

Science & Public Affairs

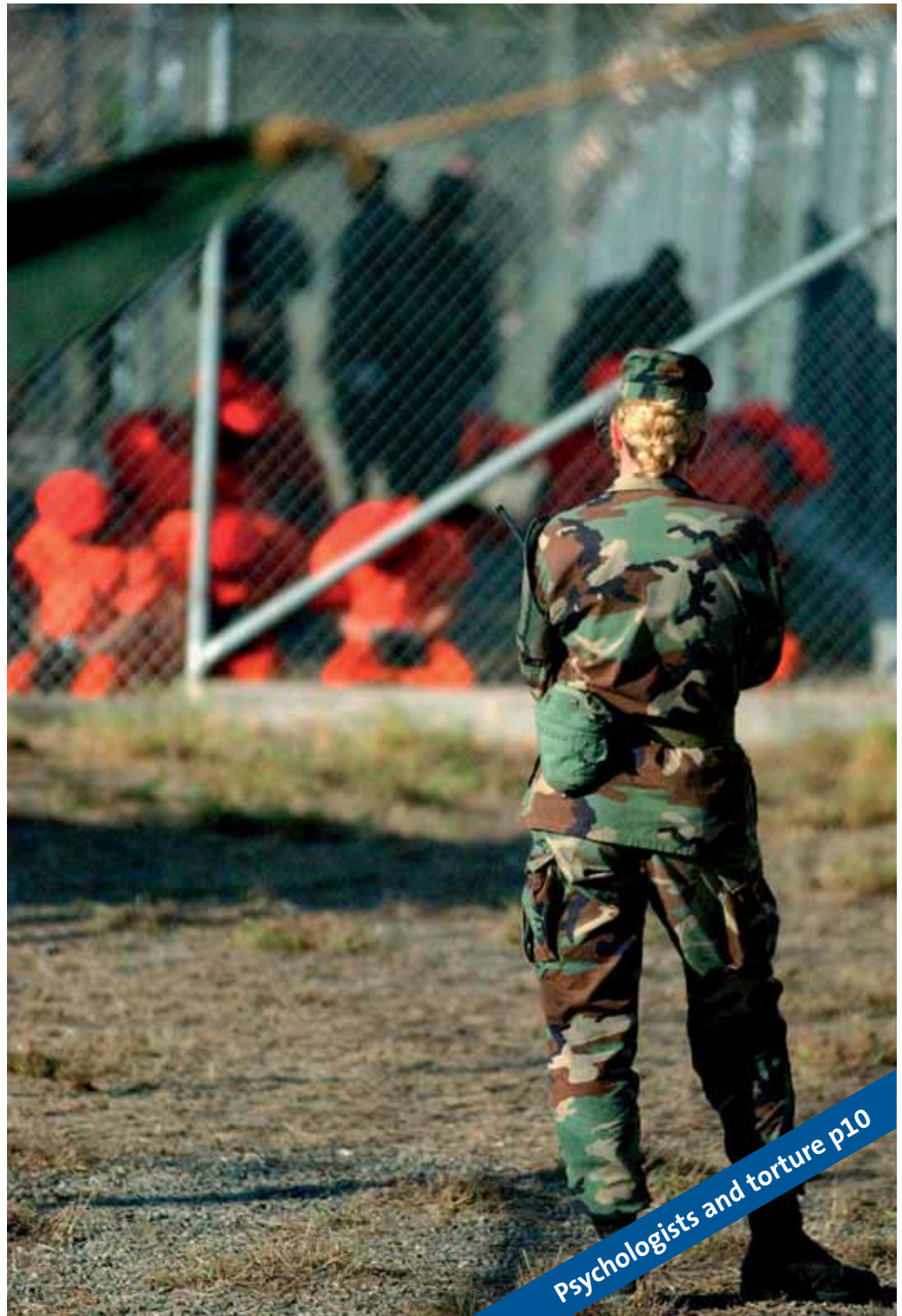
Science and
ethics: the case
of psychology



A good recruiting
sergeant for science?



People should
determine the
future



Psychologists and torture p10

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Ethics, economics and science policy-making

During March's National Science and Engineering Week, the government's Chief Scientific Adviser, Sir David King, will promote a new code of ethics for scientists. Such codes are admirable, but it has been argued that they do not necessarily help professional scientific organisations tackle specific questions. In this issue of *SPA* (pp10-11), two psychologists debate the value of the code painstakingly drawn up by the British Psychological Society (BPS) when it comes to a matter which horrifies all: the role of psychologists in torture.

Nimisha Patel insists that the code is inadequate and that the BPS should be more active on the subject, raising awareness within the psychological community about the legal obligations of psychologists. Richard Kwiatkowski defends the code, asserting that the BPS is a learned society rather than a pressure group.

The SPATalk (p4) returns to the crucial subject of recruiting young people to science. Will the new GCSE science course, Twenty First Century Science, lead more

young people to study advanced science and mathematics? Andrew Hunt argues that it will, while David Perks dismisses it as only being fit for the pub.

