Body Using Radioactivity
Oakham School, Oakham, UK
3 May
E-mail: jac@oakham.rutland.sch.uk

Silent Witness: Babes in the Wood
IOP Merseyside, Liverpool Medical Institution, UK
5 May
E-mail: davidm@liv.ac.uk

Indium Phosphide and Related Materials 2005
Glasgow, UK
8–12 May
www.IPRM2005.org

Nanotech 2005
NSTI, Anaheim, USA
8–12 May
www.nanotech2005.com

Biocomplexity VII
Biocomplexity Institute, Bloomington, Indiana, USA
9–11 May
http://biocomplexity.indiana.edu/events/bio7

14th IEE Microwave Measurement Training Course
IEE, Middlesex, UK
9–13 May
http://conferences.iee.org/microwave

The Future of Nuclear Energy in Europe
EU Conferences, Brussels, Belgium
11–12 May
www.euconferences.com

Lab in a Lorry
IOP, Balmoral Royal Ulster Agriculture Show, Northern Ireland
11–14 May
www.labinalorry.org

The Hamble Wreck 'Grace Dieu'
Winchester City Council, The Guildhall, Winchester, UK
12 May
E-mail: museums@winchester.gov.uk

The Physics of Road Accidents
Worcestershire, UK
17 May
John Beale 07801 365 204

Techniques and Instrumentation in Low Temperature Physics
IOP Low Temperature Physics Group, Rutherford Appleton Laboratory, UK
17 May
E-mail: claire.pantlin@iop.org

May Play: Calculus
Trinity College Dublin, Ireland
17–19 May
E-mail: priests@tcd.ie

Nonlinear Phenomena in Complex Systems (NPCS) 2005
National Academy of Sciences of Belarus, Minsk, Belarus
17–20 May
http://npcs.j-npcs.org/2005

A Guide to the End of the World: Everything You Never Wanted to Know
Richmond Scientific Society, Richmond, UK
18 May
Valerie Barkham 01784 259198

Einstein: Life, Science and Art
Millennium Galleries, Sheffield, UK
18 May
E-mail: M.Navin@shef.ac.uk

Einstein's Century of Physics
IOP in Ireland, NUI Maynooth, Ireland
19 May
E-mail: science.dean@nuim.ie

Awesome Electricity
INTECH, Winchester, UK
19 May
www.intech-uk.com

Electric Fields and Discharges for Microbiology and Health Care Applications
IOP Electrostatics Group, London, UK
19 May
http://conferences.iop.org/EFD

17th International Conference on Fibre Optical Sensors
Bruges, Belgium
23–27 May
www.ofs17-Bruges2005.be

Laser Micromachining: Development and Applications
Association of Industrial Laser Users, Bangor, Wales
24 May
www.ailu.org.uk

Nanomeeting-2005
Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus
24–27 May
www.nanomeeting.org

Constant Speed by the Rambert Dance Company
IOP, Sadler's Wells, London, UK
24–28 May
www.rambert.org.uk

Mechanics for Medical Device Development
IOP Stress and Vibration Group, London, UK
25 May
http://conferences.iop.org/MDD

CIC2005: 2nd National Meeting of Quantum Computing and Quantum Information
SENUMA, Popayan, Cauca, Colombia
25–27 May
www.senuma.unicauca.edu.co

Einstein Adult Learners Events
Science Museum/Open University, Science Museum, London, UK
28 May
E-mail: john.bull@nmsi.ac.uk

einstein year

For full details of Einstein Year events (indicated in **blue**) and to find out what's happening in your area, visit **www.einsteinyear.org/events**.

Dr Bunhead's Recipe for Disaster
Theatre Royal Winchester, Winchester, UK
28 May
www.theatre-royal-winchester.co.uk

Mayhem, Murder and Mystery
INTECH, Winchester, UK
30 May – 3 June
www.intech-uk.com

Eisteddfod Yr Urdd 2005: Science Pavilion
Millennium Centre, Cardiff Bay, UK
30 May – 4 June
E-mail: cerian@angharad.fslife.co.uk

CONFERENCE

Novel Applications of Surface Modification
Chester College, UK
18–21 September
Join other scientists, engineers and manufacturers to find out about present and future applications of surface modification, including reduced wear, increased corrosion resistance and improved optical properties.
Organised by the IOP Applied Physics and Technology Division. Poster prizes and student bursaries are available.
http://conferences.iop.org/APTD

JUNE 05

Stirling Physics Meeting
IOP in Scotland, Stirling, UK
1 June
http://scotland.iop.org

Your Brain and How to Use It!
INTECH, Hampshire, UK
1 June
www.intech-uk.com

8th International Conference on Web Handling
Oklahoma State University, Oklahoma, USA
5–8 June
www.engext.okstate.edu/2005call.pdf

Central European Workshop on Quantum Optics
Bilkent University, Ankara, Turkey
6–9 June
www.fen.bilkent.edu.tr/~cewqo2005

Robert Hooke: the forgotten genius of physics

Allan Chapman examines the life of the scientist who, by 1680, had developed a Grand Unified Theory of physics.

Earlier this year, as the world celebrated the successful landing of the *Huygens* probe on the surface of Titan and marvelled at the images that it sent back to Earth, I was reminded of the achievements of one of Christiaan Huygens' contemporaries – Robert Hooke. Over the past three centuries, Hooke has suffered at the hands of historians of science. While no-one has forgotten his famous 1678 Law of Spring – *Ut Tensio sic Vis* (the tension is equal to the force) – he has otherwise been relegated in history to the role of a minor character – one who was foolish enough to challenge Sir Isaac Newton.

