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Festival publicity helped change fishing policy.

Hall-Spencer, Jason

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Utafiti in Coastal Kenya

What is happiness?

Doping in sport

British Association for the Advancement of Science

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Cultural collisions

What do you do if, like Wellcome Trust medical workers in Africa, you suddenly discover that your cultural baggage is proving hard to bear for the people you are trying to help? That, in local custom, your logo of two entwined snakes foretells death? That the recipients of your therapeutic skills suspect you of giving their blood to evil spirits?

These were some of the unpleasant findings of research carried out by the Wellcome Trust in Kenya (pp10–11). Trying to get to grips with malaria and its transmission, the medical workers were unaware of the way the local people regarded them and their efforts.

In response, they developed and implemented a new approach to community engagement, which has evolved into a programme of partnership and consultation between them and the local communities. The two-way dialogue that has resulted benefits not only the local people, but also the science being carried out amongst them.

In Kenya, such engagement is encouraging. But it does not always work. This issue of *SPA* also hears about the difficulties of bringing people round a table to exchange views. Laura Potts (p19) tried to gather together people with different opinions on the role of exposure to environmental hazards in the incidence of breast cancer. The petulance she encountered – with one person even refusing to sit next to another – gives some insight into the practical problems engagement can face.

No wonder that Intergovernmental Panel on Climate Change scientists have stressed the need for future models to incorporate predictions of human behaviour, if efforts to mitigate global warming are to be effective (Shorts, p8).

The need for engagement between designers of software and computer users is spelled out in the Opinion columns. Martyn Thomas (p13) pleads for an independent review of the NHS IT programme, Connecting for Health, while Adam Laurie (p12) extols Open Source software because its community of experts examines it for bugs and security problems before it is launched.

Keith Davies (p21) wants to bring back the Haldane model of research, which would separate it as far as possible from political and administrative pressures. In his opinion, our current business model of research undermines public trust. Alan Malcolm (p20) offers a specific example: public mistrust of GM food. Will it, he wonders, scupper a new additive for ice cream?

The SPATalk (pp4–5) deals with carbon rationing. Is it a valuable way of cutting carbon emissions? Yes, believes Mayer Hillman, who argues that the only realistic and fair way ahead is by adopting an international framework based on equal per capita shares of carbon emissions across the world's population. No, retorts Claire Fox, who accuses Hillman of a 'paralysing obsession with reducing carbon emissions', and says his prescription will 'deny the gains of modernity to the under-developed world.'

Meanwhile, some good news stories. Sandra Knapp and Steve Cafferty (p17) celebrate the 300th anniversary of Linnaeus's birth by describing how his collections are about to be available online, to the particular benefit of Third-World scientists whose countries often supplied the specimens in the first place. And Jason Hall-Spencer (p24) relates how the publicity his research received at the 2005 Festival of Science has led to conservation of precious coral reefs off the UK.

Finally, Gordon Duff (p25) pays tribute to Gareth Roberts.

Wendy Barnaby, Editor
wendy.barnaby@the-ba.net

Carbon rationing: a valuable way of cutting carbon emissions?

Mayer Hillman and Claire Fox disagree

Dear ***Claire,***
The time for denial is long over. The overwhelming scientific consensus is that the Earth's atmosphere has a finite capacity to absorb greenhouse gases. In just a couple of centuries, human civilisation has burned reserves of the Sun's energy, accumulated over millions of years in the form of gas, coal and oil. The result is already serious destabilisation of the climate.

We must now all share responsibility for preventing further ecological catastrophe and the ensuing loss in the planet's habitability. A burgeoning world population and aspirations to ever higher standards of living make the search for an effective solution even more challenging.

It is wishful thinking to believe that the essential dramatic reduction in greenhouse gases can be achieved by voluntary changes in behaviour, by technological innovation, or by green taxation alone.

In the autumn of 1939, faced with the prospect of scarcity of a basic commodity, the government introduced food rationing. We are in an analogous situation now. The only realistic and fair way ahead is by adopting an international framework based on equal per capita shares of carbon emissions across the world's population. At least in principle, do you have any objections?
Yours, **Mayer**

Dear ***Mayer,***
While I commend your honesty, I disagree that climate change is an apocalyptic catastrophe that should lead to compulsory carbon rationing. No amount of hyperbole justifies such draconian austerity.

You talk of 'overwhelming scientific consensus'. It is fashionable to hide behind science to push political messages. However, while science has important things to say about climate change, it does not and cannot provide answers to how we should deal with it in society. Scientific evidence has no jurisdiction in deciding whether we cut energy consumption or ban incandescent lightbulbs.

Our disagreement is political, not scientific. It centres on how we view human progress. You express Malthusian fatalism about 'a burgeoning world population'. For me this means millions more minds to solve problems and create prosperity. You reduce the last

Bangladesh: how to cope when the water rises?

'couple of centuries' of 'human civilization' to the fact that it 'has burned reserves of the Sun's energy'.

I note that over the last two hundred years humanity has made enormous gains; from freeing millions from parochialism – hurrah for cars and cheap flights – to freeing women from drudgery – hurrah for white goods and microwaves. Don't get me started on how reducing emissions will deny the gains of modernity to the under-developed world.
Yours, **Claire**

The only realistic and fair way ahead is by adopting an international framework based on equal per capita shares of carbon emissions across the world's population

Dear ***Claire,***
You highlight 'the gains of modernity' that have come in the wake of our use of fossil fuels over the last 200 years without acknowledging the adverse consequences.

Atmospheric carbon dioxide concentrations during this period have risen in line with this use to a level that the world has not experienced for over half a million years. Citing evidence such as this can hardly be described as 'hyperbole' or as a cover to a hidden political agenda.

What matters are the practical and moral implications for current policies. I wonder whether you would have a different perspective if you were personally affected?

You dismiss my reference to the burgeoning world population as 'Malthusian fatalism'. Look at recent demographic changes before rejecting this consideration so lightly. And what is the source of your confidence in the ingenuity of 'millions more human minds' to come up with technologies that will assuredly result in reversing the process of climate change?

Do you accept that human activity is contributing to this change? If so, I ask again, do you have any objections to an equal per capita allocation of carbon emissions across the world's population to deliver the necessary reduction? Or do you have a better solution to what you so glibly reject as 'draconian austerity'?
Yours, **Mayer**

Dear ***Mayer,***
I don't deny that the huge social changes may have had some 'adverse consequences' on the planet, but overall the consequences of progress have been massively positive. Will you acknowledge the 'adverse consequences' on humanity of your paralysing obsession with reducing carbon emissions? You advocate giving up freedom at home and curtailing development in the Third World.

Historically, 'human activity' such as science and technology have allowed us to innovate precisely to deal with whatever nature throws at us. Ironically, where natural hazards do exist – like scorching temperatures and drought – people suffer not from the weather but for lack of the 'gains of modernity' such as air conditioning and mains water. Yet eco warriors have opposed building dams to provide energy and water in poorer parts of the world because they clash with environmental priorities.

As Bangladesh faces flooding, shouldn't the urgent task be to build dams, roads and dykes – as countries such as Holland do – that would allow Bangladeshis to cope with rising sea levels? Will you join me in promoting the urgent industrialisation of countries like Bangladesh to make them equal with the West, rather than merely offering the trinket of 'equal per capita carbon allocation'?
Yours, **Claire**

Dear ***Claire,***
You propose that debt-ridden countries such as Bangladesh prioritise spending the proceeds from the industrialisation of their economies to provide protection from climate changes caused by our excessive carbon emissions.

Granted you are even-handed. You preach miserabilism at home as well as abroad. You offer us... relentless personal restraint and never-ending constraints on personal freedom

But the costs of building dykes against inundation along extensive coastlines, air conditioning to keep temperatures down and drought limitation measures, would be prohibitively high. For the same reason, they could not be covered even by a substantial increase in overseas development aid set aside from our economic growth.

Moreover, you overlook the fact that a major source of the evolving catastrophe is the planet's limited capacity to safely absorb the greenhouse gases from industrialisation and growth! And what if your approach fails: where do the hundreds of millions of displaced ecological refugees go?

The truth is that we are faced with the choice of either achieving a massive reduction in our use of fossil fuels, or presiding over our own demise. Sufficient people will not contribute to this reduction to a sufficient extent and within sufficient time voluntarily. It is being increasingly recognized that the only solution is a global cap on emissions and their allocation on an equal per capita basis – the Global Commons Institute blueprint, *Contraction & Convergence*. This must be adopted urgently.
Yours, **Mayer**

Dear ***Mayer,***
Putting aside your disgraceful scaremongering about hordes of 'ecological refugees', your reply perfectly illustrates why carbon cutting orthodoxy is paralysing. You can only view the problems of the Third World through the narrow prism of global warming. However, it is not 'our excessive carbon emissions' that deprive one billion people of clean water or doom the Earth's poorest to dependence on subsistence farming. Rather, it is your man-made green fatalism that dismisses any possibility of development because 'costs... would be prohibitively high'.

Granted you are even-handed. You preach miserabilism at home as well as abroad. You started this spat comparing energy rationing today with the Second World War. At least then temporary sacrifices promised a more prosperous and free society after the war. You offer us permanent war economy: relentless personal restraint and never-ending constraints on freedom.

Whatever the scientific truth about the difficulties warming might pose to our planet, we definitely know that freedom, autonomy, reduced regulation and ambition will be necessary tools – for scientists and political activists – to deal with what faces us in the future. To abandon them – as you advocate – would be a far greater catastrophe than anything nature can throw at us.
Yours, **Claire**

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A knowledge economy with science at its core

Malcolm Wicks on engaging the public

Sparking imagination: National Science and Engineering Week

There has never been a better time to debate the central role science plays in our modern economy and society.

As new discoveries are made and new technologies emerge over the coming decades, we are going to have some huge discussions about their ethical, social and environmental implications.

The accelerating pace of change and the challenges ahead, such as climate change and an ageing population, mean that it has become increasingly vital that we talk about what the future might look like and what it might mean.

Science and technology are absolutely central to this. Science must be, and be seen to be, firmly embedded within society, and it must earn its licence to operate from society.

Informing decision making

We need to widen engagement to help inform government policy and decision making, and also build capacity for debate, reflection, understanding and appreciation of the wider benefits of science and technology to society – to create a true knowledge democracy.

The result will be a society that builds from its current pro-science stance. It will help ensure a healthy supply of the brightest and best researchers, and mean that decision makers are able to understand and respond to public aspirations, expectations and concerns around emerging science and technology.

Research has shown emphatically that the British public is not anti-science. Indeed, the very opposite is true. Over four-fifths of those surveyed by my department in 2004 agreed that science makes a good contribution to society, and 97 per cent of people agreed that it is important that our young people have a good grasp of science.

Yet, we are acutely aware of legitimate concerns over how certain areas of science and technology are governed, and over the relationship between private and public sector research.

Sciencewise

Because science needs its social licence to operate, we all need to be part of making informed decisions about how we develop and use scientific and technological advances and

how science and innovation are governed.

This is why we have developed a progressive and world-leading programme of public engagement with science that takes us far from the old and tired public understanding of science model that has held us back for too long. In January, I launched *sciencehorizons* – the first ever mass public engagement programme designed to get the nation talking about the science and technology of the future.

What is important about *sciencehorizons* is that we are inviting everyone to take part, not only the scientists, but the whole community. The aim is to spark lively debates on these important issues.

The discussions will use a specially-designed pack showing how life in 2025 could differ from today and is based on the Horizon Scans papers that map out potential future technological developments.

We want everyone to take part. Community groups, schools, families and friends up and down the country have been invited to get together in village halls, classrooms, living rooms and pubs to have their own *sciencehorizons* discussions. In fact since the launch almost 2,000 discussion packs have been requested by community groups and schools across the UK.

Research has shown emphatically that the British public is not anti-science. Indeed, the very opposite is true

Public events

Larger public events have already taken place across the country and are planned in the months ahead. For example, in April and May a panel made up of members of the public and local scientists in Bristol looked at the issues presented in *sciencehorizons* in greater depth. In June, policymakers will participate in a seminar to discuss the results and discuss how the findings can help inform policy, and the final report will be launched at the BA Festival of Science in York in September.

The results of all these activities will be used to inform policy, setting the direction of research and regulation of science and technology.

The project is part of the DTI's Sciencewise programme that helps policy makers commission and use public dialogue to inform decision making in emerging areas of science and technology.

Another major national Sciencewise project is *drugsfutures*. This will explore the issues around advances in brain science and their implications for the future of drugs. It will inform the Academy of Medical Sciences' advice to government on the future development of drug-related research and policy.

Stem cell research

I also recently announced another Sciencewise project, in the area of stem cell research.

The UK's two major public funders of stem cell research – the Biotechnology and Biological Sciences Research Council (BBSRC) and the Medical Research Council (MRC) – have been awarded a £300,000 grant to run a public dialogue programme to gain insight into public attitudes to stem cell research.

In this fast-moving and important area of science, it is essential to hear public concerns, views and attitudes, as well as to provide an opportunity for scientists to discuss with the public the challenges that researchers face and the potential benefits from this challenging field of research.

The government believes that stem cell research offers enormous potential to deliver new treatments for many devastating diseases where there is currently no effective cure. Huge numbers of people are affected by these diseases and Britain is a world leader in stem cell research.