In the wake of the Stern report on the economics of climate change, Kevin Anderson is disheartened by what he calls the 'sterile economic framing of the public debate' on the issue (p6). He sees it as a sad indictment of society's privileging of economics over science. The scale of climate change, he says, means that measures to control our CO₂ emissions cannot be evaluated with an accountant's mentality; and if we are prepared to respond genuinely to the scale of the challenge, we must rescue science from its relegation to a subset of contemporary market economics.

Science in policy-making crops up in many guises in this issue.

Tracey Brown (p29) asks what government consultations are for. She thinks of them as a sort of group hug, whose vagueness provides good cover for whatever the consulting body decides to do. The Human

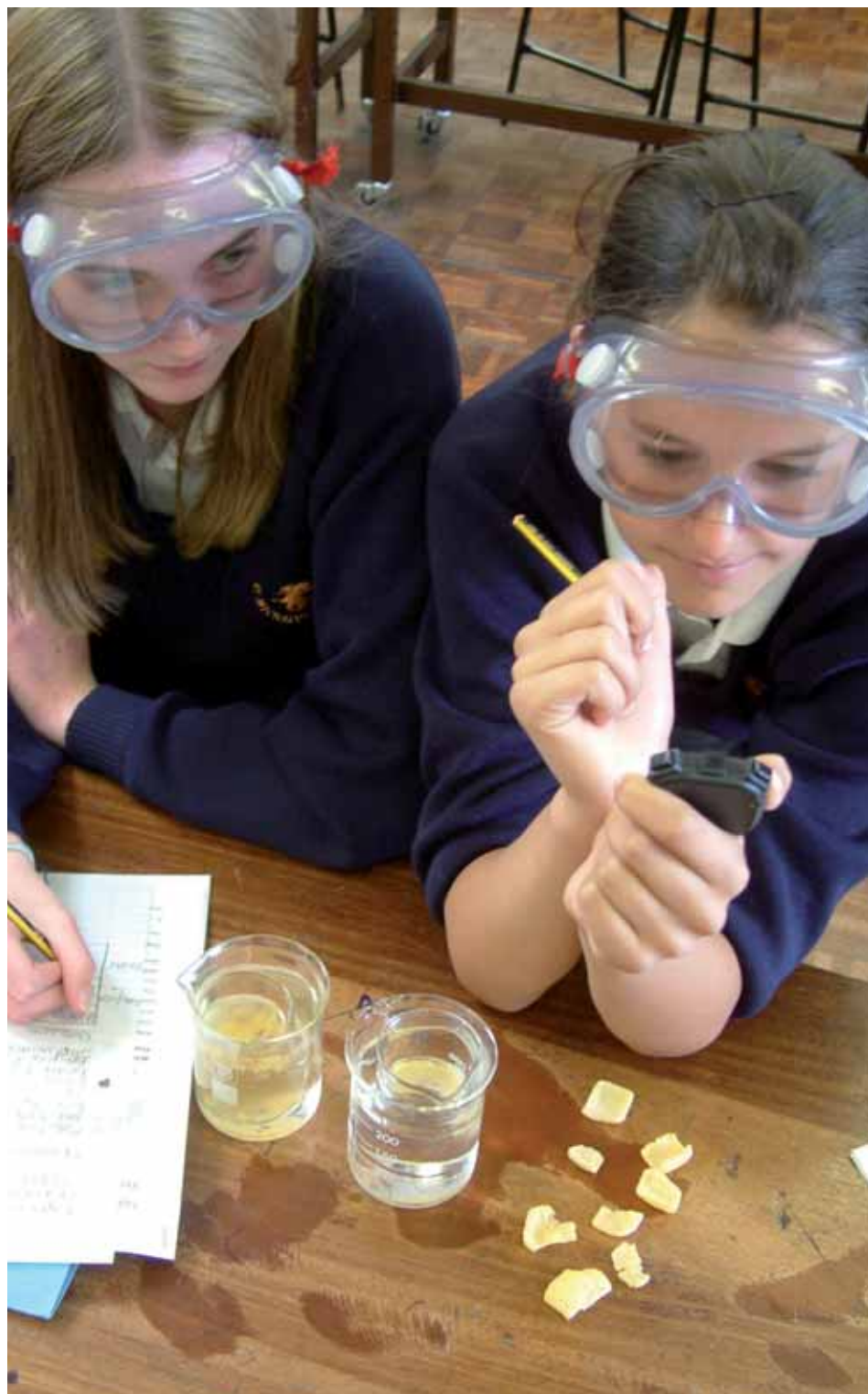
Fertilisation and Embryology Authority's current consultation over hybrid embryos is a case in point; it also figures in the *Shorts* (p8). In the controversial case of whether to cull badgers or not, the Independent Scientific Group on Cattle TB lays out the science that mitigates against culling (p12); however, the government has yet to respond to this advice, and there is no guarantee it ever will.

Continuing the theme, David Fisk ruminates on the science and politics of the health effects of pesticide spraying (p13). Jack Stilgoe (p25) introduces *sciencehorizons*, an initiative which aims to encourage citizens to have an input in shaping future technologies. And the *Exchange* (pp14-15) hears three views on the current state of expert advice to government. Alan Irwin thinks it has just begun to improve; Bill Stow explains how it works at Defra; and Sue Mayer argues that things will only change when citizens agitate for it.