This is a shame because the real Robert Hooke was one of the most brilliant figures of the 17th century. The son of an Anglican clergyman, he went to Westminster School and Christ Church, Oxford. He was elected a fellow of the Royal Society at 28 and became professor of geometry at Gresham College before he was 30. He formed lifelong friendships with some of the leading figures of the age, including Robert Boyle and Sir Christopher Wren, and he was looked up to by Samuel Pepys as an oracle and a celebrity.

Everyone who came to know Hooke was bedazzled by his ingenuity: his ability to see farther into nature than most of his contemporaries and to devise experiments and physical models through which to understand nature. As a boy he devised flying machines and even experimented with artificial muscle as a way of propelling them, which led him to the study of elasticity. Through this he became fascinated with the physics of horology and the mechanical potential of springs.

But Hooke's interests extended well beyond springs, and one is struck by the parallels between his work and that of Huygens, with whom he corresponded. Both men saw the world as a great machine and were fascinated by springs, clocks, light, gravity and the planets. Both also made major contributions to gravitational physics.

In fact, more than 60% of Hooke's published researches related in some way to astronomy. While Newton was still an undergraduate at Cambridge, Hooke – the supreme experimental physicist – was trying to measure differences in the pull of terrestrial gravity between the top of Old St Paul's Cathedral and floor level. And it was Hooke who argued, in 1665, that the planets must be gravitational bodies because their spherical shapes suggested an even packing of matter around a centre of attraction. In the 1660s and 1670s he undertook a brilliant series of telescopic studies of the Moon, Mars, Jupiter and the comets of 1664 and 1677. In 1666 he appears to have beaten Giovanni Cassini in determining the rotation period of Jupiter from a semi-permanent spot on its surface, and he confirmed Huygens' discoveries of Saturn's ring system and the motion of its satellite Titan.

Rita Greer

No surviving portrait exists, but Rita Greer created this one from contemporary descriptions of Hooke.

Significantly, Hooke realised that the human senses could be rendered vastly more acute by using them in conjunction with a range of newly developed instruments or "artificial organs" – the telescope, microscope, barometer, air-pump, pendulum clock and such – which facilitated in turn a rich harvest of new data that would be central to 17th-century science. He even turned astronomy into a laboratory science when, in 1664, he dropped pistol balls from a great height into tubs of viscous pipe clay and found that they formed crater-like depressions. He later modelled comet tails by studying the pattern of bubbles released when wax balls encrusted with iron filings were suspended in acid.

"Everyone who came to know him was bedazzled by his ingenuity: his ability to see farther into nature than most."

To Hooke the whole cosmos, from the atomic to the planetary realm, seemed to be in motion, and as it moved, it emitted vibrations. These travelled through space or air or water in wave patterns and became manifested as light, sound, magnetism, gravity. Such was his genius that, by 1680, you could say that Hooke had produced his own Grand Unified Theory of physics.

One reason why Hooke came to fall out so bitterly with Newton was that he was a mechanist. He believed that it was the scientist's (or philosopher's) job to engage with nature's causes – the cause of light, of gravity and so on – and how these causes produce effects that we can detect with instruments. Newton, on the other hand, saw physics as concerned with the mathematical expression of effects. For Newton the true causes of nature, being divine, were beyond the business of science.

In many ways, science has developed along Newtonian lines. But Hooke's contributions have been profound and enduring, not least because of his brilliant development of the experimental method and his use of sophisticated instruments as tools of scientific inquiry. The European Space Agency rightly recognised Christiaan Huygens for his contributions to astronomy. It is my hope that Robert Hooke might one day be similarly honoured by having a future interplanetary probe named after him. Such a probe would, in the finest traditions of Hooke's science, be extending human powers of inquiry into new realms of perception.

Allan Chapman is author of *England's Leonardo: Robert Hooke and the Seventeenth-Century Scientific Revolution* (2004, Institute of Physics).

particles

We were asked: What would happen if I stood on the surface of Mars in just the clothes that I am wearing now?
We replied: You wouldn't last long. The Martian atmosphere contains just 0.13% oxygen (compared with 21% on Earth) and a poisonous 95% carbon dioxide (compared with 0.03% on Earth). Just as deadly is the incredibly low atmospheric pressure. On Earth, the pressure of the gases in the atmosphere counterbalances the pressure of your internal organs – it squishes you in so that your insides can't force their way out. On Mars the atmospheric pressure is just 0.006 times that on Earth, which means that you would explode almost immediately. If you somehow managed to survive all of that, then there's the small matter of your blood boiling. The low pressure means that liquids – including blood – boil at much lower temperatures than they would on Earth.
Taken from Physics Line, a service of the Institute of Physics for BBC Southern Counties Radio.

Some sparkling results

Thanks to all of those who responded to Peter Graham's question about how to keep the sparkle in his tonic water. David Greene of Harlow suggested that he uses large stainless-steel spheres to plug the bottles, while Guy Hill of Faversham said that he could simply buy 125 ml bottles of tonic water. But the bubbly goes to Paolo Barletta of London who, after extensive experimentation, concluded that the tonic water should be quickly transferred to as small a bottle as possible and then kept in the fridge.