But there must be a proper dialogue with the wider public on stem cell research because we need to raise public awareness about the potential opportunities in this area, and researchers in this critical area must be able to hear, understand and respond to public hopes and concerns. This is why this new Sciencewise project is so important.

A key element will be to raise awareness about world-class stem cell research in the UK and the progress that is being made towards potential treatments, while communicating realistic examples of its potential.

The public dialogue will start in the next few months with the recruiting of a commissioning group, followed by an official launch this autumn.

New public dialogue centre

To take the wider Sciencewise agenda further, the Chancellor announced in the Pre-Budget Report the establishment of an expert resource centre for public dialogue on science and innovation.

This will build, across government, capacity and learning regarding the value, methods and use of public dialogue in informing policy and decision making on scientific and technological issues. It will operate as a 'virtual' resource and is being developed initially through the existing Sciencewise programme.

The drive for wide engagement in science was a key aim of National Science and Engineering Week that took place in March, with thousands of events around the country and involving up to a million people, including reaching over 300 schools that had never before taken part in science week. The week is a great time to look at the work going on in schools and laboratories all around the country to see the discoveries of the future and to help spark the imagination of teachers, pupils and parents.

There is a strong desire among the scientific community to engage with the wider public on wider issues, to build trust and awareness. It is a two-way process, and this is why I welcome the Beacons for Public Engagement initiative recently launched by Research Councils UK, the higher education funding councils and the Wellcome Trust.

Ethical code

I am also grateful to the Government Chief Scientific Adviser for his leadership in taking forward the Universal Ethical Code for Scientists. The code sets down some basic practices and beliefs explicitly, and the aim is that it should be seen as a simple illustration of the scientists' promise to the community, and as a demonstration to the public that scientists take ethical issues seriously.

We must build on our pro-science culture, ensure that we earn public trust, and encourage wide engagement. In fact, we cannot afford not to. The challenges ahead are just too great for the world of science and technology to work in splendid isolation. A knowledge democracy is vital to our knowledge-based economy.

Links

www.sciencewise.org.uk

www.sciencehorizons.org.uk

www.mori.com/polls/2004/pdf/ost.pdf

Universal Ethical Code for Scientists – www.dti.gov.uk/science/science-and-society/public_engagement/code/page28029.htm

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Shorts

In brief

Experts to assess life's worth
A comprehensive study of the world's biodiversity, to include an assessment of its global economic value and the cost of losing elements of it, has been commissioned by environment ministers from the group of eight (G8) industrialised nations alongside Brazil, China, India, Mexico and South Africa. The study will be modelled on last October's Stern Report on the economics of climate change. Its publication date has not yet been finalised.

National network for stem cell research
Minister for Science and Innovation Malcolm Wicks has cut the ribbon on the new UK National Stem Cell Network (UKNSCN), a national body designed to 'improve the coordination of stem cell research and the dissemination of research results, in addition to providing a focal point for communication with overseas researchers, the media and the general public.' See www.uknscn.org.

STEM shortages will stymie business
UK businesses will soon struggle to find employees qualified in science, technology, engineering and maths (STEM) unless the government throws real weight behind the issue, according to a report from the Council for Industry and Higher Education and LogicaCMG. Their review found that although STEM graduates have increased in number since 2002, there are fewer taking STEM A-levels – the next generation of graduates. See: www.logicacmg.com/STEMreview.

Biofuels need higher standards
Environmental groups WWF, Greenpeace, the RSPB and Friends of the Earth have warned that the government proposal to push biofuels take-up – the Renewable Transport Fuel Obligation (RTFO) – could, without tighter controls, actually worsen the climate by causing more CO_2 to be emitted and by encouraging the destruction of rainforests, peatlands and wetlands in favour of biofuel crop monocultures.

Bringing the human factor into climate models

Scientists behind the climate research for the Intergovernmental Panel on Climate Change (IPCC) reports have stressed the need for future models to incorporate predictions of human behaviour if they are to steer adaptation and mitigation efforts in the most beneficial directions.

Achieving this will, however, need an unprecedented degree of international and cross-disciplinary cooperation, as well as coordinated government funding in keeping with the significance of the challenge, explained Professor Kevin Noone, Executive Director of the International Geosphere-Biosphere Programme (IGBP), to *Science and Public Affairs*.

His comments came in the wake of the second instalment of the IPCC's Fourth Assessment Report, *Climate Change 2007: Impacts, Adaptation and Vulnerability*. This predicts a bleak future for life on the planet if average temperatures rise more than 2°C. While adaptation will be required everywhere, the report explains that the poorer countries, at most risk from the effects of climate change, will have the greater need for adaptation.

Predicting effects of adaptation
The IGBP, an international network of environmental scientists, is keen that adaptation strategies should reduce rather than add to the stress on the environment. This, they say, requires new evaluation tools that can take account of human behaviour and predict the effects of various policy and economic options. 'Adaptation always involves trade-offs. The question is what level of justice and equity we want to build into how we adapt,' said Professor Noone.

Such tools would rely on input from social scientists, economists and politicians. They would integrate this input with existing environmental models to provide decision support for adaptation. 'The infrastructure to do this is there already,' Professor Noone said, referring to the example of the international Earth Systems Science Partnership,[1] of which IGBP is a member. But creating such tools still presents a research challenge and a cultural one, because of the variety of vocabularies, approaches and models across the disciplines.

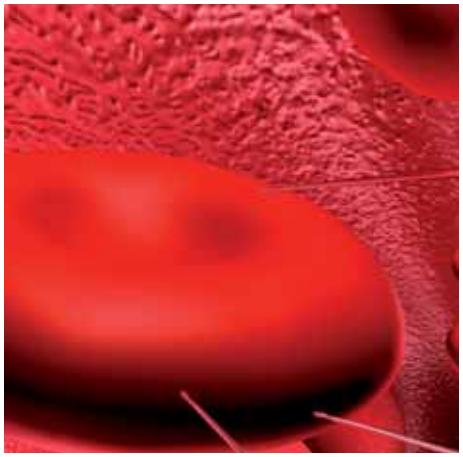
Psychological challenge
It is also important that the models take account of the real drivers of pro-social, individual human behaviour, according to Andrew Dobson, professor of politics at Keele University. Documented social science research shows that people's urge to act in the common good can be undermined by 'business as usual' fixes such as taxes and technology pushes. If it doesn't take account of such research, the model could be less successful in revealing the best route forward, he said.

More pressingly, there is also a financial challenge. 'The available funding is not sufficient, not by a long shot,' said Professor Noone. 'The problem is that [the work] does not fit neatly into funding categories. We work across disciplines and national boundaries. If we are to develop sustainable adaptation systems, we need information and knowledge that cannot be produced by any individual country or within any one discipline of research.'

1. Earth Systems Science Partnership: www.essp.org

Human behaviour: crucial in adapting to global warming

Nanotechnology risks must be examined



Medical nanobot: we need to understand the risks

A report from the Council for Science and Technology (CST), which berates the government for failing to fund sufficient research into the hazards and risks of nanotechnology, has prompted widespread approbation and a clarion call for targeted funding into safety research.

How any funding should best be directed is still up for debate, however.

Health failure

The CST's *Nanoscience and Nanotechnologies: a review of government's progress on its policy commitments*[1] congratulates the government on its support for research into nanotechnology standards and metrology, on minimising workplace and public exposure to nanomaterials, on its international nanotechnology role, and on dialogues with industry and the public. It is less impressed, however, by the progress made on research into toxicology, health and environmental effects of nanomaterials.

'Over the last five years government has spent an average of only £600,000 per year to research the toxicology, health and environmental impacts of nanomaterials. This compares with total government funding of £90 million in 2004 alone to advance research in nanoscience and nanotechnologies and promote their commercialisation,' says CST. It points the finger at an over-reliance on responsive-mode funding and calls for a strategic programme of spending directed at these research areas.

Academies' support

The Royal Society and Royal Academy of Engineering backed the report's findings. Professor Ann Dowling, chair of the academies' working group which produced the 2004 report, *Nanoscience and Nanotechnologies: Opportunities and Uncertainties*, said: 'This report reinforces the academies' serious concerns about the government's lack of progress in ensuring that these exciting technologies develop in a way that maximises their benefits while minimising any potential risks.'

She reiterated the call for targeted research funding to reduce the health and environmental uncertainties, saying this would be 'a vital step to ensuring that nanotechnologies are well regulated and inspire the confidence of the public and investors.'

Industry backing

The Nanotechnologies Industry Association (NIA) also endorsed the review, agreeing that 'more needs to be done to support the responsible advancement of nanotechnology innovation in the UK', including assessing the potential hazards. It backed calls for ring-fenced funds for lifecycle analyses and risk assessments.

Dr Steffi Friedrichs, the Director of the NIA, explained: 'The emphasis should be to conduct the right tests at the right time – *i.e.* to test those substances that are closest to commercialisation. The nanotech industries recommend that toxicologists (and funding bodies) work together with the industries and other stakeholders so that tests can be prioritised according to their commercial status. We strongly support the multi-stakeholder debate in nanotechnology.'

The issue of how to deal with toxicology research data would need to be addressed too. 'The release of research data into the public domain must be handled carefully,' explained Dr Friedrichs, adding that previous codes of conduct between toxicology labs and companies have successfully tackled the problem and that the NIA is confident it can be solved.

1. See www2.cst.gov.uk/cst/news/Files/nano_review.pdf

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In brief

Time to change career direction?

The Campaign for Science & Engineering (CaSE) has called for improvements in the quality of science and engineering careers guidance for students, based on observations published at www.sciencecampaign.org.uk/documents/2007/CaSE0704.pdf. Meanwhile, Scientists for Global Responsibility report a dramatic increase in interest in their ethical science careers work: 6000 copies of their publications were requested in the last year alone. See www.sgr.org.uk

Flying should carry health warning

The Institute for Public Policy Research (ippr) says the government should introduce cigarette-style health warnings at airports and on advertising for air travel. Presenting information such as estimates of emissions from the flight in question and comparisons of emissions for the same journey made by alternative transport would encourage more responsible behaviour, their research suggests.

Hybrids should be allowed, with care

The Science and Technology Committee has concluded that creating human-animal chimera or hybrid embryos is necessary for research but that they should not be developed beyond 14 days nor implanted in a woman. The committee criticised the Human Fertilisation and Embryology Authority for delaying its own assessments and the government for its 'prohibitive' proposals.

Science advisers to play stronger part

The government has responded to the Science and Technology Committee's report on its use of science in policy making. It has acknowledged the need to raise the profile and impact of its Departmental Chief Scientific Advisers and to further involve them and the Chairs of the Scientific Advisory Committees in departmental policy-making. It stopped short, however, of approving a Government Scientific Service.

Utafiti *in Coastal Kenya*

Bella Starling, Dorcas Kamuya, Caroline Gikonyo, Sassy Molyneux and Vicki Marsh
reveal challenges of communicating research in Coastal Kenya

Meaningful community participation has been advocated for many types of health research for some time. Forms and mechanisms are debated, but there is broad agreement on the potential for increased participation to afford greater protection, respect and empowerment to communities while facilitating research.

Nowhere is this notion more relevant than where research is needed the most – in developing countries. They bear the highest burden of disease. It is also in developing countries that the contrasts in cultural and social norms and technological know-how between researchers and research participants are often the greatest.

But are citizen voices present or heard when developing and carrying out research in such settings?

Villagers gathering for a community meeting *The Kalifi team*

Wellcome Trust research in Kenya

The KEMRI (Kenya Medical Research Institute)/Wellcome Trust Research Programme is based just north of Mombasa, in Kilifi District.[1] With a popular tourist coastline set on the Indian Ocean, the district contains the poorest constituency in Kenya. It has a high malaria burden, particularly in children: 35 per cent of admissions to Kilifi District Hospital's paediatric ward are due to malaria, and resistance to malaria drugs is a real problem. Bacterial and viral infections are also devastating.

Going back as far as 1949, the Programme has explored health concerns fundamental to the District. The centre has now developed a strong international reputation for its wide-ranging interdisciplinary research covering clinical, basic science, epidemiological and public heath aspects of major childhood and adult disease. Each year, thousands of local people give their consent verbally or in writing to take part in the Programme's research. Over 4,000 parents consent for their children to be involved in clinical studies – both observational and interventional – every year.

Throughout, research has always been conducted to the highest international ethical standards. All research, including informed consent processes, is reviewed and approved in advance by local, national and often international scientific and ethical review boards. Community engagement has been paramount: research teams have routinely consulted local administrative leaders in advance of all community-based research; and information is disseminated through these leaders, 'barazas' (public meetings) and print materials.

Why do the doctors need to take so much blood? Are they mixing and selling it? Or giving it to evil people or spirits?

Community perceptions

Given the widely acknowledged gap in understanding of research between scientists and the communities who often participate in research, researchers in Kilifi set out in 2001 to explore community perceptions of research.

They found that most people were joining studies for their immediate individual benefits, and without a good understanding of the research elements of activities. Inter-related reasons included a therapeutic misconception of research, the difficulty even research staff had in distinguishing between research and treatment for some types of studies, and the resource constraints faced by households and the public health system.

An underlying challenge is that in Kigiriama and Kiswahili – the local languages – there are no equivalent, widely understood, terms for Western concepts of 'research'. Terms such as 'utafiti' and 'uchunguzi' were, rather, synonymous with 'investigation' or 'test' for clinical treatment.