Wendy Barnaby, Editor
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A good recruiting sergeant for science?

Given the UK's declining number of students taking advanced physics and chemistry, a lot is riding on the new GCSE science course, Twenty First Century Science. The Nuffield Foundation, which designed it, describes it as giving 'all 14 to 16 year olds a worthwhile and inspiring experience of science'. But will it lead more young people to study advanced science and mathematics? Andrew Hunt and David Perks disagree.



The right kind of science education? *Chris Colclough of St Michael's RC School Billingham*

Dear **Andrew**,

Baroness Warnock's comment, reported in the *Times*, that the new science GCSE was 'fit for the pub' concisely expressed the qualms many people have about the turn away from academic science education we seem to be taking in schools. Warnock, along with Sir Richard Sykes, Rector of Imperial College, expressed disquiet that we are in danger of accelerating the decline in the number of pupils taking science further.

When I debated with Michael Reiss (Education Director at the Royal Society) recently, he made the same point: many proponents of reform are fond of saying that the new GCSE will make science education more relevant to young people, and that it holds up the promise that more of them will choose to pursue science further into A-level and beyond.

I hope you agree that both sides of this argument cannot be right. Reiss's parting shot to me was to wait and see if the numbers going into science at A-level and undergraduate level increase. Then we would know who was right.

I don't think we need to wait. Children put it like this: 'Why should I do science, I am never going to need it when I leave school?' Instead of answering their question, which should be our bread and butter, we have started to agree with them.

Yours, **David**

Dear **David**,

Like the BA, I am all for 'pub science' – the posh names are SciBARS or Café Scientifique. We had to make changes because the old one-size-fits-all GCSE science programme was meaningless to far too many young people.

Both sides of the argument can be right with a curriculum which has a strand to prepare all young people for adult life in parallel with courses to challenge those who aspire to a future in science.

Baroness Warnock and Richard Sykes have not taken a close look at the new courses. I prefer the testimony of the student who

wrote in the *Independent* that she, along with others in her school, is being encouraged to take sciences to A-level thanks to the new GCSEs. She has been engrossed in science for the first time. If it weren't for this new course, she says, she would still be tuning out in lessons and counting down the days until she could give up science.

As for rigorous science, see the review of one of our texts by a teacher for the Royal Society of Chemistry: 'Only a thorough read will give you the pleasure of following the careful and finely-tuned explanations of demanding concepts.'

Bear in mind that research shows that curriculum content is a minor factor among the influences on young people's choices when it comes to advanced study.

Yours, **Andrew**

Dear **Andrew**,

You say that science education is 'meaningless to far too many young people'. I am afraid I can't agree.

There is an unhealthy assumption lurking within this point of view that most young people just aren't up to science and that we just shouldn't bother trying to educate them, as they won't get it. Call me old fashioned, but I prefer to open my classroom doors to any child and let them come with me as far as they can on a journey into a world they couldn't otherwise reach.

That is not to say that learning science isn't a demanding thing. As Professor Steve Jones put it in the *Telegraph*, 'Science turns on a mountain of "fact, fact, fact!"—without it, any discussion of its implications becomes simple fancy.' So, surely, we need to give the next generation the best possible initiation into science if they are to really appreciate the fruits of scientific endeavour.

At bottom, I am not sure that we agree on how important science is. Unless I am mistaken, you seem to be implying that science education just isn't important for most people – ordinary citizens rather than future scientists. Is this really the case?

Yours, **David**

Dear **David**,

Science education is very important for everyone – but it has got to be the right kind of science education.

One of our main reasons for change was to make it again possible to teach science principles in a rigorous manner – something which has been steadily eroded over twenty years, as the desire to broaden access has led to continual pressure to reduce content and depth. This has not, however, resulted in

improved student attitudes to science as a career option – indeed the reverse; not only in the UK, but also in most developed countries.

Instead of offering every student the same diluted form of academic science, we have divided the normal 20 per cent time allocation into two components:

GCSE Science, which teaches how science works, along with theories that show what science has to tell us about ourselves and our world. This is crucial if people are to appreciate the impact of science on our culture, and to have informed debate about science and society issues.

GCSE Additional Science, which provides a challenging introduction to fundamental theories from the three main sciences. For some, we offer instead an Applied Science option that has turned out to be one of the great successes of our pilot programme – and has certainly encouraged more students to take up post-16 science.

Yours, **Andrew**

Recent international research has shown a very strong inverse correlation between the interest young people have in becoming scientists and the general level of development in their country

Dear **Andrew**,

The trouble with rejecting the 'one-size-fits-all' approach is that it risks leaving too many pupils without a formal science education at GCSE. Choice is not the answer. The temptation is to explicitly offer pupils a non-academic choice at GCSE. The Applied Science GCSE is no preparation for A-level sciences.

Our problem is we are just not preparing pupils to take science seriously. Too many pupils start A-level science courses with a weak mathematics and science background. As a result, a large percentage of them drop out after one year. How will it help if pupils spend a year being taught issues-based science?

