The newspaper of the physics community

June 2006

interactions

Institute of Physics

Physics fails to recruit ethnic mix

Ayala Ochert reports on research into the ethnicity of physics and chemistry students.

The problem of the under-representation of girls and women in physics has been well documented, but a new study shows that physics also has trouble recruiting students from ethnic-minority groups.

The report *Representation of Ethnic Groups in Chemistry and Physics* was written by Peter Elias and Paul Jones of the Warwick Institute for Employment Research and was jointly commissioned by the Royal Society of Chemistry and the Institute of Physics.

It looked at ethnic-minority participation in both physics and chemistry from GCSE all the way through to postgraduate level. "The picture that emerges is a complex one, with some ethnic groups under-represented at various stages and others over-represented," says Tajinder Panesor, the Institute's policy officer.

In the undergraduate physics population the study found that all ethnic minorities, except Chinese students, were under-represented relative to their numbers in the undergraduate population as a whole. But in chemistry – which is also more gender balanced than physics – all ethnic minorities, except black Caribbean students, were over-represented.

The situation at postgraduate level was much more stark. Even those who had done well in their degree "showed relatively little inclination to study physics beyond undergraduate level", according to the report.

The authors analysed several national statistics databases and looked at six stages of the "leaky educational pipeline" to identify the points when different ethnic groups leave physics and chemistry. Future study will be needed to discover why students leave and what might be done to stem the flow away from the physical sciences, they added.

At the first stage, achieving five GCSE passes at grades A*-C, Chinese and Indian pupils performed the best, followed by white pupils and then other ethnic groups. "Many black Caribbean, Pakistani and Bangladeshi students fall at the first hurdle – often before students have the opportunity to specialise in physics or chemistry. This results in a huge loss of potential talent," said the authors.

At A-level they observed a similar pattern, with Chinese and Indian students showing a strong preference for science subjects, and black Caribbean students a strong aversion. Chinese students were three times more likely, and Indian students twice as likely, to study a science A-level as their white counterparts. Chinese students were also four times more likely, and Indian students twice as likely, to achieve three or more science A-level passes. But black Caribbean males were only half as likely, and females one-fifth as likely, to get a science A-level. Pakistani and Bangladeshi students were also less likely to study science at A-level than white students. Interestingly, female black African students were almost twice as likely to achieve three or more A-levels in science than white females.

Adrian Burrows

From GCSE to postgraduate level, physics does not encompass a representative cross-section of students.

"The picture that emerges is a complex one, with some ethnic groups under-represented at various stages and others over-represented."

At A-level, chemistry was much more popular than physics. All ethnic-minority students, except black Caribbeans, were more likely to achieve an A-level in chemistry than white students, whereas only Indian and Chinese students were more likely to achieve an A-level in physics. The authors suggest that this may be because chemistry A-level is a prerequisite for studying medicine, which is seen as an attractive career path by many from ethnic-minority groups, particularly Asians.

To examine students' subject choices at degree level, the researchers calculated the number of "potential undergraduates" in each group – those who had the necessary grades and A-level combinations to study physics or chemistry at university. Here they found a high rate of attrition. Only one-third of potential Indian physics undergraduates chose to study the subject at university. Chinese students were the only group more likely than white students to study physics at university – doubly so. Only Pakistani students were more likely to transfer from being potential physics undergraduates to actual physics undergraduates. In chemistry, ethnic-minority groups were again over-represented, with the exception of black Caribbean students.

In general, students from ethnic-minority groups appear to prefer vocational subjects, such as medicine, dentistry, law, business and IT over the traditional science subjects. The authors suggest that this may be due to cultural reasons, but also note that different ethnic groups have different socioeconomic profiles, which may also play a part in both educational achievement and subject choice.

At postgraduate level, there appears to be a wholesale under-representation of ethnic-minority groups in both physics and chemistry. While fewer ethnic-minority students achieve first or upper-second class degrees than do white students, more go on to postgraduate study, but they appear to choose other subject areas.

Katharine Hollinshead, the Institute's diversity programme leader, said of the report: "It has shown us that to address the lack of ethnic mix in physics we need to start in schools with young pupils." The recent HEFCE-funded project Stimulating Demand for Physics includes a number of initiatives to do just that, she added.

For a copy of the report, e-mail tajinder.panesor@iop.org.

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NEW-LOOK INSTITUTE WEBSITE AT www.iop.org

HIGHLIGHTS

The past goes digital

Saving the cartoons from *The Beano* and souvenirs of male impersonator Vesta Tilley were among the topics discussed at a conference on conserving and digitising valuable materials, organised by the Institute's Printing, Papermaking and Packaging Group in April.

Stephen Hoskins, director of the Centre for Fine Print Research at the University of the West of England, said his group had been working with *The Beano* cartoonist Leo Baxendale to produce digital reproductions of some of his early red- and black-toned drawings. They have been photographing the originals with a high-quality scanning digital camera then reproducing them on a very large inkjet printer. A spectrophotometer mimics the human eye by measuring the colours in the original and copy, but cannot replace it, so the team works with Baxendale to fine tune the match. Moira Buick described scanning the Worcestershire Record Office's scrapbooks of cuttings and photographs of music hall star Vesta Tilley dating from the 1880s to 1919. To unfold the originals without damaging them, she supports them with a heat-sensitive tissue, and uses archival tissue paper to prevent the scrapbook bindings from crumbling from "red rot".

Fired up for dark matter

Studying interactions using a particle accelerator is like watching two people successfully collide peas fired from pea-shooters when one person is on the Sun and the other is on Jupiter, Philip Burrows told the Institute's South Central Branch on 4 May. Burrows is professor of accelerator physics at the new John Adams Institute, set up by Oxford University with support from PPARC to reintroduce accelerator science as an academic discipline in the UK.

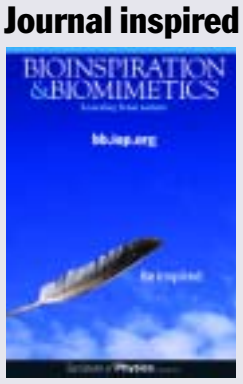
Facilities such as the Hadron-Electron Ring Accelerator near Hamburg examine matter on the smallest scales by firing electrons and protons at such high energies that the electron actually collides with the proton's constituent quarks. To investigate the dark matter thought to pervade the universe, researchers will need the Large Hadron Collider, which should find the Higgs and particles of dark matter proposed by theories such as supersymmetry if they exist, Burrows said.