Local concerns

Low understanding of research is common all over the world, indicating the challenges of achieving ethical ideals in any setting. In Kilifi this low understanding – and the resource differences between the research centre and general community – led some community members to request a level of health service provision well beyond the standard remit of research teams, and others to fill the gaps in information and understanding with their own explanations for routine activities.

In filling the gaps, community members drew on fragments of folk lore, religion and traditional beliefs. Rumours became common currency, often exchanged with humour as well as concern: Why do the doctors need to take so much blood? What are they doing with it? Are they mixing it and selling it? Or

giving it to evil people or spirits? Interestingly, very similar rumours and concerns have been reported around medical research activities from different settings in Africa, including some thousands of miles away.

The Wellcome Trust logo, shown on the Programme's vehicles, depicted two intertwined snakes. Snakes are a well-recognised symbol for devil worshipping in Kenya, and this logo was of particular concern in an area in which two intertwined snakes were reported to foretell a death in the family. People also questioned the Programme's institutional policies, asking, 'Why can't more of us be employed there?' and challenged the composition of previously established community advisory boards, set up through community leaders.

It seemed that, despite the team's best efforts and a generally positive view of the Programme, misunderstandings and concerns about its work persisted.

Community representation

In response, the Programme has begun to develop and implement a new approach to community engagement, based on action research and participatory processes.[2]

Researchers began by seeking community views on engagement strategies. Workshops involving community representatives, the District Health Management team, researchers from the Programme and an external group of ethicists, policy experts and communication advisors, drafted a communication strategy for the Programme, including community engagement. The priority area for increased communication in Kilifi was the population living around the District General Hospital, around 240,000 in number, who account for most of the hospital admissions, as well as research participants.

The thorny issues of defining the 'community', ensuring fair, balanced and accurate representation, and avoiding over-politicisation and tokenism are well described in the literature on community engagement in medical research, drawing particularly on experience from HIV/AIDS research. In Kilifi a particular dual challenge was a clear need for greater community participation in research, and no obvious existing channels to achieve this. In response, research staff are developing a novel strategy for community representation through the widespread community-based organisations (CBO) in the district.

CBOs cover a wide variety of constituencies within the community, ranging in size from small to large, and representing women, men and young people through activities such as income generation, sport, drama, music, health and farming.

Through surveying registered and unregistered CBOs in a pilot area (population around 98,000), membership in CBOs was confirmed to be high: one active CBO member to every 11 people in the population. CBOs were asked to nominate their own representatives for a new network of 140 KEMRI community representatives (KCRs) across all the areas involved in research. Nominees were endorsed as representatives at public meetings that included outreach activities such as local drama and song. An estimated 6,000 local people attended these meetings.

Researchers are now asked to specify at the outset who their communities are and how they will engage with those communities at different stages of the research project

Representatives' role

The elected KCRs undertake to strengthen communication between KEMRI and the community through regular and *ad hoc* feedback meetings with KEMRI community liaison staff, and through informally passing on information about KEMRI's activities during their normal daily activities as household, community and CBO members. In this way, they provide an additional interface for information exchange, a platform for the development of greater mutual understanding between researchers and the community, and maintain the visibility and contribution of modest communities.

Apart from communication roles, KCRs have also influenced institutional policy. Researchers are now asked to specify at the outset who their communities are and how they will engage with those communities at different stages of the research project. For unusual or particularly large studies, study-specific community engagement strategies are developed and supported through local review processes and a team of community facilitators working with KCRs and other community representatives on the ground.

The training of all staff who interact directly with community members has begun to be coordinated across the programme and strengthened by the inclusion of teaching on research concepts, participants' rights and communication.

Numerous community members have been invited into the research centre for open days, including tours and question-and-answer sessions, and now even all non-scientific jobs at the Programme are widely advertised at the local level.

Programme vehicles carry only the name, and not the logo, of the Wellcome Trust. Most importantly, the way in which the Ministry of Health and KEMRI interact locally is being re-considered, and there are far more forums for open dialogue between research staff and community members at all levels.

Partnership

What started as a small-scale communication process has evolved into a programme of partnership and consultation between researchers and Kilifi communities.

The journey has just begun, and evaluation of the community engagement strategy continues. The hope is that meaningful community engagement is strengthening the protection, respect and empowerment of the communities to whom the KEMRI/Wellcome Programme owes so much. The two-way dialogue that has grown benefits not only Kilifi people but also the science being carried out amongst them.

Evaluations over time aim to assess the effectiveness and sustainability of these strategies, provide information that can be generalised to similar research settings, and contribute to debates on the universality of ethical principles for research.

1. www.wellcome.ac.uk/assets/wtx022250.pdf

2. V Marsh, D Kamuya, C Gikonyo, Y Rowa, S Molyneux, (2007). Beginning community engagement at a busy biomedical research programme: experiences from KEMRI CGMRC-Wellcome Trust Research Programme, Kilifi. Submitted for a forthcoming *Social Science & Medicine* Special Issue.

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Effective software needs engagement

Adam Laurie celebrates Open Source

Open source: engagement benefits the users

Earlier this year, I had the honour of being invited to give evidence to the House of Lords Science and Technology Select Committee on personal internet security.[1]

I was speaking for the Open Source community alongside Alan Cox, who helped develop the programme that constitutes the central core of the Linux computer operating system. We were opposite Microsoft who were representing commercial software in general and themselves in particular.

It was a fascinating experience, and a great opportunity for a layman to see a small part of the inner workings of government and to hear what kind of issues get their attention.

Little consultation

The most meaningful discussion came at the end when Alan and I started to describe the kind of attacks that could be applied by the technically proficient against the unwitting consumer, if the technology they were provided with didn't adequately protect itself. It was all very 'James Bond', talking about fooling electronic fingerprint readers and the like, but it elicited a very meaningful response from Lord O'Neill of Clackmannan, who said: 'You guys are great at telling us what is wrong but you never give us any solutions because it seems that one of your other colleagues is trying to work out how to rip off the next generation. I am not associating you with them but people in your line of country. What do we do then, just give up?'

Whilst I can sympathise with his viewpoint, it is, in my opinion, a question of engagement, and I think this exchange is a good illustration of that whole issue.

There is a huge community of Open Source security experts out there, able and willing not only to look at security problems that already exist or may be found in new products, but also to advise and help design protocols and systems that solve these kinds of problems before they hit the streets. They bring with them a wealth of experience working in probably the most hostile environment known to man: the internet, where pretty much every security problem one could possibly think of has already been tested or theorised, and valuable lessons learned on how (and how not) to do things.

However, this group is rarely consulted in the early stages of consumer or government projects, and only tend to get involved after the fact when they take it upon themselves to do so, often by pointing out serious issues, to the discomfiture of the affected parties.

Commercial world lags behind

This engagement usually takes the form of 'Full Disclosure', in which the manufacturer or vendor is privately informed of the issue and given time to produce a fix before it is made completely public. Interestingly, Lord Mitchell assumed that Microsoft were ahead of this game. As someone who has lived through the evolution of the internet and witnessed first hand Microsoft's gradual engagement with the wider community, it is fairly amusing to see them being hailed as the leaders in this field, when they are, in internet timeline terms, very much 'the new kids on the block'.

It's worth remembering that it was fully five years after the internet became a practical reality that Microsoft finally caved in and added the internet standard networking protocol (TCP/IP) to its default stack in Windows 95. It wasn't until the Windows Millennium Edition release in 2000 that they included automatic updates, two years after the Open Source community provided them for Linux.

They are currently promoting 'Responsible Disclosure' (their version of 'Full Disclosure') as a means of engaging with the Open Source security research community, but again, they are many years behind, as this has been standard practice in the Open Source community itself for over 10 years. However, this is not to say that Microsoft aren't trying, and I don't want to come across as particularly anti-Microsoft.

Consumers benefit

The Lords Committee is expected to publish its report this summer, and one of the things I hope will come out of it is the realisation that the commercial world does not always have all the answers (and even when it does, they may have simply adopted what for the rest of us has been commonplace for some time).

Open Source has a lot to offer. At the end of the day, Open Source software only exists because it does what it sets out to do, does it well, and does it primarily for the benefit of its user base which is, increasingly, all of us – the consumers.

1. See http://tinyurl.com/2jyhbq

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Connecting for health?

Martyn Thomas calls for a review of the NHS IT programme

Connecting for Health, the NHS National Programme for IT (NPfIT), is meant to 'deliver better, safer care to patients'.[1] However, it is showing many of the symptoms displayed by large IT projects that have failed in the past.

Twenty-three of us, all professors of computing and systems at UK universities, have called for a review. We have a wide range of IT experience, and have studied many failed projects, as well as many that succeeded. Our professional opinion is that a constructive, independent review is urgently needed, to ensure that the risks to NPfIT are properly recognised and managed.

We are not asking to carry out the review ourselves: we simply believe that professionals should speak out when necessary in the public interest.

Source of most problems

Most IT project disasters stem from problems with requirements or specifications, usually because the future users of the system have not been involved enough. Either the requirements keep changing, or they are a focus of conflict – for example, if the users of the system do not want to adopt new work practices the system will impose. When a project's requirements keep on changing, the project will be delayed, costs will rise and things may get out of control.

Desperate attempts to contain costs and to keep to milestones reduce flexibility and lead to other compromises, as suppliers interpret their contracts ever more strictly. When milestones slip, the slips typically get concealed by re-interpreting the specification or the milestones, as people often prefer to postpone the day of judgment.

Sometimes, real technical problems arise. It often turns out that the designers had simplistic fault assumptions: the dependability criteria turn out to be wrong, or missed, or both. Even when a working system is introduced, if the specification does not fit the real needs, users may create so many work-arounds that the project's goals are undermined.

Problems specific to NPfIT

In the case of NPfIT, there are many reports of changing specifications, delays, cost escalation, dependability problems, and significant technical issues. We have made some of these reports available to a general readership.[2]

NHS IT programme: making medicine safer?

The Department of Health has acknowledged that the specifications (which date from 2002 and 2003) are now obsolete; as Connecting for Health learned more about users' real requirements, the specification has evolved significantly. It has become clear that the system will require the clinical professions to work differently. We have heard many clinicians criticise the proposals as impractical, or complain of a lack of information about the system's current goals.

Costs now appear much higher than anticipated, and Accenture has already left the project. There is sharp technical debate about whether the proposed data standards are fit for purpose. Some early implementations have been criticised sharply on their usability and dependability.

We cannot be certain how serious the underlying problems in the project might be, but our experience suggests that the symptoms may well be the early signs of a failing project.

Action for review

We sent an open letter to the Health Committee of the House of Commons in April last year, expressing these concerns. This led to many people contacting us with specific issues: from clinicians to health service managers to experts in computer companies.

We discussed our concerns with Dr Richard Granger, Chief Executive for Connecting for Health, and the NPfIT management team, who agreed that an independent review could be useful. Dr Granger asked us for draft terms of reference for an independent review; we responded nine months ago but Health Minister Lord Hunt has now ruled such a review out. Two of us met the new NHS Chief Executive in January this year, but he too said a review was unnecessary. Yet every month that passes provides further reports that sharpen our concerns.

There are two possible ways of viewing NPfIT. The optimistic view is that the specification is now stabilising into something that can be built, and that will deliver benefits to the NHS. The pessimistic view is that things have run out of control and that, even if the planned systems are delivered, they will not be worth the costs, or the delays.

We hope that the optimistic analysis is correct, in which case an independent review can help by improving communications and building stakeholder confidence. We fear that the pessimistic analysis may be correct, in which case an independent and constructive technical review can provide evidence and recommendations to help the NHS to recover. Either way, our expert and impartial opinion is that there should be a review.

1. See the programme's website, www.connectingforhealth.nhs.uk/. *SPA* asked Connecting for Health to defend the programme, but they were unable to deliver a piece.
2. See www.nhs-it.info

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What is happiness?

Rita Carter, Richard Schoch and Sebastian Saville have different recipes

Take control of your brain

Conquer superstition, urges Rita Carter

Happiness is a state of mind – an experience. And experience is a physical phenomenon.

Perceptions, moods, thoughts and sensations do not exist in some mysterious spiritual dimension; they are bodily functions, some of which we can now describe in quite precise chemical and anatomical terms. Change your brain and you have changed your mind.

I propose that we do just that: use our burgeoning knowledge about the brain, along with the ingenious technology we are developing, to produce happiness directly.