At a recent GCSE training day, it became obvious that many schools were unprepared to risk entering pupils for separate science GCSEs under the new regime. This runs counter to the government's target that every child who achieves level 6 in their SATs should have an entitlement to study separate sciences by 2008.

My concern is that we are pulling schools in the opposite direction. Separate sciences

are still an option, but they are not the priority. Instead, schools are told to concentrate on teaching 'how science works' and delivering 'science in the news' style media studies lessons. This is at best a distraction from delivering a sound science education to every child.

Yours, **David**

Dear **David**,

Recent international research has shown a very strong inverse correlation between the interest young people have in becoming scientists, and the general level of development in their country. The work of physicists and engineers is no longer seen as crucial to people's wellbeing in more developed countries – irrespective of school structures and curriculum patterns.

There are schools that can buck the trend through good teaching, supported by ambition at home and experiences which highlight the opportunities open to those with qualifications in maths and science.

In any case, science education should not be considered in isolation. There is a pressing need to improve young people's competence and confidence in mathematics if they are to go on with science.

While university admissions and league table scores are narrowly based on the results of three A-levels, we are not going to persuade many more young people to study pure physical sciences and maths so long as it is demonstrably more difficult to get good grades in these subjects.

We need to open up new routes to science, which is what the Applied Science GCSEs have begun to do. Maybe not into A-level physics, but certainly into a range of worthwhile advanced work-related science courses. It is a mistake to have too narrow a definition of what counts as science.

Yours, **Andrew**

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Climate change in a myopic world

Kevin Anderson gives a personal view



Paying lip service to climate change: the expansion of aviation

As an academic whose employment and conscience are dominated by climate change, it is disheartening to observe the sterile economic framing of the public debate on the issues, and the absence of meaningful policy arising from it.

The outlook

Put simply, carbon dioxide (CO₂) is the principal greenhouse gas and global CO₂ emissions are increasing at a rapid rate (see box). More alarmingly, there is no indication that this rate is likely to change significantly in the coming decade. A major world recession notwithstanding, it is difficult to envisage global emissions peaking before 2020 at the earliest. Even within the UK, it would require a radical sea change in attitudes towards CO₂ emissions for any substantial reduction to occur over the coming decade. Should this happen, the UK's CO₂ emissions will, nevertheless, probably continue to rise for the next four or five years.

Current global emission trends suggest there is a very high probability that the world will enter a prolonged period of what some have referred to as 'dangerous climate change'. The sooner deep reductions in global CO₂ emissions can be achieved, the less we

will venture into this 'dangerous' and unpredictable territory.

Stern review

Within the UK, 2006 provided several important indicators that the government was prepared to begin to consider seriously the issue of climate change. The first was the lengthy energy review process, within which climate change was a principal factor.

The second was the Treasury-commissioned *Stern review: the economics of climate change*,¹ the headline message of which was that scientific evidence for significant human impact on the climate is overwhelming and demands an urgent global response. Moreover, Stern stated categorically that 'the benefits of strong and early action on climate change outweigh the costs'. In Stern's view, acceptable levels of atmospheric CO₂ (450 - 500 parts per million by volume [ppmv] CO₂) could be achieved at a cost of approximately one per cent of global GDP by 2050, whilst the cost of inaction would probably be in the region of 5 to 20 per cent of GDP. Stern proceeds to detail a series of recommendations for stabilising emissions at or around the 500ppmv CO₂ level.

I don't wish to trivialise the depth and

detail of Stern's analysis, but he essentially foresees carbon prices and the subsequent development of carbon markets as providing the cornerstone of carbon dioxide mitigation policy. This economic foundation, he suggests, should be buttressed by a comprehensive suite of complementary measures, ranging from, for example, 'the removal of barriers to behavioural change', to 'creating the conditions for international collective action'. Stern concludes with a relatively upbeat message that 'there is still time to avoid the worst impacts of climate change if strong collective action starts now.'

It has taken a relatively narrow financial interpretation of the science to alert policy makers

Economics, not science

The publication of Nicholas Stern's thorough and, at times, solemn review has served to catalyse both public and private concern over our escalating emissions of CO₂. Whilst the broad acknowledgement of climate change as a serious and urgent policy issue is certainly welcomed, I, and I suspect many climate scientists, see the response to the Stern report as another sad indictment of society's privileging of economics over science.

For more than a decade, dedicated climate scientists have attempted to provide public and private policy makers with reasoned and accessible arguments as to why our emissions of CO₂ should be curtailed. Despite the wealth of reports from, for example, the Intergovernmental Panel on Climate Change and the UK's own Hadley and Tyndall Centres, it has taken a relatively narrow financial interpretation of the science to alert policy makers to the repercussions of a climate-induced collapse of existing human societies and ecosystems. In policy parlance science, and even society and nature, have simply become subsets of contemporary market economics.