Celebrating Maxwell's birthday

The career of Edinburgh-born physicist James Clerk Maxwell was celebrated in a lecture tour of Scotland in April by Basil Mahon, author of *The Man Who Changed Everything: the Life of James Clerk Maxwell*. The tour, supported by the Institute of Physics in Scotland, was one of many events to mark the 175th anniversary of Maxwell's birth in 1831.

Mahon illustrated how Maxwell's famous equations describe the symmetrical dependence between electric and magnetic fields. Though he never wrote them down in their modern form, Maxwell – dubbed "daftie" at school – had made one of the greatest contributions to classical physics. Mahon also described Maxwell's serendipitous demonstration of the first colour photograph, which others were unable to repeat. Only years later was it realised that a lucky combination of circumstances had allowed him to achieve his result.

Journal inspired by imitating life



A new online journal – *Bioinspiration and Biomimetics* – has been launched by the Institute of Physics. The journal is aimed at scientists and engineers who draw on biological systems for their inspiration to solve scientific problems and develop new technologies. The first issue includes a topical review of artificial compound eyes and a paper on nucleation and growth of apatite by a bioceramic. *Bioinspiration and Biomimetics* is intended to provide an interdisciplinary research forum. Online access will be free until the end of 2006.
http://bb.iop.org

Blog joins in the nuclear debate

By Heather Pinnell

Potential Energy – a blog to debate whether the UK should invest in new nuclear power facilities – was launched by the Institute on 16 May. The online diary is being composed by three independent writers as they investigate the scientific issues around nuclear power and report on their findings.

The three – two journalists and a science information officer – were chosen because they were committed to approaching the debate in an open-minded and objective way. They are free to make their own inquiries by speaking to relevant people, attending meetings and visiting facilities where they think this could shed light on the debate.

Visitors to the site can post their own comments as they follow the entries. There will be six short posts each week – two from each of the contributors – over the 10-week period that the blog will run, and the site will remain open for viewing after that.

The idea for the blog came from the Institute's outreach officer, Samuel Rae, and from physics in society manager Caitlin Watson, partly in response to the government's current energy review. Rae said: "We wanted to provide a forum for in-depth debate about the nuclear issue, to provide time and space for getting into the nitty-gritty of the debate without shying away from the physics behind it. When you read some newspaper articles about nuclear power they can be quite dry. We're trying to stimulate interest by personalising the discussion through an online journal."

The contributors are Gia Milinovich, who writes and blogs on science topics and is a science and technology broadcaster; journalist and author Caspar Henderson; and Kat Arney, an information officer for a cancer charity who is also on the team of the radio show *The Naked Scientists*.

Watson commented: "If we are to have a useful debate on the possibility of nuclear as a future energy source, people need to know a bit about the science that is involved. We hope the website, the posts and the comments will provide an excellent source of information on the scientific issues of nuclear new-build."

Those involved in creating the blog hope that Institute members will want to join in the online debate and that other bloggers will talk about the site in their own blogs.
http://potentialenergy.iop.org

STARRING GIRLS

Russell Watkins

Filming for a new DVD to help teachers keep girls involved in physics took place at the Latymer School in Edmonton, London, in April. *Saving Nellie* will feature television actors James Fleet (left), who plays Hugo in *The Vicar of Dibley,* and Helen Baxendale (right), whose credits include *Friends*, as love-struck teachers coming to the rescue of "Nellie" (Jordan Loughran, centre) before she joins the brain-drain of girls from physics education. The DVD will support a new guide being developed by the Institute to help teachers increase participation of girls post-16.

Education and the web occupy ARM

The past financial year has been a good one for the Institute, which remains on a steady course, honorary treasurer Tony Scott told the Branch, Group and Division officers who had gathered for the Annual Representative Meeting at the Institute in London in May. However, if the Undergraduate Bursary Scheme proves as successful as is hoped, there will be more calls on the Institute's funds, he said.

Honorary secretary John Beeby thanked the members for their work in what had been a highly successful year, encompassing Einstein Year, the launch of Lab in a Lorry, the international review of physics research, the dance *Constant Speed* and the Institute's new Strategic Plan.

The Institute's new website, which will go live on 1 June, was showcased and the representatives were told about the Institute's new HEFCE-funded project aimed at attracting more students into physics at university and at A-level.

Some members were concerned that the Institute's educational events were disproportionately supported by independent schools. Peter Main, the Institute's director of education and science, acknowledged the problem, which he said was shared by many similar organisations. The Institute is trying to overcome this elitist image through its involvement in initiatives such as Aimhigher (which targets non-traditional students), said Main.

Others expressed fears that the continuing decline in A-level entries would jeopardise the future of the subject, though Main stressed that reversing this decline was a top priority for the Institute.

It was suggested by one member that the Institute's conferences did not match the standard of those in Germany and the US. Membership director John Brindley explained that the style of conferences reflected the choices of the Institute's subject divisions themselves. They had very different objectives from the large American Physical Society events, for example, and usually had more scope for student involvement.

Einstein Year made a difference

Einstein Year is judged to have been an overall success for physics, reports *Ayala Ochert*.

An independent evaluation of Einstein Year found that events were of a consistently high standard and that the year helped forge new links between physicists and their local communities.

The year also helped changed young people's attitudes towards physics – those who participated in Einstein Year events showed a "small but consistent increase" in interest in physics over those who did not, according to the evaluation.

As well as the high-profile Einstein Year events – such as the launch of the year with a BMX biker performing the Einstein Flip and the Rambert Dance Company's production *Constant Speed* – there were also more than 500 locally organised events around the UK and Ireland in 2005. The evaluation of the year, conducted by the Institute of Education at the University of London, involved exit interviews from participants at many of these events. It also included an attitudinal survey of 11- to 14-year-olds throughout 2005.

The survey found that young people in this age-group generally have a positive view of the impact of science on society. They also realise that physics is important and, despite the stereotypes, appreciate that anyone can become a scientist. Having said that, none of the young people surveyed said that they wanted to become a physicist themselves.

"These results are interesting," says Caitlin Watson, who was programme manager for Einstein Year. "The challenge for the physics community now is to develop activities that not only engage young people but also show them how they can connect and contribute to science themselves."

Ram Shergill

The dance *Constant Speed* was just one of the events during Einstein Year that helped raise the profile of physics.

The evaluators personally visited many of the year's locally organised events – held in libraries, universities, public spaces, community halls and arts centres – and found them to be professionally organised and of a consistently high standard. Around 50 of these events were supported by Einstein Year grants from the Institute, and the evaluators said that such grants were of enormous importance to event organisers in enabling activities to take place.