Beyond chemicals

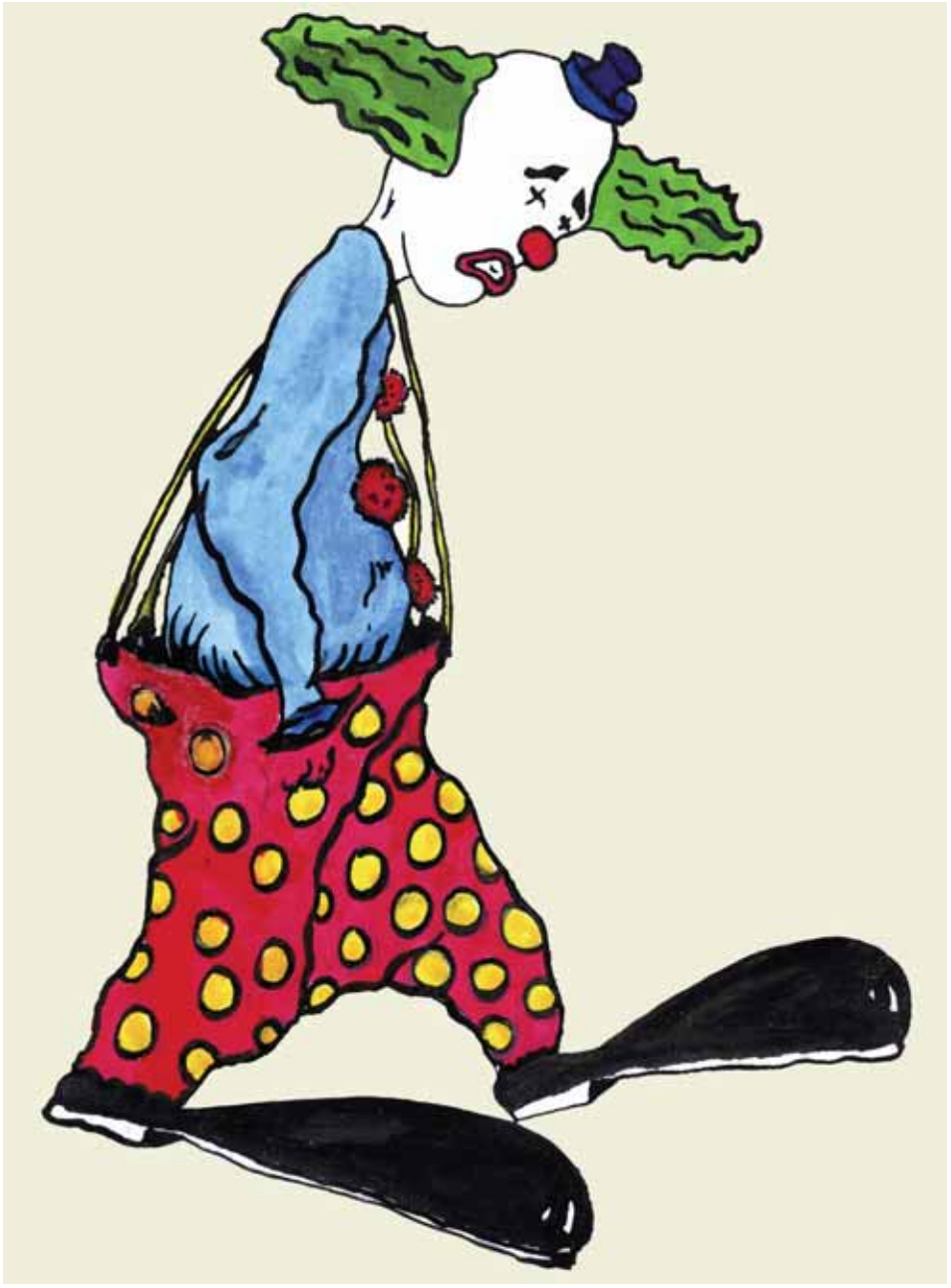
There is no question that this can be done. Mind-altering chemicals have always been used on a massive scale and in the last couple of decades millions of people have been lifted out of misery by antidepressants. They work.

Yet people hate to admit this. Those that have benefited from drugs like Prozac tend to explain the change in them by saying things like: 'I decided to get out more', or 'I started counting my blessings', or 'I fell in love'. They offer these as causes of their transformation, without acknowledging that they would not have happened without the drug.

Altering brain function

It is true that all drugs have a downside – altering brain function by putting a chemical through the bloodstream is bound to produce side-effects and hit and miss results. Happily, though, our increasing knowledge of brain function is allowing us to use much cleaner and more precise technology. Brain implants, for example, are already showing positive results in people with severe depression.

I am not suggesting that every unhappy person should have a device put in their brain. The principle, though – altering the electrical function of the brain directly, rather than via chemicals – can be used also in non-invasive techniques. Transcranial Magnetic Stimulation, for example, involves merely waving a magnetic wand over the skull.



Happiness: how to find it? *James Nunn*

It may sound like magic, but the evidence suggests that it works.

Let's meddle

Eventually, I believe we will use techniques like this to transform ourselves from the inside out. But I fear it will be a long time coming, because this approach is bedeviled by a kind of 'yuk' factor. We don't want to believe in blatantly physical remedies for our discontents because we don't like to acknowledge that we are entirely physical entities. Some ancient superstitious part of our brains insists that human consciousness is in some way 'spirit stuff' which is God-given and therefore not ours to meddle with. To do so is hubris.

This, I believe, is what really stands between us and happiness – superstition. It is time we got rid of it, and took control of our own brains.

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Being good, not feeling good

Happiness needs effort, argues Richard Schoch

We've lost the ability to understand the essentially moral nature of happiness.

We've settled for mere enjoyment of pleasure, mere avoidance of pain. Somewhere between Plato and Prozac, happiness stopped being a lofty achievement and became an entitlement.

More than two thousand years ago, when the ancient Greeks first thought about what 'the good life' means, happiness was a civic virtue that demanded a lifetime's cultivation. Now, it's everybody's birthright: swallow a pill, get happy; do yoga, find your bliss; hire a life coach, regain your self-esteem.

But it doesn't have to be that way. We can enrich our lives by encountering the great religious and philosophical traditions of happiness – and then put them to work in our lives today.

In the right place

Those traditions insist that we do not have to become someone else to be happy.

In a way, that's trivial: how can we be other than who we are? But what's far from trivial is the belief that to find happiness we must turn our backs on everything that is familiar, forge a new life, perform extraordinary acts, or exchange a dismal present for a fantastic future. Such efforts are wasteful because they squander the opportunity that is always before us: to become not someone else (that's the perverted goal of the 'makeover') but a better version of the person we already are.

Whoever we are, in whatever circumstances we face – and for nearly all of us, they will be ordinary ones – the possibility of happiness always surrounds us. We are always in the right place, though we do our best to forget it.

Hard work

The sages and the saints also tell us something that we're reluctant to hear: happiness is hard work. True happiness is the orientation of your life towards meaning, purpose, and value. It's a reflection upon the quality, the character, of your life as a whole. Happiness isn't about feeling good – it's about being good.

That's what Aristotle meant when he called happiness an activity – because it requires skill and focus. Far from being a state of passive enjoyment, like relaxing in a bubble bath, or eating a box of chocolates, happiness demands effort.

The Roman emperor Marcus Aurelius said that happiness feels more like wrestling than dancing, because being happy means 'standing prepared and unshaken to meet whatever comes'. Happiness, then, is something that we resolve to achieve, and to strive for it means that we regard our life as a journey in which we move purposefully toward that ultimate goal.

How do we get to happiness? It's like that joke about the tourist in Manhattan who, realizing that he's lost, asks a passerby, 'How do you get to Carnegie Hall?' The answer: 'Practise!'

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The good, the bad and the ugly

Sebastian Saville reflects on drugs and happiness

The idea of happiness, what constitutes it and how it may be achieved, changes with time and place.

Human beings have, throughout history, in each time, place, and culture, used drugs of various kinds to modify, extend and intensify happiness. We humans have evolved in partnership, in symbiotic relationship, with a whole multitude of mood- and mind-altering chemicals. We are not the only animals to engage in these practices, but it seems there is something specifically human which leads us to use drugs and to develop social patterns, stories, myths and explanations of such uses: to generate drug cultures.

Good drugs

There is a range of contemporary drug taking that is socially accepted, and sometimes positively encouraged.

We regard it as a civilized thing to enjoy a convivial glass of wine at table; and indeed alcohol oils the wheels of most social gatherings. Beyond this, if we are feeling low, we visit our doctor, who is likely to prescribe an antidepressant for a while to pick us up; or, if we are too 'up' already, a tranquillizer to bring us down. Drug companies are labouring continually over a spectrum of new products to make us more intelligent, awake, potent, competitive and happy, and our governments and corporations approve. Huge sums are spent on pushing these new products. These are the good drugs.

Bad drugs

The bad drugs are obvious; we hear about them often.

Addiction to heroin, dependence on cocaine; now perhaps even the return of *Reefer Madness*. The illegal drugs, those from which our governments must protect us, even those of us who do not wish to be protected. The lines seem clear cut, and we are told that they are. No happiness here.

Yet substances regularly cross the boundary. A hundred years ago, opium was to be found in almost every home: God's Own Medicine. Curing everything from headache to toothache to insanity; the idea that it could be made illegal was unthinkable. Tobacco, meanwhile, appears to be making the reverse journey, from a must-have accessory for those who aspire to beauty, modernity and coolness, to a loser's habit.

The dividing line is not a natural part of the world, but a line we ourselves draw. It changes over time and place, and can be redrawn.

Ugliness

The ugly is the outsider's world: the world into which one is cast when one transgresses the boundaries of the good. It is largely the product of our own policy: the 'war on drugs'.

Drugs and their use have always been, and are likely to remain, a part of the equation of human happiness. The sooner we recognize this, the less needless unhappiness we will generate.

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Doping in sport

Phil Willis looks towards the London Olympics

Sport matters to people, and any scandal associated with British sportsmen or women resonates way beyond the immediate sporting world. An athlete caught enhancing his or her performance by illegal doping methods can be a matter of national humiliation.

With this in mind, the Science and Technology Committee set out to 'horizon scan' what may be the human enhancement technologies (HETs) of the next decade, and to examine the UK's arrangements for countering doping in the run up to and during the 2012 Olympics.[1]

Not in the starting blocks

So, which illegal HETs could threaten the integrity of the 2012 Olympics? As the body directly responsible for anti-doping in the UK, we expected UK Sport to have a good knowledge of these and to be involved in the development of methods to test for them. However, this was not the case. We were concerned to find that in response to our call for evidence to this inquiry, UK Sport had to consult a number of leading experts to identify this information and that it does not 'horizon scan' on a regular basis.

A number of witnesses in our inquiry were more informed. For example, we heard that pharmaceuticals of interest in the sporting world may include stimulants which act on the central nervous or cardiovascular systems, perhaps in raising aggression, confidence, or alertness.

Illegal methods

A well-known example of a modern designer drug is Tetrahydrogestronone (THG), an anabolic steroid modified to make it undetectable under normal drug testing. THG was discovered following a major investigation in 2003 which resulted in the British 100-metre sprinter Dwain Chambers, amongst others, receiving a two-year ban.

Hormones may also pose a threat to fair play during the 2012 Olympics. Examples include Human Growth Hormone which can aid recovery from injury, promote strength and burn fat; or glycoprotein hormone erythropoietin (EPO) which regulates red blood cell production and hence the oxygen-carrying capacity of the blood.

Blood doping is also thought to be something the testing authorities will need to be vigilant for in 2012. This is the practice of boosting the number of red blood cells in the circulation, usually intravenously, in order to enhance performance in endurance events.

More needs to be done if the UK is to play clean

Gene doping, or the modulation of an athlete's genetic material, is another area of concern. Genes of interest to the sporting world could include those involved in increasing production of naturally occurring substances such as Insulin-like Growth Factor-1 which stimulates muscle growth and speeds healing and repair. Other techniques could effectively switch genes on and off as required.

Recommendations

As a Committee, we feel more needs to be done if the UK is to play clean. Science should be used to develop more sophisticated detection techniques, including testing blood samples as well as urine. We also want it to be mandatory for UK athletes to compete internationally in the 12 months prior to the games before they are eligible to take part, as this would make it easier to detect unusual increases in an athlete's performance.

A separate body needs to be established to undertake drug testing of athletes in this country, independent of UK Sport and the national governing bodies of individual sports. This should also be responsible for monitoring and evaluating potential new substances and methods as they are developed.

The Committee also supports the idea of a pilot project looking at the feasibility of a doping passport. This would be used to record an athlete's physiological profile over set time points during their career. A four-year ban should be imposed in all incidences where doping has been proven, and there should be a mechanism whereby cheating athletes would have to repay all financial gains going back to their last clean test.

Athletes should also have to disclose sources of doping before they are allowed to return to competitive sport, and we would even urge the government to look at the experience of those countries which have criminalised doping in sport.

Legal techniques

Our inquiry also looked at legal enhancement techniques like nutrition and improving our understanding of the mechanics of movement – methods which can only enhance the health of the competitor. But the temptation to act illegally will always be there.

It would be a sad moment for sport in the UK if the 2012 Olympic Games were remembered as a major sporting event in which illegal doping detracted from its success. We believe that if the government and sporting bodies concerned act on our recommendations, this can be avoided.

1. *See Human Enhancement Technologies in Sport*, www.publications.parliament.uk/pa/cm200607/cmselect/cmsctech/67/67.pdf

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Linnaeus's collections go online

Sandra Knapp and Steve Cafferty celebrate

The Swedish botanist Carl Linnaeus was born 300 years ago this year. The Linnean Society of London holds 14,300 specimens of plants he collected or received from friends and colleagues, and other collections of insects, animals and letters. As part of the celebrations of the Tercentenary of his birth, the Society has embarked on a large-scale programme to create a digital archive of all of these important specimens.

These collections are never lent outside London, and the digitisation will help scientists all over the world. The high quality images for the first elements of the project will be available through the Linnean Society's website from the end of 2007.