Unique scale

If this were just the sour grapes of scientists wishing to be regarded with the reverence accorded to economists, it would be of little relevance to the climate change debate. However, not only does the severity of climate

The challenge

- The principal greenhouse gas of concern is carbon dioxide (CO₂). Other direct and indirect greenhouse gases are important, but for this synopsis, focussing on CO₂ provides an adequate sense of the scale of the problem.
- There is no international agreement as to what constitutes the threshold between acceptable and dangerous climate change. However, within both the EU and the UK a threshold has been defined in the form of 'limiting average global temperature increases to no more than 2°C above pre-industrial levels'.*

- In very broad terms, the latest science suggests 2°C can be correlated with atmospheric concentrations of CO₂ of between 300 and 450 parts per million by volume (ppmv). The current CO₂ concentration is 381ppmv and, as an outcome of the ongoing combustion of fossil fuels, is rising at about 2ppmv each year.
- Global CO₂ emissions are increasing at approximately 2.5 per cent each year. Even within those countries driving the international climate change agenda, CO₂ emissions continue to rise, with the UK and the EU no exception to this trend.

- CO₂ remains in the atmosphere for over 100 years. Consequently, long-term emission targets are essentially irrelevant. What is important are the cumulative emissions over the next 50 years or so. Each year's emissions will add to those emitted during the preceding years. It is only when the analysis is conducted on the basis of cumulative emissions that the scale of the challenge and the urgency with which CO₂ emissions need to be reduced become truly evident.

* Defra (2006), *Climate Change: The UK Programme 2006*. Defra. London, p.20.

change only gain currency within policy realms when couched in terms of pounds, shillings and pence, but so does the debate on how to control our CO₂ emissions. Policy makers will only contemplate seriously mechanisms for mitigating CO₂ emissions that can be demonstrated not to threaten short-term economic competitiveness and preferably offer early monetary returns.

Again, this accountant mentality would not be a concern if it could be reconciled with the direction and scale of the message emerging from the scientific analysis of climate change. Unfortunately, there appears no scope for reconciliation, despite valiant attempts by some to characterise climate change and the mitigation of CO₂ in terms of win-win opportunities.

Certainly, there have been cases in which responses to looming environmental crises were achieved at small economic cost, or even on the basis of win-win opportunities (for example, acid deposition and ozone destruction respectively). But these are poor analogies for climate change and CO₂ emissions.

Three aspects of the scale of the problem collectively negate the appropriateness of analogies. Two of these scale issues work in conjunction: the global pervasiveness of the fossil-fuel energy system, and the quantity of fossil fuel that has, is and will probably be combusted. The other arises from the disjunction between political timescales and those associated with the carbon cycle.

We need to begin by revisiting the financial accounting model that has come to dominate our lives

The dilemma

We are faced with a dilemma. Do we continue to pay lip service to the issue of climate change, and hope our children will understand our preference for barely-veiled hedonism over stewardship? Or are we prepared to respond genuinely to the scale of the challenge we have brought upon ourselves?

If it is the former, we should carry on as we are; with a weak European Carbon Emissions

Trading Scheme, the expansion of aviation with token green gestures and offsets, installing a few wind turbines and several nuclear power stations, buying the occasional hybrid car and swapping to energy-efficient light bulbs – all with a self-congratulatory, but ultimately insincere, pat on our own backs.

If it is the latter, we need to begin by revisiting urgently the financial accounting model that has come to dominate our lives, and re-establish society's dominance over economics. Has the tripling of our economic wherewithal since the 1950s brought about a tripling in our sense of wellbeing? Do we really gain significant benefits from our daily access to *mange tout*? Are the noise, pollution, accidents and physical division of communities by busy roads adequately compensated by our easy access to private transport?

If we are prepared to exchange our current self-delusion for a more honest recognition of the scale of the challenge, the message is one of hope not of despair; with a potentially prosperous future measured, if at all, by a range of metrics of which money is just one.

1. See www.tiny.cc/4fRGM

@ a glance...

I am disheartened by the sterile economic framing of the public debate about climate change

The response to the Stern report is another sad indictment of society's privileging of economics over science

The scale of climate change means that measures to control our CO₂ emissions cannot be evaluated on the basis of little economic cost or even win-win opportunities

If we are prepared to respond genuinely to the scale of the challenge, we must re-establish society's dominance over economics

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In brief

Does Defra do science well?

Sir David King, the government's Chief Scientific Adviser, has published the findings of an investigation into how Defra uses science as part of its planning and policy-making. He commends Defra's efforts to ensure the quality of the science, but recommends improvements in the department's processes for commissioning and managing scientific research. See <http://tinyurl.com/vrq6a>

Tick, tick

The Bulletin of the Atomic Scientists (BAS) has moved the Doomsday Clock two minutes forward so that it now reads five minutes to midnight. The clock conveys the threat to civilisation (originally from nuclear weapons). The move, said the BAS, reflects global failures to solve the problems posed by nuclear weapons and the climate crisis. See *SPA*, December 2006, pp 6-7.

Innovation needs social shifts too

The Economic and Social Research Council's Sustainable Technologies Programme concludes that both social and technological innovation is needed for society to shift to a more sustainable path. The director of the programme, Professor Fred Steward, said: 'We urgently need policy innovations to fill the gap between public investment in technological research and efforts to influence social behaviour.' See www.sustainabletechnologies.ac.uk.