The grants funded a wide variety of activities, including a rocket festival in Radstock and a physics poetry day in Bristol that encouraged people to think about what words summed up physics for them. Jem Finer, artist-in-residence at the department of astrophysics at Oxford University, used his grant to help build a radiotelescope out of recycled materials to capture the interest of local residents.

In Reading, younger children were introduced to relativity through story telling and puppetry in their local libraries. And, in Scotland, young people discovered how physics is essential to archaeology in an activity called "Physics Under Your Feet".

Apart from changing young people's attitudes and increasing the number and quality of physics outreach events, an important aim of Einstein Year was to build sustainable links between physicists and their communities. The Institute helped to train Einstein Year ambassadors at universities around the country and supplied them with Physics To Go packs to help them put on successful activities.

A birthday party pack was also developed and, on 14 March, hundreds of children around the country celebrated Einstein's birthday with fun, physics-based games.

"What really made a difference last year was the enthusiasm and energy of the physicists around the country who got involved – often in their own time – and took physics to their local communities," says Watson. "Without them Einstein Year wouldn't have been the success it was."

Students try to go "carbon neutral"

Four physics students will attempt to live a "carbon-neutral" existence for five days while camping outside the town hall in Cheltenham. Camp Energy: Survival of the Physicists will run during the Cheltenham Science Festival on 7–11 June.

Postgraduate students Michelle Cain and Andrea Taroni, and undergraduates Anthea Cain and Tom Whyntie, will aim to use no more energy than they can generate through solar panels, a wind turbine and a pedal-bike hooked up to a battery. Any electrical equipment they use (including a laptop they will use to keep a blog) will have to be powered in this way.

The four will consume only British produce bought locally, cook using coppiced charcoal and face daily challenges such as making a solar cooker and a hot tub. They will also encourage festival visitors to sign pledge cards on sustainable lifestyles.

Website to help new teachers

By Ayala Ochert

A website to support new teachers of physics post-16 went live in April. The site is called Teaching Advanced Physics (www.tap.iop.org) and contains advice on how to prepare lessons, as well as lots of ideas for experiments and worksheets for students on more than 150 topics.

"It is one of the largest resources of free material on advanced physics anywhere in the world," says Chris Shepherd, the Institute's teacher support manager. Ideally, newly qualified teachers should get advice and help from more senior teachers at their school. But the shortage of specialist physics teachers means that many new teachers find that they're on their own. "The site offers advice and tries to act as a substitute for a good mentor or a wise colleague," explains Shepherd.

The experiments assume access to just the most basic equipment and limited access to experienced teachers. "This is a worst-case scenario but sadly a very common one." In addition to the lesson plans and experiments, there is advice on how to teach the topics covered in the post-16 physics syllabuses of the UK and Ireland.

The resource was drawn together with the help of experienced physics teachers. It also includes substantial amounts of material from the Institute's own innovative Advancing Physics A-level as well as the Salters-Horners physics A-level.

"What we are making available is equivalent to two large textbooks of material, and we're giving it away," says Shepherd. In the future, additional features will be added to the site, including video clips and cross-references to relevant questions on past exam papers.

● After lobbying by the Institute, the Department for Education and Skills has agreed to pay teacher training institutions an extra £1000 for every physics and chemistry PGCE student. It is hoped that the extra money will act as an incentive for those institutions to actively recruit more physics and chemistry trainees.

There was more good news for the training of physics teachers last month, when the Gatsby Foundation agreed to an additional £1 million funding over the next four years for the Physics Enhancement Programme (PEP).

The project aims to recruit non-physicists, including engineers and other scientists, and gives them six months' physics training prior to starting a PGCE so that they are ready to train as physics specialists. The Institute provides support and mentoring for PEP participants throughout their training and early career.

www.tap.iop.org

IN BRIEF

● The campaign to prevent **Magnetic Resonance Imaging** (MRI) from being limited on health and safety grounds has taken an important step forward. The European Commission has agreed to set up a working group to review the controversial new European directive on MRI that specifies the limits, following pressure from the Institute and other concerned groups.

If implemented in its present form, the European Union's Physical Agents Directive would set strict limits on the time that operators of MRI equipment could spend in an electromagnetic field and could outlaw some techniques altogether. This could jeopardise medical uses – such as MRI scans for diagnosis and for monitoring patients during surgery, as well as curbing the use of MRI for research purposes – when the directive comes into force in 2008 (see May, p2).

● **Authors who write for the Institute's electronic journals** have started revealing more about themselves. The electronics journals website now features a gallery of short interviews with more than 120 authors giving brief answers to questions ranging from "What research projects are you working on at the moment?" to "If you could have dinner with any 3 people, past or present, who would they be and why?"

The section, entitled "60 seconds with...Authors Edition", follows the same format as the popular interviews with librarians on the site, with a photo and answers to set questions.

www.iop.org/ej/authors_edition

NEWSMAKERS

Sir Gareth Roberts has been appointed chairman of the Engineering and Technology Board (ETB). Roberts is president of Wolfson College, Oxford, and a former vice-chancellor of Sheffield University. He was director of research at Thorn-EMI from 1986–90 and was author of the "Roberts Report" on provision of skills in science and technology, *SET for Success*. He takes over from former chairman Sir Peter Williams on 6 June.

David Bodanis is the winner of this year's Aventis Prize for popular science writing for his book *Electric Universe: How Electricity Switched on the Modern World*. Bodanis has donated his £10 000 prize money to the family of David Kelly, the government adviser who died following public controversy over his views on the strength of intelligence about Iraq. Bodanis had made the donation, he said, because "science is all about truth, and this is one realm where a lot of people feel that truth hasn't come out". He added that he hoped his gesture would "tell some people in England something about the importance of truth".

Why school science gets energy wrong


Jon Ogborn

"The everyday meaning of energy is very close to the scientific concept of 'free energy'."

At first sight, energy is a simple enough idea to teach as part of any school science course. It is, after all, part of everyday talk ("My, you're full of energy today"); it appears in advertisements ("A bite of X gives you instant energy"); it plays a role in political argument ("What renewable energy sources do we need?"). A teacher can talk about energy without being challenged, as long as they use the word in one of these commonly understood ways.

In most current school courses, all that is added is a set of names for "forms" of energy – kinetic, potential, "heat", chemical, electrical – and the statement that energy is only changed from one form to another, and never lost.