Linnaeus's system

The science of taxonomy is that of describing and documenting the natural world, and of discovering the relationships between different kinds of plants and animals. Today, many different sorts of data, from physical characteristics, to behaviour, to gene sequences, are being used to describe and study the identity and evolutionary relationships of organisms.

In order to maintain a standard set of names and usage, taxonomists use a system established by Linnaeus in the mid-eighteenth century, and modified and improved since. Linnaeus 'invented' the two-word scientific names we still use today for living things – *Homo sapiens* (our own scientific name), *Solanum tuberosum* (the potato) and *Drosophila melanogaster* (the fruit fly) are all names that use Linnaeus's binomial naming convention.

Research obstacles

Linnaeus and subsequent taxonomists used specimens to show how names applied to actual plants and animals. Later generations of taxonomists established rules for naming (today the Codes of Nomenclature), among which is included the concept of a type specimen. A bit like the gold standard, the type is 'the' specimen designated by the person describing a new species. Other specimens are used to show variability, but the type is a fixed point to which a name is tied.

Types are very important for decisions about the identity of organisms, and are critical for those who are describing and documenting diversity. Type specimens are carefully looked after by herbaria and museums, and are sometimes lent to scientists working in other parts of the world. Some, however, are very fragile, or too historically precious to be lent, and scientists need to come to the institution where they are held to examine them. This can be prohibitively expensive, and occasionally impossible due to travel restrictions, especially for scientists from the developing world. Most of the world's diversity lies in the developing world, while most type specimens are held in the developed world. Enter technology to the rescue!

Widening access

In recent years British institutions that hold plant collections (including the Natural History Museum, the Royal Botanical Gardens, Kew and the Royal Botanic Garden Edinburgh) have prioritized access for colleagues not only in the developing world, but also to the general public. The historically important plant specimens held by the Linnean Society (often among the oldest type specimens for widespread species) are uniquely important for science and access to them is of global interest.

An image of the type specimen will often enable a scientist to make a decision as easily as the real thing; digital imaging is revolutionizing access to scientifically important primary data. Plant specimens – as essentially 2D objects – are particularly well-suited to imaging, and if the image is high enough quality, even tiny features can be seen.

Conserving biodiversity

It may seem that the digitization of such specimens is an esoteric exercise, useful only to a few academics. These digital images, however, will be important in many ways. Conservation of biodiversity, one of the great modern challenges, depends partly on the ability to accurately identify and name species of plants and animals. Universal access to the images of type specimens will help us to stabilise naming, and to better communicate about threats.

The Global Strategy for Plant Conservation (GSPC) has as one of its targets a widely accessible working list of all known plant species. Digital access to those important specimens tied to names will help pull the botanical community together to achieve this goal.

A specimen of *Protea lepidocarpodendron* – the black-bearded sugarbush – from Linnaeus's herbarium. Linnaeus named the genus *Protea* in honour of the god Proteus, who could change his form at will, because the plants had such varied and different flowers *Acknowledgement: Linnean Society of London*

Linnaean specimens are particularly important for conservation. Many of those species described by Linnaeus are today our most invasive weeds. Accurate identification will help identify new areas of spread of invasive species, one of the five greatest threats to biodiversity identified by the Millennium Ecosystem Assessment (MA). Digitization to improve access is important not only for these scientific and conservation goals, but also brings the treasures held in our great collections to a wider public, as part of a cultural and scientific heritage we all share.

Links

The Linnean Society of London (www.linnean.org)

Global Strategy for Plant Conservation (www.plants2010.org)

Millennium Ecosystem Assessment (www.maweb.org)

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New help for women in SET

Industry targeted, reports Roger Livesey

March 2007 saw the launch of the CEO (Chief Executive Officer) Charter for Women in SET, backed up by the UKRC (UK Resource Centre for Women in SET) Quality Mark. The Charter applies to industry the approach pioneered in the 2005 UKRC Athena SWAN Charter, which is accompanied by a system of SWAN awards.

The aim of the UKRC CEO Charter is to increase the participation, at all levels, of women in SET, to develop and communicate the business case for gender equality and to promote change within major companies and networks.

The CEO Charter and the Quality Mark were launched by Minister for Science and Innovation, Malcolm Wicks, at the UKRC annual conference in March this year.

At the time of writing, the UKRC CEO Charter had been signed by the CEOs of two major companies, thus committing themselves and their senior managements to actively support this aim. One UKRC Quality Mark had been awarded – to Freescale Semiconductor, which has a major semiconductor manufacturing operation in East Kilbride. The company impressed the UKRC sufficiently to be awarded the mark at 'silver' level (assessment is an ongoing process and a company might be expected to start at the lowest level, 'bronze', and proceed through 'silver' to 'gold').

Commenting on the award of a silver quality mark, the UKRC final assessor Dr Clare Wilson, Employer Liaison Coordinator, said: 'This was an excellent performance, especially considering the relatively short time Freescale has been working in the area. However, it built on excellent work on other aspects of equality with very good existing approaches in a wide area, for example its approach to flexible working.'

The two major companies which had signed the CEO Charter were Atkins and BT Openreach. More are in the process of signing.

Businesses of any size are eligible to apply to sign the CEO Charter.

SWAN Charter

Membership of the Athena SWAN Charter, which has been administered by the Royal Society, is open to all UK universities, university departments and research institutes which are committed to working towards the achievement of the aims of the Athena Project: 'the advancement and promotion of the careers of women in science, engineering and technology in higher education and research, and to achieve a significant increase in the number of women recruited to top posts.'

Skilled workers are good for business

So far, 25 members have signed up to the Athena SWAN charter and 16 SWAN awards have been made – 11 bronze and five silver. Some case studies can be found on the Athena website.[1]

Details of the CEO Charter and UKRC Quality Mark can be found on the UKRC website.[2]

To date, the UKRC has provided sole funding for the Athena SWAN charter; but in the future the UKRC and the ECU will be providing joint funding.

1. www.royalsoc.ac.uk/athenaswan/awardwinners.htm
2. www.setwomenresource.org.uk/en/advice_services/employers/

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Rachel Morfill works flexibly

A Chartered Electrical Engineer and Data Analysis Manager at National Grid, Rachel joined 14 years ago as a graduate – one of three women among 16 men.

The changes since then have contributed to her staying at National Grid. 'It's when you have a child you find that working 9 to 5 and staying late isn't always the right option,' she says.

Rachel believes it was important that these changes were driven from the top, lead by Steve Holliday, who is now the company CEO. 'National Grid would not have moved forward without the senior level support,' she says, 'but it's not just that; a big problem for women is lack of confidence, and knowing that there's support behind you gives you the confidence to be yourself.'

Rachel works flexibly, working from home one day a week to meet family commitments. In addition, over half of her all-male team works flexibly. 'It's not just a thing for women,' she says.

An example of the change was the differences Rachel experienced during her two periods of maternity leave. 'The first maternity leave was only three months but on my return I was completely out of touch. The second time I was on leave for a year but the introduction of a "Keep in touch" scheme meant when I came back, I knew all the new faces and was up to date on developments,' she says.

The voluntary scheme ensures that employees on leave receive regular news by email, are invited to team briefings and social events and hear of job vacancies while they are away.

Divided we stand

People don't want to exchange views, discovers Laura Potts

'It's all good data', my colleague Sarah Nettleton would reassuringly remind us, after another frustrating episode in our research project *Divided We Stand: bridging differential understanding of environmental risk.*[1]

True enough: as social science, the project yielded some fascinating insights into how and why people were reluctant to talk and listen to each other;[2] but I am left with a nagging disillusionment about the process, and its implications for the 'new social contract' between science and society.

Hearing different viewpoints

The explicit aim of the project was to bring together different viewpoints on the role of exposure to environmental hazards in the incidence of breast cancer, by providing opportunities for all the participants to hear each others' arguments and evidence.

We involved a range of communities of interest: women with personal experience of breast cancer, lay health activists, environmental campaigners, specialist breast cancer nurses, oncologists, public health practitioners, epidemiologists, biologists and toxicologists. We were also keen to establish more equitable participatory processes for science and policy-making, and to examine the relationship between professional and lay knowledge. As well as using traditional qualitative research methods – interviews, focus groups, participant observation – we organized three hearings: one in a city, one in a rural market town, and one in an area with concern about a recent cluster of cases. And, finally, a national hearing in Westminster, supported by the chair of the All Party Parliamentary Party Group on cancer.

The theory: different from the reality

How hard can that be? Surely, just business as usual for experienced social researchers? But the stumbling blocks we encountered were far greater and more intractable than we anticipated.

Unwilling participants

Getting people to take part at all was the first problem. A cancer epidemiologist told me we were 'barking up the wrong tree'. An oncologist argued there was no point his coming to a local hearing because 'the advance of our scientific understanding in these areas is unlikely to be facilitated by dialogue'. A Department of Health spokesperson claimed that the primary prevention of breast cancer wasn't on their agenda.

There were a few sticky moments in the process of the hearings too: at the national hearing, the director of an environmental NGO refused to sit next to the CEO of a UK public health body. Places round the table were allocated alphabetically, but still she insisted on moving to another position.

What was going on? Professionalism demands boundaries for both discipline and identity, through vocabularies and practices. It seemed to be very hard for some to overcome those learned behaviours, and old habits of stereotyping and mutual suspicion of The Other die hard.

All sorts of evidence

The contemporary 'tyranny of the evidence base' overlooks the existence of different sorts of evidence, and of different sorts of people's concerns. Arguably, we get a more complete picture of the multi-factorial jigsaw of breast cancer causation if we are more inclusive; a recent Demos report[3] asserts the value of all sorts of expertise. In the US, the community-based research initiative supported by National Institute for Environmental Health Sciences is taking just such an approach, but our experience in the UK suggests it may be decades before that might be adopted here.

Common ground

In a posthumous review, John Higgins[4] wrote of Edward Said's commitment to finding 'common ground' as 'a fundamental moral and political principle': 'identifying and occupying such common ground are not easy tasks because they are activities that can involve a questioning rather than a fortifying of self, and usually mean giving up the sense of security that comes with the absolute denigration of your opponent'.

Our hearings were organized on the basis of the best advice we could find, from business, deliberative democracy and human communication – and years of experience as social researchers. They demanded, as Higgins suggests, considerable 'intellectual effort', and while we were not, perhaps, blessed as Said was, with 'uncommon talent...charm and personality', we were welcoming, informative, reliable and committed.

Next move

It's time to move on. A colleague and I have a new project under funding review. We want to bring together the genetic researchers and the environmental researchers looking at causes of breast cancer, to learn from each others' work and begin to shape policies for primary prevention.

The questions framing this dialogue will come from a broadly based steering group, and will attempt to establish a common language for understanding what contributes to the continuing rise in incidence of the disease. I'm optimistic that the lessons learned from *Divided We Stand* will help us establish some common ground this time.

1. *Divided We Stand, bridging differential understanding of environmental risk*, as part the Economic and Social Research Council's *Science in Society* programme
2. www.esrcsocietytoday.ac.uk/ESRCInfoCentre/Plain_English_Summaries
3. Jack Stilgoe, Alan Irwin and Kevin Jones: 'The Received Wisdom: opening up expert advice'
4. Higgins, J., 2004. *Times Higher Education Supplement*, 9-7-2004

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The ice protein cometh?

Alan Malcolm anticipates just desserts

For more than a decade, those opposed in principle to GM technology have banged on about all the benefits accruing to producers and not to consumers (assuming of course that you exclude those whose pension funds are invested in profit-making companies).

Even those who by their job description (*eg* Chair of the Food Standards Agency) are obliged to sit on the metaphorical fence, have begged for the scientists and the industry to provide something other than yellow rice with which to tickle the palates of the UK electorate (or at least their under-voting-age offspring).

And now here it is.

Mush

Most of us know that when water freezes, it is unusual in expanding. Burst pipes are one thing, but at least fish can swim around underneath the ice on ponds and the ocean.

The consequences for the food industry are slightly more complex, not to say disastrous. It is difficult to freeze foods such as strawberries because the ice crystals that form so disrupt the cell structure that, on thawing, all that results is mush.

One way to deal with this is to take advantage of the fact that any substance – including molecules such as sucrose, glucose and fructose – depresses the freezing point of the solvent it is dissolved in. However this affects both the taste and the nutritional qualities of the product.

The hunt has long been on for an alternative.

Fishy lessons

How do fish keep their body fluids liquid while swimming in waters which may be below 0°C (and yet which do not freeze because of the saltiness of the oceans)?

Amazingly, a whole family of proteins exist which, by an interaction (not totally understood in molecular terms) with water, alters the way in which the liquid freezes. In particular, the crystals that form when freezing does eventually takes place, are microcrystalline rather than the long needles that are usually present.

When these proteins are included in ice cream manufacture, they enable both the sugar and fat content to be significantly reduced, with no loss of organoleptic (that smooth seductive mouth feel!) quality.

The problem is that to produce enough for Europe's vast appetite for ice cream (now increasing thanks to climate change) would involve wiping out much of the fish stocks of the North Atlantic. Therefore, ever conscious of such environmental challenges, the decision was taken to put a relevant gene into yeast and to produce the protein by fermentation. This approach therefore mimics the production of blood clotting factors to treat haemophiliacs, which stops them from being infected with HIV.