All eggs in one bird-flu basket

The Royal Society and the Academy of Medical Sciences have criticised the government for stockpiling one type of anti-viral drug in preparation for a possible Asian influenza pandemic. Recent research at the Centre for Ecology and Hydrology suggests that widespread use of the drug Tamiflu could cause a serious environmental challenge. Large quantities of the drug would end up in rivers via sewage. The virus in ducks would develop Tamiflu resistance and encourage a new strain of avian flu to develop.

Hybrid embryos in existential limbo

The Human Fertilisation and Embryology Authority (HFEA) is holding a public consultation on 'hybrid' and 'chimera' embryo research rather than outlawing it altogether.

Researchers had feared a ban following a recommendation to this effect in the government's recent White Paper reviewing the Human Fertilisation and Embryology Act.

'Step change'

The HFEA admitted that this type of research involves issues that are not 'black or white'. Chief Executive Angela McNab said: 'The issues around hybrid and chimera research are unique and different from mainstream human embryo research.' She conceded that there is no clear agreement within the scientific community about the need for and benefits of the research, and that it would represent 'a significant step change in UK science'.

The research in question – for which two groups of scientists at UK universities have applied for a licence – involves placing genetic material from the nuclei of human cells within the 'shells' of animal eggs, from which nearly but not all animal genetic material has been removed, in order to grow an embryo. The resulting embryo would contain less than one per cent animal DNA and would produce an abundant and reliable supply of stem cells, which can develop into any kind of human tissue, for medical research. Its supporters anticipate the process circumventing the shortage of human eggs, which is currently a limiting factor in the production of stem cell lines for research.

Reactions

The Royal Society and the scientists in question welcomed the HFEA's announcement. Professor Sir Martin Rees, President of the Royal Society, said: 'It is unfortunate that this judgement has been delayed. However the decision to consult widely ... is a sensible one. It is now vital that the consultation takes account of our current understanding of the science and the potential future benefits.'

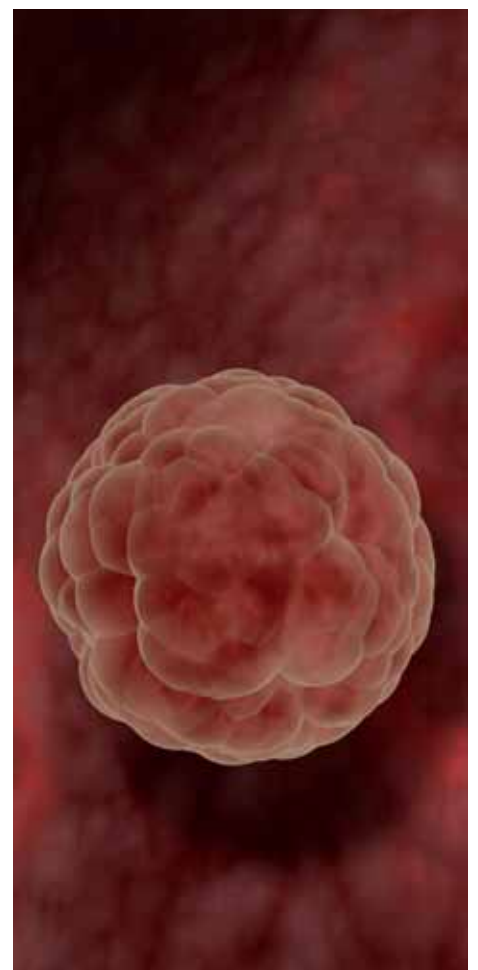
Aisling Burnand, Chief Executive of the BioIndustry Association (BIA), said: 'The BIA is pleased that the HFEA's announcement does not support the proposed ban in the government White Paper on research using hybrid embryos.'

'There is widespread scientific and public

support for this ground-breaking medical research ... Preventing [it] would ... completely undermine the government's support for stem cell research and its commitment to establishing the UK as a world-leading location for innovative scientific research.'

However, the campaign group GeneWatch UK is cautious. 'Claims of future miracle cures are being used to sell this type of research to an uneasy public,' Helen Wallace of GeneWatch commented. 'There are real doubts about the scientific relevance of chimeras for studying human diseases. The value of developing therapeutic cloning techniques using animal eggs is also questionable, since vast numbers of human eggs would still be needed should successful treatments ever be developed.'

The HFEA's public debate and consultation is underway now and will be completed around autumn this year. To take part, see www.hfea.gov.uk.



Early-stage embryo

Millennium Assessment opportunities remain under-exploited

The Millennium Ecosystem Assessment (MA) has not yet triggered the responses it deserves, according to the House of Commons Environmental Audit Committee.

The MA is a ground-breaking, global research exercise that involved 1300 scientists in a four-year process of gathering, analysing and presenting international biodiversity and ecosystem data. It reported its findings in March 2005.

MA as economic indicator

The committee's report notes that the MA showed how human activity is leading to species extinction, climate change and worsening poverty, and explores how the UK might contribute towards resolving these issues.