So what's the problem? One is that "forms of energy" readily becomes an empty word game. The name of the energy form is just taken from the context, with zero added understanding. Pupils and teachers are happy, but mainly because there is no intellectual work to be done. A bigger problem is the difficulty of saying what energy actually is. Teachers and textbooks frequently say that energy is "what makes things happen", that it is "the go of things". Sensible as this sounds to pupils, it is plainly wrong. It leads one to say that energy is needed to melt ice but not that energy is needed to freeze water, although both involve the same amount of energy (but flowing in opposite directions). Also, one wants to say that a person needs energy from food to stay alive, or to say that we need fuel to warm our homes or run our cars and factories.

In these and many similar cases, the term "energy" is being recruited to deal with problems that, to be understood, require the Second Law of Thermodynamics, not simply the First Law. The everyday meaning of energy is very close to the scientific, Second Law concept of "free energy". As total entropy increases, free energy decreases. So it is correct to say that free energy is needed to make things happen. But free energy is lost, not conserved. That's why there is a world fuel crisis.

The problem ultimately is that school science is obliged to try to run before it can walk. School biology and chemistry need to use the idea of energy before its physical meaning or its measurement in terms of force multiplied by displacement can be taught. To do so, they use the everyday meaning of energy without acknowledging that this is fundamentally Second Law thinking. Of course, Second Law thinking is exactly what these subjects need, but no-one dares say so. It is pretended instead that the idea of conserved First Law energy is enough, when it rather obviously isn't.

Biological talk about energy, which often comes earliest in school teaching, presents the trickiest scientific problem. Living organisms maintain themselves in a steady state by having a continuous throughput of energy (and matter) which destroys free energy overall while increasing it locally. In that sense, living things "need energy to stay alive".

A better way to teach energy

All this means that teachers do face a big problem. "Energy", which they have to say is conserved, all too obviously does "get lost" because the examples given are really of free energy, which always decreases in any (irreversible) process. So students' commonsense understanding, although in a way exactly correct, runs counter to what they are being taught. In practice, this is resolved by letting the meaning of the term slide backwards and forwards between the two interpretations, which may be good for comfort but not for coherence.

The obvious remedy – to get the physics right first and insist on having both First and Second Law thinking – simply isn't available. To "get the physics right first" would require holding back discussion of energy in biology and chemistry until physics teaching had established the idea of work as the measure of energy transfer, shown that this never changes the total energy, and discussed thermal transfer of energy as well. That way, you couldn't teach about energy from a biological or chemical perspective much before A-level, and you would probably have put off a lot more students from science. Add a need to discuss the Second Law, and it might be argued that one had better wait until university. Nobody with any sense would advocate such a position.

So what is to be done? It could help if, as early as possible, pupils played with simple machines like levers to show that although you can magnify a force, or a displacement, you can't magnify both together. More of one means less of the other. It would be good to have less emphasis on word games involving "forms of energy" and more emphasis on where the energy comes from, where it goes, and how it gets there.

I'd also like to see more emphasis on dissipation, understood as the spreading out of energy among vast numbers of atoms or molecules. It is needed to make sense of the conservation of energy, and to understand the direction of processes.

School science should also have some simple version of Second Law thinking to hand. Ultimately what matters is differences or gradients – differences of temperature, of concentration of matter, of potential energy. The idea that (irreversible) processes always "go downhill" seems to me to be viable as a piece of teaching. It also offers a language that could be in common between all the sciences, making it much less important who does what first.

Jon Ogborn directed the Institute's Advancing Physics A-level project, and is emeritus professor of science education at the Institute of Education, London.

focal point: council news

New community-based strategy for publishing

The Council of the Institute of Physics met on 27 April 2006 and discussed the following:

- Jerry Cowhig, managing director of Institute of Physics Publishing, presented an overview the company's new strategy, outlining its aspiration to become the world's number one in its field by repeating its performance over the last five years, when it doubled output of journals while continuing to improve quality. This growth will be driven by investment in core titles, continued innovation through new journals, such as *Bioinspiration and Biomimetics* (see page 2) and further expansion of electronic publishing, which has been a key part of the success story, with downloads having increased by a factor of 200 in less than 10 years.

  The growth of community websites has been phenomenal, Council heard. For example, the news service PhysicsWeb gets 250 000 visitors a month, and the global portal Nanotechweb has become the world's leading website in the field of nanotechnology. The new strategy is to put more resources into such community websites, putting the world's scientists in each area in touch with the Institute and its journals. Council endorsed the new publishing strategy.
- Katharine Hollinshead, the Institute's diversity programme leader, gave Council an extensive overview of the issues facing the physics community in general – across education, academia and business – and in the diversity of the Institute's membership and governing bodies.

  Council welcomed the progress being made through the efforts of the diversity programme. In particular they welcomed its scientific approach and sound research principles, based on data collection and evaluation, which will lead to a more profound understanding of the fundamental issues and to effective interventions in this complex area.
- Council also considered the following items:

  – final amendments to the Institute's Charter and Bylaws;

  – the 2005 annual report and accounts and annual review of 2005, both of which will be available to all members prior to the AGM in July 2006;

  – membership subscription rates for 2007.

profile: Heather Reid

Fair outlook for science

Heather Pinnell meets a forecaster putting physics on the map.

David Wimsett/UPPA

Heather Reid communicates physics under the umbrella of the Institute.

In Scotland, physics graduate Heather Reid is instantly recognisable to many television viewers as "Heather the Weather" – the country's best known weather forecaster, who is seen nightly on the BBC's *Reporting Scotland*. But there's a lot more to Reid than simply fronting the weather forecast.

For one thing, the weather bulletin itself is just the tip of the iceberg of forecasting. At the BBC, weather presenters don't merely read a script – they're fully fledged scientists, usually employed by the Met Office and involved in the complex task of forecasting.

"The process that we use is called numerical weather prediction," says Reid. "We build a super-computer model and, using information from all over the world, we move the initial conditions forward through time. One tiny error in the initial conditions could have a massive effect, and that's what makes forecasting so challenging."

Reid and her colleagues can't simply rely on the computer model. They must also look at charts and satellite information and use their own analysis to correct the model. "The computer model tends to overdo the rain when there's a weather front coming in from the west of Scotland," Reid says.

After a degree in physics at Edinburgh University followed by an MSc in image processing, Reid joined the Met Office in 1993, initially working in satellite research. But when her talent for television presenting was spotted during a course at the Met Office College, she was asked to be a forecaster.

She wasn't always single-mindedly intent on a forecasting career. "My parents were great believers in holidaying in Scotland so weather played a part in my upbringing. But I didn't really become interested until the third year of university, through my interest in satellites."