Constructing a molecule

The DNA was not of course extracted from fish – nobody wants to think of such a source while tucking into a Magnum.

First the protein sequence was determined. Using the genetic code, it was then possible to predict several gene sequences which would be capable of coding for such a molecule. We now know which triplet codons are preferred by yeast (not the same ones as fish use), and so this sequence was constructed in the laboratory using an automated DNA synthesiser. The actual molecule made had never previously existed in nature.

This was then inserted into the same type of yeast that for several years has been used to make vitamin pills for health food stores, and for several millennia to make bread and beer.

The promoter was placed under the control of a *gal* switch, meaning that the desired protein synthesis could be switched on by the introduction of galactose into the fermentation medium.

Everyone's a winner

So we now have a product that helps to conserve fish stocks in the sea, reduces the nutritional imbalance of a popular food, and uses a traditional food grade yeast. There is even a side benefit – if your ice cream thaws slightly between supermarket and home, or even while little brother is making up his mind at lunch which variety to go for, when the ice cream is refrozen, it reforms much of its original texture, rather than producing those nasty crystals which stab the tongue and gums.

But for those who have been paying attention, it is of course a GM product (albeit not transgenic), and therefore likely to be banned by anti-hedonistic dodos such as Peter Melchett and Michael Meacher.

Will the public swallow it? Only time will tell.

Never in nature: less sugar and fat but equally smooth

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The author is a member of the Advisory Committee on Novel Foods and Processes which has recently reviewed this product.

He is also a former Chair of the British Nutrition Foundation, and was Deputy Chair of Technology Foresight on Food and Drink.

Any views expressed here are his own and do not represent those of any of the above.

Bring back Haldane!

Keith Davies argues that the business model for research leads to lack of public trust

Science advice to government is unavoidably political. This conflict of interest has driven a wedge between science and society. If science is to survive in its current business-oriented research context, it will need to be able to deal with the conflicts of interest that will undoubtedly arise between different stakeholders.

Trust in a business environment

Over the last several years, there has been growing concern within the scientific establishment that the integrity of science is being undermined. For many scientists, this loss of faith seems unfair and simply unwarranted.

Where controversial biotechnology is concerned, others claim that today's distrust is very real and based around conflicts arising from questions around perceived benefits and, perhaps more importantly, ownership. Research that may benefit some sectors of business may not be compatible with the public good, leading to conflicts of interest.

Even within the scientific community itself there are tensions. Taking the issue of GM crops, for example, there can clearly be a conflict of views between molecular biologists, who insist on the precision and safety of genetically modified crops, and ecologists, who are more cautionary about the benefits and consequences of their use.

Revise the business model

It is around these and similar issues that society wishes to see science as transparent and accountable. Over the last two or three decades, however, there has been a change in the relationship between scientific knowledge and research. The 'gatekeepers of knowledge' used to be the editors of journals and careers determined by previously published research; today, modern laboratories are headed by a Chief Executive Officer and the new gatekeepers are the grant-awarding bodies whose membership includes people with industrial and commercial interests. The emphasis has changed from past research, to future research, and with this a change in bias from public service to business and wealth creation.

It may be that we need to abandon the idea of science as wealth creator, and once again put greater distance between customer and contractor. The 1918 Haldane report

GM corn: tensions between different groups

recommended that the research required by different government departments should be separated as much as possible from political and administrative pressures. We should consider reinstating Haldane's principle when it comes to public service research.

Science in a business context

The social philosopher and business thinker Charles Handy argues that the traditional *raison d'être* of businesses – to maximise returns for shareholders – is outmoded. He thinks that future companies will have constitutions.

Society can be seen to be made up of businesses as a wall is made up of bricks. But modern walls are held together by mortar which is the connective tissue between the bricks. I would therefore like to suggest that our education system, its art and its science are in part the connective tissue that holds the wall together. Turning science into purely another outmoded business or brick will weaken the wall.

Traditional business models have focused minimally on economic sustainability and maximally on growth and wealth creation. But this focus is changing. New business models adopt a triple sustainability, taking not only economic sustainability into account, but also environmental and social sustainability. They emphasise the importance of internalizing the views and priorities of both internal and external stakeholders in a spiral process driven by successive rounds of innovation, while being sensitive to social, environmental and economic considerations. This approach produces a very different model to the one constructed around a single simple notion like wealth creation.

Science in modern society

We live in a scientific society, and science is at the vanguard of innovation and clearly has a larger role than simply being the connective tissue that holds society together. However, if science is to survive in the business context, it will need to be able to deal with the conflicts of interest that will undoubtedly arise between different stakeholders.

The last few years have seen the public's distrust of science grow when it comes to the environment and the issues concerning their wellbeing. In these circumstances, it needs to be open, accountable and demonstrate good governance.

Overall, in a democracy, this will require a delicate balancing act, that can cope with the different vested interests of the various stakeholders. Whether this can be done with a constitutional approach that incorporates triple sustainability thinking, without a return to public sector funding and the Haldane Principle, is an open question.

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The views expressed within this manuscript are strictly those of the author and it is written in his personal capacity as a citizen scientist; the opinions expressed are his own and do not represent the views of Rothamsted Research or the Biotechnology and Biological Sciences Research Council of the United Kingdom.

Action on climate change

Trust is important to BP, says John Browne

Three fundamental values have always sustained human development: trust, confidence and optimism. Yet today, those values are suddenly being undermined by concerns about energy security and global warming.

Trust, confidence and optimism have taken us from a primitive economy, in which every individual and every family had to look after themselves, to an integrated society in which we rely on others to provide the basics of life, such as food, clean water and, of course, energy. If we reaffirm our values, they will help us meet the challenges of our own time too.

Companies, too, require trust, confidence and optimism if they are to be successful. As far as BP is concerned, we have had our problems in the last two years, including a tragic accident at our Texas City refinery, in which 15 of our colleagues died, and an oil spill in Alaska. We are determined to restore trust in our operations and we are working with everybody, from unions, to employees to regulators to apply the lessons learned, particularly those related to process safety.

Long-term risks

There are three long-term risks which we all ought to be concerned about. The first is political. Instability in the Middle East, the threat of confiscation and the risk of energy being used as a political instrument are all contributing to concerns that the supply of energy could one day be seriously disrupted.

The second risk is rising demand. Oil is not running out. At current levels of demand, there is estimated to be 40 years of oil and gas supplies. But the rapid development of China, India and other emerging economies is inevitably putting a strain on production. Demand in 15 years' time could easily be 25 per cent higher than it is today.

The third risk – and the one about which I feel most passionately – is climate change. The science is still evolving, but the balance of opinion in the scientific community has tipped decisively towards believing that the temperature in the atmosphere is rising, and this has been caused by man-made carbon emissions.

Climate change

In his film *An Inconvenient Truth*, Al Gore says climate change is a planetary emergency. But it is also a humanitarian one. Climate change jeopardises all our confidence in the future. It raises the prospect of rising sea levels, more desertification, crop failure and heat waves.

Furthermore, as far as the energy industry is concerned, there is the additional risk that we and our products will get the blame for global warming. If that happens, the time and effort we have spent carefully building up trust and legitimacy in the communities in which we operate would suddenly prove fruitless.

Ethanol: BP is researching supplements

One clear theme emerges strongly from these major, long-term risks. They share common solutions. There is an urgent need for us all – national governments, companies and individuals – to act now in order to slow the pace of energy demand, to improve our energy efficiency and to reduce carbon emissions.

Taking action

In the last 10 years, BP has tried to take a lead in the industry on all these issues, but especially on climate change. In 1997 we 'left the church' of large oil companies and I committed BP to reducing our own greenhouse gas emissions to 10 per cent below 1990 levels. We met that target seven years early, in 2002. I have also called for the development of an international carbon trading system.

BP is investing some of the cashflows received from oil and gas in our new alternative energy business. We are investing in solar and are on track to triple our manufacturing capacity of solar photovalvic panels within two years. We are developing a world-leading wind power business. We have assembled a large land bank. We are also investing in other innovative technologies, including carbon capture and storage.

One of the areas with most promise is biofuels. BP already buys and blends over 500 million gallons of ethanol in the US. And earlier this year we committed $500m to a biosciences institute at the University of Berkeley, California, which will develop new crops and new techniques to supplement the contribution to cleaner fuels already made by ethanol.

The challenges we face are serious and if we do nothing, they could be catastrophic. But the history of human development shows that if we work together and retain our trust in each other, our confidence and our optimism, we can triumph over almost any adversity.

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Carbon reduction in the UK: is there any point?

Gordon Walker and Patrick Devine-Wright assess community renewables

When faced with the extraordinary scale of the challenges involved in reducing carbon emissions, it is easy for local actions to appear futile. If China is on a trajectory of growth that in terms of total carbon emissions is projected to overtake that of the USA, is there any point in people in the UK reducing their infinitesimally small current and future contribution to the global carbon footprint?

For an increasing number of people, communities and businesses in the UK, the answer to that question is a clear 'yes'. For some, it is a matter of doing the right thing and acting on responsibilities to current and future generations; for others, a more pragmatic need for the UK to lead by example and to realize the wider benefits that a more sustainable economy or lifestyle might bring.

Whatever the motive, we find many examples of initiatives that can contribute towards shifting to a low carbon economy, and each of these needs to be properly evaluated.

Community renewables

One such initiative, examined in a recently-completed research project,[1] is community renewable energy.

Community renewables sit somewhere between the big private windfarms of the major energy players and small microgen installations on domestic roofs. They involve many different forms of renewable energy technology – wind, solar, biomass, ground source heat pumps, microhydro – installed to supply electricity or heat to community buildings or to bring money and jobs into cooperative community ventures.

Gamblesby village hall with its new turbine
John Perkins

The development of such projects has been actively supported by government policy since 2001. We identified over 500 projects under development at the end of 2004, with many more since taken forward largely in rural communities across different parts of country. The alternative technology activists of the past have become the community project managers and consultants of the present, inspiring a diversity of people to become actively involved.

Gamblesby

The small rural community of Gamblesby in Cumbria had endured foot and mouth and a decline in facilities to the point where only the village hall remained. This had fallen into disrepair, and badly needed a better heating system. In order to attract funding for renovation, the village hall committee of retired professionals, businessmen and local farmers produced a business plan that stressed renewable energy and materials and a high input of DIY from the village. With advice from the local support team of the Community Renewables Initiative, the committee obtained grants – including for under-floor heating fuelled by a ground source heat pump.

Villagers got involved in different ways: digging trenches in the car park for the underground piping, barrowing ballast and plumbing the system. The result was a heating system that was easy to use and economic to run. A phase 2 project involved the installation of a 6Kw wind turbine.

Outcomes

In the context of the carbon reduction agenda, this project may seem insignificant. However, such projects can set wider social dynamics in motion. In researching this and other case studies – including wind farms, biomass district heating systems and solar installations – we were able to examine what local people learnt from being involved.

We found that all the projects had some positive impact on local people's understanding and support for renewable energy, and that there were spin-offs of various forms. In the case of Gamblesby, the project was being picked up through the web and site visits as an example for other villages to follow. Villagers had developed local expertise in ground source heat pump technology, and individual local villagers had been motivated to install microgeneration technology in their own homes.

Such catalytic and positive outcomes are not always realized so readily. In one of our case studies, a community became very divided over the development of a small wind farm project set up by local farmers. Its claimed community credentials did not stop it being viewed, by some locals at least, as just as intrusive as any other wind farm.

Community benefits

We found that projects are most accepted and most productive when local people are extensively involved, and when there are clear beneficial collective outcomes for the community.

The research shows that there is much enthusiasm for a localized community approach to renewable energy becoming part of the hybrid and distributed form that low carbon energy generation in the UK will need to take. The approach is also an important part of the process through which policy initiatives can stimulate change and innovation at a local level.

1. The project was funded by the ESRC.
Project web site: http://geography.lancs.ac.uk/cei/communityenergyproject.htm

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Festival publicity helped change fishing policy

Jason Hall-Spencer has a good news story

In the late 1990s, I saw chunks of coral reef being trawled up off the UK at a time when the fishing industry was moving into deeper waters along the European Continental Shelf edge.

As a trained marine biologist I was flabbergasted, since the text books said that coral reefs were restricted to warm tropical waters.

It turned out that corals were amongst the first life forms discovered during pioneering deep-sea surveys off southwest Ireland in 1869. In fact, at least as many coral species are described from the deep sea as from shallow waters and large, reef-forming corals have been known to occur in the cold waters off Scandanavia since the times of Linnaeus. However, it is only in the past few years that advances in acoustic survey and digital underwater filming technology have allowed us to film and study these deep-water habitats in detail, rather than relying on remote sampling such as with grabs.

Festival of Science publicity

At the BA Festival of Science in Dublin in 2005, I was able to showcase new video taken off the southwest of Ireland from an international expedition surveying previously unseen pristine habitats at a depth of 1000 meters. The videos revealed spectacular new species of corals, but also showed that deep-sea trawling was inadvertently damaging coral reefs that were thousands of years old.