The report concludes that the government has started to 'talk the language of the MA' but needs to do more to ensure that MA findings become integral to its policies and practices. Committee member Colin Challen MP said: 'It is with some urgency that the government should act to ensure that the environment is not damaged by policies in areas as diverse as planning, transport, taxation, development and trade.'

The report urges the government to 'introduce an economic indicator that measures growth in a way that recognises environmental limits and more accurately describes human well-being.' It recommends a full, MA-type assessment for the UK.

UK best placed

The committee found that many governments have been slow to grasp the importance of the MA. It called for the UK to 'galvanise international action' by setting up a Millennium Ecosystem Fund to support studies in developing countries that will help them develop without damaging the environment.

As *SPA* went to press, Defra had not yet prepared its formal response and declined to comment. Janet Ranganathan, Director of the People and Ecosystems Program at the World Resources Institute in Washington DC – a partner in the MA – observed that the UK has done more than many other countries. However, she has not seen any significant take-up of what she perceives to be the



Urdaibai Biosphere Reserve, Spain: valued for its services rather than its resources www.ec.europa.eu

groundbreaking conceptual framework of the MA report; which is that it 'looks at everything through the lens of ecosystem services'. This brings a different perspective to ecosystems so that they are valued for the services they provide (and on which life depends), rather than for their resources (in order to exploit or preserve them).

Dr Terry Parr, from the UK's Centre for Ecology and Hydrology (CEH), confirmed Ranganathan's view of UK efforts: 'In terms of being able to provide data for broad-scale assessments of the state of UK biodiversity and ecosystems, the UK is one of the best placed in the world,' he said, referring to several national observation programmes such as the National Biodiversity Network, the Environmental Change Network and the Countryside Survey (www.countrysidesurvey.org.uk).

The committee also found that development non-government organisations have failed to engage sufficiently with the MA findings, a view shared by Janet Ranganathan. Oxfam UK declined to comment, saying it did not have a specific policy position on the issue.

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In brief

RAE gives way to metrics

University research funding allocations in England are to be assessed by a metrics-based scheme replacing the Research Assessment Exercise. The process, under development by the Higher Education Funding Council for England, will use a set of indicators to include research income, postgraduate numbers and research quality, combined with advice from experts. The first assessment exercise for SET subjects will be in 2009.

Financial connections still under wraps

A study of research papers on molecular biology and genetics, published in *Nature* between January and June 2005, shows that some scientists are still failing to disclose their financial interests, such as patents on their research or connections with industry. The study was undertaken by GeneWatch UK, which is calling for universities and institutes to establish a public register of scientists' interests.

Europe looks at nano-prospects

'Nanologue', an EU-funded project looking at the social, ethical and legal implications of nanotechnology, has delivered a scenarios-based report entitled *The future of nanotechnology: We need to talk* and a web-based tool called the Nano-Meter. This allows researchers and product developers to analyse the societal impacts of their applications during product research and development. See www.nanologue.net.

PS: It's serious

The UK Treasury has published a postscript to the Stern Report on the economics of climate change, accompanied by a Technical Annex. Together they address some of the comments made by reviewers of the report, including challenges to its models and data. See www.hm-treasury.gov.uk/independent_reviews/. Meanwhile, the Intergovernmental Panel on Climate Change has published its sobering fourth assessment at www.ipcc.ch.

Science and ethics: the case of psychology

During National Science and Engineering Week, the government's Chief Scientific Adviser, Sir David King, will be promoting a code of ethics for scientists.¹ Admirable though such codes are, how helpful are they in enabling professional scientific organisations to tackle specific questions? The British Psychological Society (BPS) is currently debating one such issue – the role of psychologists in torture – in the context of its new Code of Ethics and Conduct.² Here, Richard Kwiatkowski presents the BPS's view, and Nimisha Patel explains why she finds it wanting.

Science and ethics underly our actions

maintains Richard Kwiatkowski

Psychologists are interested in virtually every area of science and society. We carry out a vast range of research: from autism to management, cognition to criminality, and dementia to peak performance. Psychology covers a vast field – with deconstructivist qualitative researchers at one end, and clinical neurophysiologists at the other. It is in this context that the Code of Ethics and Conduct, introduced in March 2006, actually took eight years of design, debate and consultation to develop and agree.

Code for guidance

Before last March, the BPS had issued various statements concerned with ethics. This was helpful in bringing these issues to the attention of the public, and of reminding psychologists of their own ethical position and responsibilities.

The new Code significantly clarified the situation for psychologists, who now have a central reference document. However, it can only be a guide to thinking and subsequent action. Research comparing codes of ethics in the UK and US (where much more specific guidance exists for psychologists) indicates this could be counterproductive and lead to a legalistic mindset.

Principles and values

As well as the fundamental principles that psychologists have to uphold, the Code contains explicit statements of values. For example, the first ethical principle is respect, and the statement of values associated with

it reads: 'Psychologists value the dignity and worth of all persons, with sensitivity to the dynamics of perceived authority or influence over clients, and with particular regard to people's rights including those of privacy and self-determination.'