Her enthusiasm for physics was first sparked at her school in Paisley by an inspirational teacher, and she loved the mathematical side of it. She was accepted for teacher training in physics and maths but decided not to take up the place. Yet her passion for communicating science remains and she gives frequent talks to young people and teachers, promoting physics. "My parents are both teachers so I've always had that 'sharing-knowledge bug' from them. This is a way of doing that without the shackles that teachers have."

She gave her first talk in 1995 on behalf of the Institute at the Edinburgh International Science Festival family fun day. "Very prestigious scientists were asked to be speakers and I was only about 25, so it was very daunting, but I really enjoyed it. I saw there was an opening there for getting a lot of physics across to young people. The people I met through the Institute and the science festival network became my social life and it's how I met my husband [Miles Padgett] as well."

Padgett serves on the Institute's Science Board, and Reid on the Education Board as well as Council and the committee of the Scottish Branch. She is also on the Science and Society Panel of PPARC. In 2005 the Institute presented her with the Kelvin Medal and Prize for outstanding contributions to the public understanding of physics.

Nowadays, she gives most of her talks at events for large numbers of children. "P6 and P7 [older primary school children] are a fantastic audience and they're not put off by physics and maths – they're full of questions and answers. With older teenagers you have your hands full keeping their interest, but it's all about context. Weather is a great vehicle for teaching all the sciences and maths, and it's sad that it's only associated with geography at school."

"Weather is a great vehicle for teaching all the sciences and maths."

Reid cares passionately about teaching, and is heavily involved in the Institute's annual Physics Teachers Meeting in Stirling. "Physics education is a massive problem, and we have to make teaching more attractive to physics graduates – not just financially. It's becoming synonymous with a huge amount of red tape and assessment, and we have to make an effort to free teachers up to enthuse young people, as I was enthused as a 12-year-old."

In her role on the Institute's committees she says she tries "to lend a Scottish voice to Portland Place". She explains: "Though I do work south of the border, my expertise lies in being aware of what's going on in Scottish society. I tend to do bits and pieces with almost everybody involved in physics promotion in Scotland. It's where my strength lies."

Although she's been offered television work in London, she's not been tempted to uproot. "I love Scotland and I get a lot of satisfaction from forecasting Scottish weather in detail."

OBSERVATIONS

This year's Institute of Physics Schools Lecturer, Pete Edwards, describes his journey around the country with his talk "Gravity, Gas and Stardust".

"Physics presenter needed". Little did I know back in April 2005 just how much those three words would affect my life. They formed the subject line of an e-mail inviting applications for the Institute's 2006 Schools Lecturer, and mine was accepted. Since March this year, I have driven more than 2800 miles, stayed in 15 hotels and spoken to more than 3000 children. It feels like the lecture tour is now in full swing – only another 23 dates between now and December.

In my day job as outreach officer at the Ogden Centre for Fundamental Physics I spend a lot of my time talking to schoolchildren about our universe, so I know just how much they are fascinated by the cosmos and their place in it. That made the choice of a topic to engage 14- to 16-year-olds relatively easy. My plan was to address the big questions: How and when did our universe begin? What made it look like this? How will it end? I also felt it was important that the content of the talk should have as many links to the national curriculum as possible.

It is vital to involve the audience in any show, but it's not always easy to develop hands-on activities for astronomy (it's difficult to fit a real galaxy into a lecture theatre). While researching possible demonstrations, I got help from lots of teachers and gradually my talk took shape. Many of the activities are based around the properties of light and spectra, and I began to look around for a good example of an emission spectrum from a gas.

And so it was that I found myself walking into a unit on an industrial estate in Gateshead to commission a bespoke neon sign that would shine out the word REDSHIFT. I managed to convince the owner of the company that I wasn't completely crazy by giving an impromptu seminar on Big Bang theory, together with a question-and-answer session with three intrigued members of the workforce.

One major advantage astronomy has over many other subject areas are the fantastic pictures. I spent a considerable amount of time sourcing images and movie clips from various astronomy groups around the UK. As part of their outreach programme the Institute for Computational Cosmology in Durham produce 3D movies, and it was always my intention to include some clips in the talk. Luckily, the Institute of Physics agreed to pay for 12 000 pairs of red/blue cardboard glasses to allow the audience to take a 3D fly-through of the local universe and see the results of the largest computer simulation of the universe in 3D.

Life on the road can be dreary. Another traffic jam followed by another soulless hotel. But there are advantages. Having driven around Brighton four times in the rush hour and travelled down a Cornish lane that got narrower and narrower and then simply ended, I have developed new abilities (and levels of scepticism) interpreting the instructions from my satellite navigation system.

My management skills have also been put to the test. That said, I've also had a lot of help organising my travel and financial arrangements, building kit and developing and producing animations. The local contacts at each venue who organise the parking and provide that vital cup of coffee have also helped make my visits enjoyable.

So has it been worth it? Would I apply again? Yes and yes. I am passionate about science and I enjoy trying to instill that passion in young people. It's wonderful when a show goes well and you feel the rapport with your audience. To experience the buzz as we take a virtual journey through the universe or hear a "wow" when you show a picture of a supernova remnant makes all the kit problems and traffic jams irrelevant.

Enthusing the next generation of scientists is a great way to spend a year. Next week "Gravity, Gas and Stardust" visits Ipswich. Bring it on.

If you would like to contribute to **OBSERVATIONS** please send an e-mail with your idea to interactions@iop.org.

Institute of Physics

interactions

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LETTER FROM

...the webmaster

I may be showing my age here but I remember a time when, if an organisation called you for a job interview, your first response was always: "Please send me your latest annual report". Of course those days are long gone and now we live in the age of the "information super-highway".

So, when the invitation came from the Institute of Physics to interview for the position of web editor, I wasted no time in pointing my browser at www.iop.org.

Hmm.

On leaving the home page and moving around the site I found myself distracted by the various different page designs. Was I still looking at the same organisation? Within a few clicks the navigation had defeated me.

I have to admit that I ended my first session on the site with a feeling of trepidation and the thought: "They're going to ask me what I think of the site. And I'm going to have to tell them."

Fortunately, the goal of the web redesign was to address these concerns. The realisation was that the current website, although housing comprehensive and valuable information for the physics community, did not do the Institute justice.

The website is now the global shop window of any organisation and conveys that all-important first impression. If that first impression is one of confusion, an organisation may well have lost someone with an important contribution to make.

On 1 June, the Institute will have a new website. Following rigorous consultation with members and staff, the new design gives each section a unified, yet distinctive, look and feel. The top-level navigation will stay with you as you move through the site, and you will never be more than one click away from returning to a central section.