The Royal Society had published evidence obtained in the UK, France and Norway that showed trawling damage to deep-sea habitats all along the deep-water margin of the European continent. At the 2005 Festival, this issue really caught the public imagination. I was giving a presentation of new expedition results that were podcast live on the internet, and this was followed by a flurry of newspaper and internet articles together with interviews about the story for radio and TV. This provided me with opportunities to dispel the myth that the deep sea is a monotonous expanse of mud, and to get across the message that, in fact, we have a rich complexity of deep-sea habitats around the British Isles. I was also able to suggest practical solutions to better harness these resources.

Industry collaboration

On the back of this publicity, I was granted access to government satellite tracking data showing where the international fleets of fishing boats were trawling. It turned out that areas that were rich in reef-forming corals were generally avoided by fishermen due to the damage the rough grounds caused to their gear and their catches. However, on a typical deep-water fishing trip each vessel trawls 30 square kilometres of seabed and, on occasion, the habitats formed by long-lived organisms are severely impacted.

By showing the industry charts of where corals were known to occur, and overlaying satellite tracking details of where they fished, it was possible to design closed areas that excluded trawling and other forms of fishing that impact the sea bed. It was clear that the last thing the fishing industry wanted was to be seen to be wilfully damaging the marine environment, and they were proactive in suggesting closed areas that would benefit their long-term economic sustainability. Our joint aim was to create a 'win-win' situation, coupling effective habitat conservation with no economic loss to the fishing industry.

It was imperative that we avoided suggesting the closure of areas that could displace trawling effort from habitats that had been impacted onto areas that were pristine.

Lobbying

With industry involvement and a sound scientific basis, the World Wide Fund for Nature and I began to lobby the EU Departments of the Environment and Fisheries.

Since the 2005 BA Festival, colleagues and I have highlighted the issues on lecture tours of fisheries advisory groups and international scientific symposia. We have helped the International Council for Exploration of the Seas to formulate advice to the EU and the North East Atlantic Fisheries Commission.

Between January and March 2007, the concerted and collaborative efforts of many people paid off with the closure of large coral-rich provinces (on Rockall and Hatton Banks) to bottom fishing gear.

Long-legged squat lobsters which live on a previously undescribed species of precious black coral west of Ireland

Publicity changed policy

This has been a major success story. The BA Festival brought new scientific findings to wider public attention, and this has ultimately influenced positive changes in policy for the long-term benefit of all.

The work raised many issues, including improvements to the satellite monitoring of fisheries and the development of a coherent network of offshore marine protected areas. It is gratifying that these issues are being given urgent attention by policy makers both at UK and EU level.

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Sir Gareth Roberts

Gordon Duff remembers a champion for science

Sir Gareth Roberts: endearing Welshness

Gareth Roberts was a distinguished research physicist who played a key role in keeping education and science at the top of the government's agenda. President of Wolfson College, Oxford, at the time of his death, he was a strong and charismatic leader, capable of achieving a consensus where others could not.

The son of a quarryman, Roberts was born in 1940 in Penmaenmawr, North Wales. Raised in a Welsh-speaking home, he learnt English at school and attended chapel every Sunday. From the John Bright Grammar School in Llandudno, he progressed to the University College of North Wales at Bangor, gaining a First in Physics in 1961, followed by a PhD in the nascent field of semiconductor physics.

By the age of 34 he held the chair of physics in the New University of Ulster at Coleraine. In 1976 he moved to Durham University, and was elected a Fellow of the Royal Society in 1984.

In 1990 he was appointed Vice-Chancellor of Sheffield University, a role in which he was strikingly successful. His personal qualities of integrity and fairness engendered trust, and enabled him to implement far-sighted policies – for example, widening social access to the university – with strong support from all the faculties.

Many of his initiatives had their origins in Roberts's 'Town and Gown' dinners, which he hosted with his wife, Carolyn, at their university residence. On these evenings, guests took part in much-enjoyed quizzes (which invariably included the question, 'In what year did Cardiff win the FA Cup?').

Campaigning against cuts

In 1995 Roberts was elected Chairman of the Committee of Vice-Chancellors and Principals, now known as Universities UK. His two-year term of office was among the most turbulent on record, as the CVCP collided with the government over its continuing cuts in university funding. Led by Roberts, the CVCP joined forces with the campus unions to mount a vigorous campaign to make the political parties and the public aware of the financial plight of the universities.

The resulting Dearing Inquiry into Higher Education, commissioned in 1996, drew heavily on input from the CVCP. The New Labour government accepted many of the principles in the 1997 Dearing Report, building on the key recommendation that the costs of higher education should be shared among those who benefit.

Many of his initiatives had their origins in Roberts's 'Town and Gown' dinners, which he hosted with his wife, Carolyn, at their university residence. On these evenings, guests took part in much-enjoyed quizzes (which invariably included the question, 'In what year did Cardiff win the FA Cup?')

Roberts then joined the Board of the Higher Education Funding Council for England (Hefce). He was a powerful advocate for research funding for universities, while his detailed review of the Research Assessment Exercise – the vehicle through which universities receive much of their research income – was presented to the UK's four higher-education funding bodies in 2004.

Gareth Roberts chaired the Research Careers Initiative (1997-2002), aimed at enhancing the working conditions, training and employment opportunities of over 37,000 contract research staff in UK universities and colleges.

SET for Success

His pragmatic approach led to an invitation from the Chancellor of the Exchequer, Gordon Brown, to undertake a comprehensive review of the supply of skilled scientists needed to support a competitive modern economy. Roberts's report *SET for Success*, published in 2002, highlighted the serious shortages in the funding and supply of scientists, engineers and mathematicians in UK schools and universities, and the steps needed to remedy the situation. The government gave its full backing to his report, investing £1.25bn in science and technology at all levels.

Roberts was an inspirational President of the Institute of Physics (1998–2000) and the driving force behind the foundation of the Science Council, launched in 2000. Last year, he was appointed Chairman of the Engineering and Technology Board.

Science in schools

In recent years, Roberts became increasingly involved in promoting the study of science and technology in schools. He chaired and reorganised both the Network of Science Learning Centres and Setnet, the DTI-sponsored body responsible for school science enrichment, and was President of the Association of Science Education. An engaging (and humorous) public speaker, he presented the Royal Institution/ BBC Christmas Lectures in 1988, on 'Science and Technology in the Home of the Future'.

There was an endearing Welshness about Gareth Roberts – he lost neither the lilt in his voice nor the deep love he felt for his homeland. At all times his family came first. He was a life-long and loyal supporter of Tottenham Hotspur Football Club.

When cancer was diagnosed towards the end of last year, Roberts continued with fortitude and equanimity in the same organised and dignified way in which he had conducted his entire life. He was working at home up until the very end.

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The most devastating diseases of plants

James Brown denies the fungi are winning

The Triumph of the Fungi: A Rotten History, by Nicholas P. Money (Oxford University Press, 2007, ISBN 0-19-51891-X)

Plants are assailed by an extraordinary range of diseases: blotches and blights, rusts and mildews, rots and wilts. *The Triumph of the Fungi* romps through the history of research on some of the most deadly ailments caused by fungi and the superficially similar but unrelated water moulds.

The title consciously echoes a classic of popular science writing from 1940, *The Advance of the Fungi*. The author, E.C. Large, an engineer turned plant pathologist, explained to a non-specialist readership how these microbes cause diseases and how pathologists had learnt about them. In the decades since *The Advance* was published, new diseases have appeared and spread, huge progress has been made in the science of plant pathology and methods of disease control have improved greatly.

It might seem that the time is ripe for a new book which tells non-experts about the current state of this subject, so vital for economic production for food and raw materials. Sadly, *The Triumph* is not that book.

Devastating fungi

Has the advance of the fungi become a triumph? Professor Money seems to think so. He is concerned with the most spectacular and destructive diseases of crops and forests: the rust which devastated coffee in Sri Lanka, potato late blight which brought famine to Ireland, chestnut blight which ravaged forests in eastern North America. Yet these diseases are remarkable precisely because they are exceptional. It is quite mistaken to think that agriculture is on the brink of a fungus-induced calamity.

Not only does *The Triumph* focus on eye-catching but unrepresentative diseases, but much of it is written in a flippant manner which does not help to explain some unfamiliar and occasionally obscure science.

Professor Money writes engagingly and informatively about heroes and heroines of plant pathology such as Anton de Bary, who discovered how late blight infects potatoes, and Marie Schwartz, who showed that Dutch elm disease is caused by a microbe.

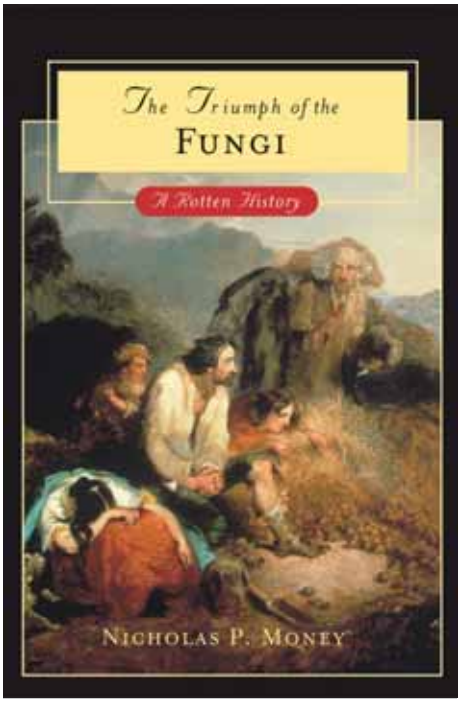
At his best, he grips the reader's interest with accounts of how key discoveries were made and how the science has often become entangled with politics. So it is distracting to find such a passage cut short by a personal anecdote or a frivolous remark. I was left with the strange sensation that Money does not believe his subject will actually hold the reader's attention unless the scientific pill is heavily coated with humorous sugar.

Frivolity and sensationalism come together at the end of the book, with a spectacular but implausible suggestion that masses of fungal spores caused the extinction of large, flightless dinosaurs (but apparently not the small, feathered ones, the birds). Maybe this just adds another crazy notion to the pile of ideas about the Cretaceous mass extinction, but it will not help to persuade readers that there is serious science elsewhere in the book.

The triumph of the humans

There is an entirely different story to tell about plant diseases, a quieter but more optimistic tale about the triumph of the human mind.

Fungi are indeed permanent threats to farms, forests and gardens. They adapt to new plant varieties, they become insensitive to fungicides and new pathogens arise and spread. Yet by and large, people learn to cope with them and control them. Stem rust caused devastating epidemics on wheat in the USA in the 1950s, but fifty years have passed without comparable damage. Why?



Not so rotten after all

Because little by little, plant pathologists and plant breeders have made steady improvements in the resistance of wheat to the stem rust fungus.

Wheat alone provides a catalogue of diseases (powdery mildew, glume blotch, leaf rust are others) which have been reasonably well controlled by patient application of the scientific method in breeding new varieties, developing fungicides and improving crop management. Even the control of potato blight and coffee rust has been improved in this way, though they are still noxious pests when conditions suit them.

The Triumph of the Fungi leaves the reader with the impression that our food, furniture and landscapes, not to mention car tyres, are at the mercy of a barbaric army of microbes. Yet plant pathologists serve the same role in combating these alien forces as Roman soldiers did on Hadrian's Wall: constant vigilance, skirmishes and sorties, a few hard-fought battles in an unpleasant environment have kept most diseases at bay. The fact that there is little or no news about the vast majority of fungi is the good news about plant pathology.

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Understanding the real world

M. D. Smith challenges a dogma

It was refreshing to read Kevin Anderson's forthright opinions on the post-Stern bandwagon ('Climate change in a myopic world', *SPA* March 2007, pp 6–7).

The 'inconvenient truth' is that it is the energy profligacy of our western way of life which is the cause of greenhouse warming. Those who believe that, with just a few minor, painless adjustments we can continue on our merry way while the rest of humanity catches up, and still avoid dangerous climate change, need to think again.

If there is a central dogma of modern political life, it is this: economic growth is good; more economic growth is better; limitless economic growth is best of all. Anyone from outside political life who questions the central dogma faces accusations of 'not living in the real world'.

Why is this? For decades, free-market economists and big business have hammered home their message that quality of life increases in direct proportion to economic and material wellbeing. So good a job have they done that most of the western world believes it to be true. Comparative studies of mental health, however, suggest otherwise: if anything, we are less happy now than our parents' and grandparents' generations were 50 years ago.

Science has a message for all of us, politicians, economists and consumers alike: the *real* 'real world' is entirely indifferent to our economic wellbeing; the *real* 'real world', indeed, is indifferent to our very existence. A life with less may be a happier life. It is certainly better than no life at all.

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Experimentation on animals

Gill Langley corrects some misconceptions

Corina Hadjiodysseos says that anti-vivisectionists argue against animal experiments on the basis that they are not 'necessary' (*SPA* March 2007, p 26).

As a scientist who has campaigned professionally against animal research for 30 years, I believe she has mischaracterised our opposition.

Those who oppose animal experiments do so primarily for two reasons. The first is that it's unethical deliberately to cause pain or suffering to sentient individuals (humans or animals of other species) without their freely-given, fully-informed consent, and when the affected individual is not expected to benefit personally from the intervention. This moral framework is widely accepted for the human species.

Since there is no logical or biological justification to distinguish morally between all humans and all other animals, the position is also valid for other sentient species. Most animals cannot give consent and will not benefit from experiments conducted on them.