But it's more than just a cosmetic change. In the course of the research that went into the initial stages of design, the words "identity" and "authority" came up many times. The new site will strengthen the identity of the Institute as an organisation that supports physics and physicists.

By representing the information, products and services the Institute offers to its varied audiences through one cohesive and consistent medium, it will also reinforce the authority of the Institute.

In short, the site will speak with one voice. On 1 June we hope you will enjoy a refreshing new experience of the Institute.

Adrian Laws is the Institute's webmaster. The new website will go live on 1 June 2006.
www.iop.org

Frozen photons?

Philip Ball's article "Materials that will matter" (May 2006) contains a seriously misleading claim about wafer-thin films "that can reduce the speed of light by a factor of 40". He then goes on to predict that these devices "ultimately... might bring light to a complete standstill" leading to "the storage of information in 'frozen photons'".

This is not the first time I have read such bizarre claims, and it is time to correct the completely mistaken notion that light (photons) can be slowed down, and even stopped. Photons always travel at the speed of light – the very bedrock of Special Relativity is that the speed of light is fixed for all observers. Photons always travel at 3×10^8 ms^{-1} and can never do otherwise or they cease to exist.

Light signals travelling through media other than a vacuum certainly seem to move at different speeds, but the individual photons always travel at the above speed. Lower apparent speeds in various media are due to complex processes of scattering, absorption and re-emission.

Physicists and science writers need to be more responsible and resist the allure of a catchy pseudoscientific headline.

Keith Atkin
Sheffield

Philip Ball responds: *Atkin is referring to the fact that what is altered in "slow-light" media is the group velocity, not the speed of individual photons. But, still, a light pulse entering the medium will take (in this case) 40 times longer to exit than it would if passing through a vacuum. "Frozen photons" would actually be the constituent particles of a light pulse that doesn't get anywhere because the photons are effectively bouncing back and forth at the speed of light, although they don't of course have zero velocity themselves. I tried to indicate this by using quote marks.*

Nuclear plenty

I fully agree with Jack Simmons ("Letters", May 2006). Figures from the OECD and the UN International Atomic Energy Agency indeed confirm that in 2001 the sources of economically recoverable uranium amounted to over 3 million tonnes. Given that the current rate of use is about 70 000 tonnes per year, and allowing for some reprocessing, reserves are enough to last at least 45 years with present reactors – even without breeding. The same sources put highly probable deposits at another 12 million tonnes at least.

Nuclear electricity is at least three times less dependent on fuel prices than gas-fired electricity, so higher uranium prices will have much less effect on electricity prices than the equivalent rise for a gas-fired electricity generator. A future breeder programme will increase the productive use of uranium, and the down-blending of weapons-grade uranium from spent nuclear warheads that is already taking place will add to the available enriched uranium.

Even if lower grade ores were to be widely used, because uranium has at least 20 000 times more energy intensity than a fossil fuel any increase in the use of energy in extraction will have little impact on CO_2 emissions over the nuclear cycle.

Terri Jackson
Bangor, County Down

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

notices

NEW MEMBERS

Christopher Aedy, Abbas Ahmadi, Paul Appleyard, Richard Buckley, Iain Butler, Paul Carroll, Clare Chatterjea, Rhodri Davies, Lucia Cavalieri Dunbar, Beatriz Fernandez-Dominguez, Andreas Freise, Martin Gallacher, Jimena Gorfinkiel, John Heathcote, Anthony Higgins, Benjamin Hinson, Barry Hughes, Lee Jones, Patrick Kelly, Laura Kormos, Lee Lam, Peter Morrall, Mark Nicholson, Simon Phaladi, Elizabeth Pyle, Simon Quinn, Michele Routley, Derwyn Rowlands, Andrew Russell, Abdul Solangi, Weizhong Zhao.

NEW FELLOWS

William Foulkes, Madeleine Glick, Robin Grimes, Edward Morland, Christopher Phillips, Derek Raine, Karen Russ, Philip Russell, Annette Smith, Richard Walker.

IN MEMORIAM

Edmund Bellamy, Robert Gould, David Frank Moore, Alan Norris, James Michael O'Sullivan, Chandra Sharma.

ANNOUNCEMENTS

● **Details of how chartered engineers** can join the International Register of Professional Engineers are now available in a new leaflet published by the Engineering Council UK. Those who join the register can use the title IntPE and benefits include recognition of qualifications in several countries and immediate membership of many national engineering organisations. Copies of the leaflet can be downloaded from www.engc.org.uk/documents/UKEMFIntPE.pdf or e-mail international@engc.org.uk.

● **A new comedy about physicist Richard Feynman** and his work on the Manhattan Project has opened at the Hampstead Theatre, London. It runs until 17 June. Set a month before the first atomic bomb test, the play *Clever Dick* promises "a Red under the bed, a ticking toad in the safe and a very curious young girl with her own plans" in Feynman's hotel room. For details, see www.hampsteadtheatre.com or call the box office on 020 7722 9301.

● **An electronic discussion list** for people interested and active in communicating physics to public audiences is available at http://networks.iop.org/archives/physics_comms.html. Anyone interested can join the list to let others know about useful physics communication resources, ask for advice or information, share activity ideas and keep in touch with other communicators.

MEMBER OFFER

● **Online subscription prize draw**
Vittorio Bethune from Livingston is April's prize-draw winner. He wins a 512 MB data stick. For your chance to win a data stick, pay your membership subscription online at http://members.iop.org when you receive your subscription notice.

Visit whatson.iop.org for full details of all Institute of Physics events.

JUNE 2006

Summer Lecture and AGM of the Yorkshire Branch
AGM plus lecture by Martin Lunn, curator of astronomy at the Yorkshire Museum.
Yorkshire Branch
Physics Department, York University
5 June
http://yorkshire.iop.org/iop-london/AGM2006

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
Future Inn, Plymouth
7 June
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
Novotel, Bristol
8 June
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

Annual Physics Teachers Meeting
Meeting for teachers of physics in England and Wales.
Education Department
Rugby School, Rugby, Warwickshire
8 June
http://teachingphysics.iop.org
Booking required

IOP Superconductivity Group AGM
AGM including invited speakers.
Superconductivity Group
76 Portland Place, London W1
9 June
victoria.johnson@bristol.ac.uk
Registration required

Does God Play Dice with Angles?
Talk by Prof. Miles Padgett of Glasgow University at the IOP in Scotland AGM and annual dinner.
IOP in Scotland
Heriot-Watt University, Edinburgh
9 June
http://scotland.iop.org/events.html
Booking required