Assumed benefits

The second argument used by many anti-vivisectionists is that the validity of medical research on animals has largely been assumed rather than proven. The government's own advisory committee agreed that animal research 'has to be judged case-by-case and subjected to detailed, critical evaluation'.[1]

There has been little such evaluation, but very recently a number of systematic reviews have revealed certain animal experiments to have been badly designed and poorly predictive of human outcomes.[2]

1. Animal Procedures Committee (2003). Review of cost/benefit assessment in the use of animals in research, p25-26. www.apc.gov.uk/reference/costbenefit.pdf
2. P Perel et al (15 December 2006). British Medical Journal doi:10.1136/bmj.39048.407928.BE

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Do your homework!

An open letter to science teachers from Lee Turnpenny and Michael Carroll

Recently, a nascent Christian organisation, absurdly named 'Truth in Science',[1] distributed glossy paraphernalia to the science departments of UK secondary schools and sixth form colleges.

The material promotes so-called Intelligent Design (ID), advocating its inclusion as an alternative to evolution in science lessons. To date, this marketing ploy has apparently proven effective in persuading at least 59 schools of its scientific worthiness.

Tactics

Creationist ideals are being propagated in some of the increasing number of faith schools, which already constitute a third of our education system, a perfectly legal consequence of the non-separation of church and state. Moreover, the decline in the actual proportion of graduates with science and maths degrees is happening at a time when religious politics are increasingly in the public consciousness. And now Truth in Science positions itself as arbiter of what should be taught in all science classes.

Truth in Science's tactics conform to the declared 'wedge strategy' of the politically and media-savvy ID movement: the objective of equal time in school classrooms as the basis for attacking scientific materialism. The ensuing 'scientific' controversy is ripe media fodder, perpetuated by a limited number of pro-ID scientists who, first and foremost, happen to be committed theists. The publicity generated affords ID undue credibility as an alternative scientific explanation in a supposedly balanced debate on evolution.

No evidence

This might seem a noble enough venture and it is good to be sceptical; after all, evolution cannot answer all questions on the history of life, can it? ID proposes that evolution is deficient in its account of gaps in the fossil record, and what it considers the 'irreducible complexity' of certain natural structures (the eye and the bacterial flagellum being pet examples). However, whether or not you accept this charge, defaulting to an unexplained 'designer' (by implication, 'God') does not constitute a scientific alternative because it fails on one fundamental requirement – evidence! You don't have to believe evolution; but refutation requires evidence for a plausible alternative argument. Scepticism, then, should consider why ID advocates have none to proffer.

Any attempt to dislodge a scientific paradigm like evolution has first to demonstrate the same explanatory power. Consider whether ID accounts for the extinction of over 95 per cent of species that have ever inhabited the earth; and the numerous imperfections that afflict extant living organisms (and yes, that includes human beings). Any intelligent designer would surely not engineer bodies that carry built-in flaws – it would indicate a deficient, imperfect intelligence.

This is where ID backfires: an attempt to blend evolution with occasional supernatural intervention is a resort to discredited 'God of the Gaps'-style theology, rejected by the majority of thinking religious people. Don't be misled by supposed distinctions, as recently advocated by Rachel Ankeny in this magazine.[2] ID is merely creationism in its latest guise. As such, it is not only pseudoscience, but also shallow religion (and consequently has no legitimate place in religious education classrooms either).

Pawns in the evolution debate

Ignorance fosters barbarity

Darwin bequeathed us the fabric connecting all biological diversity, from bacteria to the nature of human consciousness. There is no other valid scientific explanation for how species emerge. Read that again – no other scientific explanation. If your school insists on teaching ID, then it should at least be obligated to scrutinise it with the rigour of scientific analysis, whereupon its flaws will become evident, and you can then point out exactly what is going on. Teachers, do your homework![3]

Responsible education requires conveying the importance of how to think. Rachel Ankeny suggests ID opponents assume a general lay non-appreciation of what science is. However, it is Truth in Science and the ID movement who exploit both the assumption that the lay public is too stupid to recognise pseudoscience, and its susceptibility to marketing ruses. We should not assume that religious groups who foster their image as bastions of moral integrity would never resort to such strategies.

Be wary of the pontificating of those who yearn for a return to what they paint as a more pastoral world. On the contrary, promoting ignorance fosters medieval barbarity. Creationism and ID are not just Christian ideals, but appeal to fundamentalists of other faiths. It is now plausible that, by virtue of the Racial and Religious Hatred Act 2006, the teaching of evolution is under threat from zealots who may be able to claim their beliefs are being illegally offended.

Now, more than ever, public scientific awareness is essential. Truth in Science and the Intelligent Design movement, while posturing as science, are underhandedly marketing a faith position.

1. www.truthinscience.org.uk/site
2. R. Ankeny, *Science & Public Affairs* (December 2006), 'Intelligent design: Why is such junk science so popular?'
3. See http://bcseweb.org.uk/ for a useful information resource

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How public engagement came down from the mountain

Tom Wakeford

When I was young I was in digs occupied by fellows with Oxbridge degrees. I thought, 'My God, clever fellows' – you know – 'keep your mouth shut when they're doing the crossword 'cos you'll say the wrong word!' One of them was a principal lecturer: a brilliant chap.

One day he went out on his bike and the chain came off. He walked all the way back for me to put the chain on. He couldn't do it, so I showed him, but a week later the same thing happened again. I discovered a man could be brilliant in his own way — but couldn't put a chain on a bike.

I realised then there was a thing called the educated idiot; that common sense was spread across the population and that there are professors who are idiots – just the same as there are navvies who are idiots. For the first time in my life I began to realise that to be educated and to have one of these wonderful degrees didn't confer wisdom on you. So when I go to the NFU [National Farmers Union meetings] and hear that a famous professor said something – well, maybe he can't put a chain on his bike, either!

This is the story told by a Cumbrian farmer to Peter and Jean Williams, the as-yet unsung pioneers of two-way processes of engagement between citizens. In 1987 these two extraordinary people took part in conversations which, two decades later, are beginning to influence the way the UK generates new knowledge.

The Williams had spent their whole lives among the Lakeland fells. They were held in high esteem by the isolated hill farmers who packed their children off every day to the small school where Peter was headmaster. Then, just after he retired, the Chernobyl reactor melted down.

Facts wrong

Over the next few weeks, hill farmers in Cumbria and Wales found themselves at the whim of government agencies and their scientists. Large numbers of sheep were prevented from going to market or even culled, based on the guesswork of supposed experts at MAFF (the Ministry of Agriculture, Fisheries and Food - now DEFRA, the Department for Environment, Food and Rural Affairs). These same officials predicted that the hillsides would soon contain so little radioactivity that the disruption to farmers would be minimal. People who worked the fells, and others, suggested that MAFF's models were based on erroneous assumptions, but they were ignored.

In fact, the MAFF scientists had got their facts drastically wrong. Among the errors they had made was to assume a sheep's diet was just grass. Yet farmers knew that for much of the year sheep survived by eating lichens and mosses, which concentrate radioactivity in their tissues, leading to sheep swallowing far more radiation than in the scientists' models. Twenty years on, some Cumbrian farms still can't sell their lambs.

The perspectives of non-specialists are discussed on equal terms with those of specialists such as scientists, engineers and social researchers

Hands-on expertise

Hoping to understand more, Peter and Jean teamed up with Brian Wynne, a social researcher who had also grown up in the area. They sat with local farmers, not as experts extracting data, but as co-inquirers.

Williams, Williams and Wynne demonstrated that the knowledge of non-scientists such as farmers, shepherds and other farm workers was more reliable than much of that used to deal with the crisis by MAFF officials. Yet, this hands-on vernacular expertise was often dismissed by the unaccountable scientific elite as merely being the ignorance of lay people.

Inspiring others to carry out similar co-inquiries, Wynne has prompted new thinking that has gradually brought concepts of citizen participation and public engagement in science into the mainstream. Organisations as diverse as DTI's Sciencewise, Greenpeace and the Rowntree Trust have adopted two-way mechanisms of dialogue, allowing the perspectives of non-specialists to be discussed on equal terms with those of specialists such as scientists, engineers and social researchers.

A good listener

The Beacons of Public Engagement programme reflects this growing acceptance of the importance of non-specialists. The higher education funding bodies for Scotland, England and Wales are investing £8 million into changing the culture in our learning institutions with the aim of 'specialists involving, listening to, developing their understanding of, and interacting with non-specialists'.

Though Peter Williams died shortly after the Chernobyl research was complete, he and Jean made a vital contribution to showing our scientific academies that wisdom and good judgement are partly about being a good listener - not something you can learn merely via a university degree.

Further reading: Alan Irwin and Brian Wynne 1996, *Misunderstanding Science?: The Public Reconstruction of Science and Technology*. Cambridge University Press.

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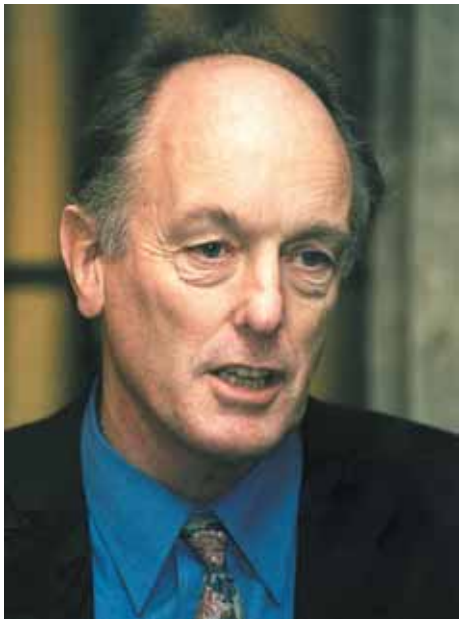
Combating climate change

Ian Gibson wants to invest in plant science



Climate change has become the media story of the decade, and rightly so.

When it comes to combating it, however, it seems that planting trees to offset carbon emissions could actually contribute to global warming unless the trees are planted in the tropics.[1] First generation biofuels are also giving us a nasty surprise. The deforestation of developing countries, currently taking place in the rush to make way for biofuel plantations, is having a far more severe effect on the planet than many of us imagine.

Climate change presents us with a set of extremely complex problems. So what is the solution? It comes in the form of UK plant science.

There will be competition for farm land between biofuels and food. Bioscience offers us potential solutions

Biomass

Instead of looking abroad to solve our energy needs, we should be concentrating efforts in the UK on a 'second generation' of bioenergy crops which use biomass.

Miscanthus, switch grass, willow and poplar can all be grown in the UK. They use less land area than existing biofuel crops, are renewable and carbon neutral. They do not use the same volume of chemicals and pesticides which other crops such as rape-seed have been criticised for.

At Rothamsted Research they are growing short-rotation-coppice willow. This will grow on marginal land and requires little input. If we can get 350,000 hectares of UK land growing 'second generation' bioenergy crops which can then be processed to produce fuels such as biodiesel, this will meet seven per cent of UK petrochemical needs without reducing food production and with very little input.

The BBSRC has just put in £20m to the research. But we face a situation where, before the research is done, many companies and countries are going ahead and planting vast areas of biofuel crops which are actually damaging the environment.

If we are able to produce more bioenergy crops in the UK we will be able to control how they are farmed and regulate the CO_2 emitted. We will also guarantee our future energy security.

Biofuels *v.* food

Inevitably there will be a competition for farm land between biofuels companies and the food industry. Bioscience offers us the potential solutions we need.

It is predicted that, by 2050, the average temperature in East Anglia will have risen by 3 degrees Celsius. In addition to this, there will be greatly reduced rainfall, greatly increased water evaporation and a great deal more CO_2 in the atmosphere.

Arable farmers will need crops which can grow and be harvested under variable temperatures and rainfall. Farmers will face new infections and parasites. Wetter winters will make cereal crops more prone to fungal diseases such as Fusarium ear blight. We will simply not be able to continue on with the same crops or the same variety of crops which are traditionally grown in the UK.

Bioscience solutions

As well as increasing rain water catchments, irrigation and irrigation efficiency, we must also look at the genetic make up of plants that survive in extreme climates. We can protect cereal crops from fungal diseases by introducing genes with a natural resistance. Once we isolate the genes which allow plants to cope with temperature, these too can be bred into commercial crop varieties.

Scientists at the John Innes Centre have isolated several genes which control whether a plant needs a cold period before it will flower. This cold 'trigger' can be bred in and out of plants to produce winter and spring varieties. This technology will be increasingly important as the temperature rises.

How long will Britain remain at the forefront of plant science if we do not make the necessary investment?

More investment

It is clear that plant science has a central role to play in our future and in combating climate change. Yet at the same time there are talks of job losses in plant science institutions. Rothamsted Research experienced a net staff reduction of 17 during 2005/06. The John Innes Centre in Norwich is at present a world class institution producing world class research in this area. But how long will Britain remain at the forefront of plant science if we do not make the necessary investment?

BP recently decided to establish a $250 million biofuels research centre in California rather than the UK. One of the persuading factors was that Governor Schwarzenegger agreed to match the investment while the BBSRC was only able offer £20m.

If climate change is an important issue for government, and it seems that everything from the Labour Government's Climate Change Bill to David Cameron's organic trainers suggest that it is, then plant science must be made a national priority, soon.

1. See www.llnl.gov/pao/news/news_releases/2007/NR-07-04-03.html

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