Visit to the Hog's Back Brewery
Branch visit to a real-ale brewery in the village of Tongham.
South Central Branch
Tongham, Guildford, Surrey
9 June
http://scentral.iop.org
Booking required

Successful SMEs 2006
Presentations with discussion session and networking reception.
Business & Innovation Department
76 Portland Place, London W1
12 June
http://industry.iop.org
Booking required

ONE-DAY MEETING

Consultancy, Change and Innovation
Large organisations have an increasing demand for consultants to help them cope with the changing business environment. This meeting aims to help consultants tailor their offering to meet these needs.
Consultancy Group
76 Portland Place, London W1
28 June
http://conferences.iop.org/CCI
Registration required

Practical Options for a Nuclear Renaissance
A meeting on the technical options available for a nuclear power programme.
Energy Management Group
76 Portland Place, London W1
13 June
http://conferences.iop.org/nucren

Plasma Surfaces and Thin Films
One-day meeting with invited speakers.
Ion and Plasma Surfaces Interactions Group
76 Portland Place, London W1
14 June
http://conferences.iop.org/PST
Booking required

Nonlinear Dynamics of the Cardiovascular System
Talk by Dr Aneta Stefanovska of Lancaster University.
Lancashire and Cumbria Branch
Frankland Colloquium Room, Lancaster University
14 June
http://lancashire.iop.org

Energy Futures: the Hydrogen Scenario
Talk by Prof. Keith Ross of the University of Salford.
North East Branch
Room LT2, Herschel Building, University of Newcastle
14 June
http://iop.ncl.ac.uk

SCHOOLS LECTURE 2006

Gravity, Gas and Stardust
Various venues throughout England, Scotland and Wales.
June – December 2006
An interactive presentation by Dr Peter Edwards of Durham University. Aimed at 14–16-year-old students, it covers such questions as: how and when did our universe begin, how did it evolve and how will it end?
Education Department
http://teachingphysics.iop.org/events/student_events/schools_lecture

Laser Applications for Micro and Nano Engineering
Speakers and workshops from industrial users and researchers.
Optics and Photonics Division
Exitech, Oxford
14 June
courses@ailu.org.uk

Nanoscale Physics and Technology Spring Meeting
Talks, posters and AGM of the Nanoscale Physics and Technology Group.
Nanoscale Physics and Technology Group
University of Bath
16 June
www.bath.ac.uk/physics/nano.html
Booking required

Summer Visit to the Science Museum, Wroughton
Visit for branch members.
South West Branch
Science Museum, Wroughton, Wiltshire
16 June
http://sw.iop.org/Events.htm

East Anglia Branch AGM
AGM plus talk by Famelab winner Mark Lewney of the UK Patent Office.
East Anglia Branch
Conference Centre, St Edmundsbury Cathedral, Bury St Edmunds
17 June
http://anglia.iop.org/events.html

ONE-DAY MEETING

Environmental Electrostatics 2: Measurement Methods in Electrostatics
Historic methods and modern instruments used in environmental electrostatics will be discussed.
Environmental Physics Group
76 Portland Place, London W1
5 July
http://conferences.iop.org/ECW
Registration required

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
Ramada Jarvis City Hotel, Ingram Street, Glasgow
20 June
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
Jury's Inn Hotel, Jeffrey Street, Edinburgh
21 June
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

Physics Can Be Easy!
Free day conference on Key Stage 3 and 4 physics, including practical sessions.
Merseyside Branch
Chadwick Physics Building, University of Liverpool
22 June
http://merseyside.iop.org

Summer School for Physics Teachers
Residential event for teachers of physics in Scotland.
IOP in Scotland
University of Glasgow
26–30 June
http://teachingphysics.iop.org/teacher_support/inset/summerschool06.pdf
Booking required

Materials Systems for Emerging Technologies
One-day meeting with invited speakers.
Dielectrics Group
76 Portland Place, London W1
27 June
http://conferences.iop.org/MSE
Registration required

Annual Liverpool Physics Teachers Conference
Free event with activities and talks.
Merseyside Branch
Chadwick Laboratory, University of Liverpool
29 June
http://merseyside.iop.org
Registration required

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
4 Whitehall Quay, Leeds
29 June
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
Novotel, Sheffield
30 June
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

In Situ Electron Microscopy and Analysis
Meeting on present and future directions with invited speakers and poster session.
Electron Microscopy and Analysis Group
76 Portland Place, London W1
30 June
http://conferences.iop.org/ISEM
Registration required

JULY 2006

Mobile Careers Surgery
One-to-one careers advice for Institute members.
Professional Standards Department
Wales (venue to be announced)
5 & 6 July
http://careers.iop.org/Mobile-careers/mobile_careers_surgery.html
Booking required

Spectroscopy and Dynamics Across the Spectrum
A meeting on novel techniques.
Molecular Physics Group
York, UK
6 July
c.mayhew@bham.ac.uk
Registration required

Physics Update Course
Course for practising teachers of physics.
Education Department
Sheffield University
7–9 July
http://teachingphysics.iop.org/teacher_support/inset/update.html
Booking required

BEAMS 2006
16th meeting of the International Conference on High-Power Particle Beams.
Atomic Weapons Establishment/co-sponsored by Institute of Physics
St Catherine's College, Oxford
9–13 July
http://conferences.iop.org/beams2006
Booking required

CONFERENCE

Electrostatics 2007
The conference will include workshops, speakers and an exhibition. The deadline for abstracts is 15 September 2006.
Electrostatics Group
St Catherine's College, Oxford
25–29 March 2007
http://conferences.iop.org/ELE
Booking required

Carbon 2006
International conference on the science and technology of carbon materials.
British Carbon Group
Robert Gordon University, Aberdeen
16–21 July
http://www.carbon2006.org
Registration required

Nanomaterials: Small-scale Life-changers
Seminar at Euroscience Open Forum with researchers involved in cutting-edge work.
Royal Society of Chemistry/Institute of Physics Policy Department
Deutschen Museum, Munich, Germany
17 July
www.esof2006.org
Registration required

Plasma 2006
International symposium on the intrinsic Josephson effect in high-T_c superconductors.
Superconductivty Group/ESF Arrays of Quantum Dots and Josephson Junctions Programme
76 Portland Place, London W1
17–19 July
http://aqdjj.lboro.ac.uk
Registration required

SEPTEMBER 2006

Physics by the Lake
Theory of condensed matter summer school.
Theory of Condensed Matter Group
St Martin's College, Ambleside, Cumbria
3–15 September
http://www.physicsbythelake.org
Booking required

Photon06
Invited speakers, tutorials and an exhibition.
Institute of Physics/UK Consortium for Photonics and Optics
University of Manchester
4–7 September
www.photon06.org
Registration required

Quantum Physics of Nanostructures
Talks on nanoscale quantum effects in particles, quantum dots and nanowires.
Nanoscale Physics and Technology Group
Falcon Hotel, Stratford-Upon-Avon
18–20 September
http://nprl.bham.ac.uk/QPN
Registration required

CONFERENCE

BRSG: 50th Jubilee Meeting
Two-day event including a programme of invited speakers and oral presentation of some of the contributed papers.
Magnetic Resonance Group
University of Nottingham
5–6 September
http://conferences.iop.org/BRSGC
Registration required

Imaging in the Eye III: Technologies and Clinical Application
Forum for scientists and clinicians.
Optical Group
76 Portland Place, London W1
22 September
http://groups.iop.org/OP/docs/imaging_in_the_eye.pdf

OCTOBER 2006

Is it Possible to Keep the Lights On and Save the Planet?
Talk by Prof. Maxwell Irvine of Manchester University.
Lancashire and Cumbria Branch
Frankland Colloquium Room, Lancaster University
11 October
http://lancashire.iop.org/liopcal_05_06.htm

NOVEMBER 2006

Low Temperature Techniques Course
Basic techniques for newcomers to experimental research.
Low Temperature Group
Aston Business School, Birmingham
8 November
dawn.stewart@iop.org

ONE-DAY MEETING

Physical Acoustics Tutorial Day and AGM
The tutorials will cover ultrasound-phased arrays and therapeutic applications, experimental noise and artefacts, and statistical energy analysis.
Physical Acoustics Group
76 Portland Place, London W1
21 September
http://conferences.iop.org/PAT
Registration required

The life of Mars – as seen by cartoonists

Martin Ince tours an exhibition dedicated to cartoons that have mined the red planet for humour for over a century.

Richard Graham

Cartoons are probably seen by more people than any other form of visual art, and top cartoonists such as Matt in the *Daily Telegraph* and Steve Bell in the *Guardian* are as influential in their own way as big-name columnists. So it is appropriate that cartoons now have a museum of their own.

The Cartoon Museum opened this year in central London, just metres from the British Museum. Small but carefully designed and curated, it is worth a visit in its own right, but there is an added incentive to get along between now and July 1. Science – in this case space exploration – is the focus of the museum's first big special exhibition, Mars in their Eyes.

Curated by Colin and Judith Pillinger, the exhibition is notable first of all for its size. It contains 121 cartoons by 112 artists, and Colin Pillinger says that he had more than 800 cartoons to choose from for the exhibition. Of course Mars was a mythological object before science came along. As Venus has its imagined connection with love, so does Mars with war. The earliest cartoons in the exhibition relate to its "martial" connotations. One published by *Punch* in 1890 even used war and peace to explain the planet's changing colour – redder when the soldiers are at peace in their dress uniforms, yellower when they are at war and in khaki.

In more recent times, the red planet has become a familiar cartoon object because of the sheer number of attempts humans have made to send space probes there. While the high days of lunar exploration were packed into a few years in the 1960s and early 1970s, Mars probes have now been wending their way for 40 years and the numbers are still growing. Some of the missions have had huge public profiles – not least Colin Pillinger's own *Beagle 2* – and the close approach of Mars to Earth in 2003 built interest yet further.

For scientists, the fascination of Mars is that it is similar enough to the Earth – with volcanoes, polar caps and water-cut valleys – that it can teach us a lot about our own world. Cartoonists agree. They too use Mars as a tool to tell us something about ourselves. Several of the cartoons involve the same joke, in which one Martian says to another: "Do you think there is intelligent life on Earth?" Colin Pillinger says that he rejected many more with the same sentiment. In a variant, some cartoonists have humans speculating on intelligent life on Mars while being oblivious of their own race's idiocy, as shown by famine, war and other misfortunes.

Other cartoons mine Mars for topical context. The US is seen invading Mars after oil is discovered there, or *Beagle 2* is destroyed before it can send back pictures of local residents such as Osama bin Laden or Elvis. And from a bygone era, when US Viking probes were sending back images of the Martian surface, comes a 1976 *Daily Telegraph* cartoon by Garland showing the latest pictures from Britain, with millions of unemployed in a "bleak and dismal landscape".

By contrast, Martians themselves are cast by cartoonists as fun-loving types far removed from the menacing creatures of Wells' *War of the Worlds*. Some of them regard the arrival of *Beagle 2* and other space probes as the excuse for some harmless amusement. My own favourite of the whole collection is by Ronaldo Diaz. It shows Martians laughing helplessly at a NASA *Mars Rover* around which they have erected screens showing bare desert, concealing the cities beyond.

Cartoonists also regard it as obvious that enemy action is to blame for the exceptionally high failure rate of Mars probes. In one, a thuggish pair of Martians who have just bludgeoned *Beagle 2* to scrap metal are anticipating doing something similar to a *Mars Rover*, despite the difficulty of catching something on wheels.

The sizeable part of the exhibition to do with *Beagle 2* recalls the scale on which it captured the imagination of the British public. In one cartoon, *Beagle 2* is shot for the Mars equivalent of sheep-worrying as it pursues local life-forms. In another, it is yet another piece of Earth vandalism, disrupting the Mars Cup Final as it lands with a crash. The peculiar origin of *Beagle* (outside the usual funding stream for big science projects) meant that completing it involved Colin Pillinger being thrust into a media spotlight, and he appears in caricature form in more than one of the artworks on show. Despite his rural air, he enjoyed the media circus that accompanied *Beagle*'s arrival on Mars, on Christmas Day 2003.

Martians themselves are cast by cartoonists as fun-loving types, far removed from the menacing creatures of Wells' *War of the Worlds*.

Of course, Colin Pillinger uses both the exhibition and the useful catalogue to push the case for *Beagle 3* – a better version of *Beagle 2* that would, he claims, be equipped to rule on whether there is life on Mars. As he sees it, the UK is spending less than other countries on space and even the mighty US risks getting distracted by expensive manned Mars missions.

Science policy and science budgets cannot, of course, be decided by cartoon captions, but the exhibition is well worth a visit for anyone interested in our fascinating relationship with the red planet.

Martin Ince is contributing editor of the *Times Higher Education Supplement*. Mars in their Eyes is at the Cartoon Museum, 35 Little Russell Street, London WC1, until July 1 (www.cartoonmuseum.org).

particles