The Ethics Committee found it impossible to see how a psychologist could be involved in 'forcible interrogation' (or whatever the current unpleasant euphemism for torture is) and not contravene the four key principles laid out in the new Code, namely **respect** (as above), **competence** (including undertaking action in an ethical manner), **responsibility** (to clients) and **integrity** (including fairness). Transgressors could therefore be disciplined under the Code, though it might well be that other legal remedies would take precedence.

Internalising ethics

All members of the BPS have received the new Code, as the BPS believes that all psychologists should be personally engaged with ethics. Ethical behaviour is a core aspect of what it means to be a professional psychologist. Fundamentally, as we state in the Code, when considering professional behaviour, 'Thinking is not optional'.

This position is sometimes hard to explain. It would be easier to reissue parts of the code as statements. However, that does not allow context to be considered, does not enhance learning and engagement, may present the illusion that dilemmas are easy to address, and without statutory registration of psychology, it may imply a formal authority to

control psychologists (especially non-members) that we do not have.

If it's covered by the Code it's the BPS position. Members asked to do anything unethical can point to the Code or take advice from the Society or the Ethics Committee.

Views, not opinions

The BPS is a learned society and a charity; it is, however, not designed to be a pressure group. As psychologists, we have community sanction to act and speak out in a specific domain because of the scientific basis of our discipline, and our ethics. We need to use that basis to support our positions; otherwise our views are simply opinions.

Torture is morally wrong and unacceptable. The extant scientific evidence suggests that it is ineffective. Finally, it is clearly against our Code. For all these reasons, no psychologist should be involved.

1. Available at <http://tinyurl.com/yax7hh>. See also Council for Science and Technology (March 2006), Universal ethical code for scientists, Science & Public Affairs, p.21

2. Available at <http://www.cst.gov.uk/cst/business/files/ethical-code-letter.pdf>

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The BPS should do more

The Code is inadequate, insists Nimisha Patel

Historically, psychological knowledge and skills have been used in developing methods of torture, and have been shown to be used in interrogation for 'national security' purposes in Guantánamo, Abu Ghraib and elsewhere in the 'war on terror'. In the current controversy about the involvement of health professionals in such interrogations, several professional health bodies have felt it necessary to make explicit their position on the matter.

Health professionals' positions

The British Medical Association has stated unequivocally that there is no role for physicians in interrogations for national security.¹ Similarly, the Royal College of Psychiatrists² condemns psychiatric participation in the interrogation of detainees, whether in military or civilian settings, quoting the Surgeon General's statement that 'it is a gross contravention of medical ethics, as well as an offence under applicable international instruments and UK law for health personnel to engage, actively or passively, in acts which constitute participation in, complicity in, incitement to or attempts to commit torture or other cruel, inhuman or degrading treatment or punishment'.³ Without publicly engaging in the debate, the BPS has published its first ever Declaration concerning torture (currently under revision).⁴

Whilst a step in the right direction, the question remains: what should the BPS do to prevent psychologists' involvement in torture? The organisation might argue that its Declaration and its recently revised Code of Ethics and Conduct is sufficient. Rather than embark here on a detailed critique of these documents, it is important to examine their status.

Status of the Code

First, although the Declaration is an important statement, it has no legally or professionally binding authority. In short, it is a statement of good intent, and on its own, not an enforceable rule or standard.

Neither is the Code a set of rules, but a

framework for ethical decision-making. It omits any mention of the legal status of torture; it fails to make explicit a health professional's obligations in this matter under international law.

Torture and other forms of ill treatment are prohibited in international law and under customary international law. Thus, any complicity in torture, or an act of torture, whatever the form or circumstances, is a criminal act, and in some situations a crime against humanity.

The BPS fears that acknowledging obligations under international law in the Code would 'legalise' it. It would not; however, the acknowledgement would inform and protect the organisation as well as psychologists facing difficult decisions in the course of their work. Whilst psychologists may face disciplinary action if their conduct is in breach of the Code, they should be aware that if their conduct amounts to torture or other ill treatment, they may face criminal or civil prosecution too.

Ways forward

In meeting its public health obligation, the BPS needs an explicit organisational commitment to preventing torture by upholding and promoting standards in international law. This requires it to go beyond the current Declaration and Code by making explicit reference to obligations under international law within the Code. It should raise awareness within the psychological community about the legal obligations of psychologists, the relevant ethical rules and guidance already published, and the nature of torture, along with its health impact and the ineffectiveness of torture as a method in interrogations.

Clear mechanisms should be created to support those who may face difficulties (for example, with their employers) as a result of compliance with such ethical codes; and to those who wish to report breaches by others.

For effective implementation of the Code regarding torture, appropriate mechanisms should be ensured to investigate and punish relevant breaches, and to assist legal



Countries with high fertility are more likely to endure civil conflict

mechanisms for redress; and to make publicly available decisions made about such breaches.

Lastly, psychologists have a public health duty to inform policy makers of relevant psychological evidence on the harmful effects of torture and of its ineffectiveness as a method for obtaining reliable and valid information.

1. M Wilks (2005). A stain on medical ethics, *Lancet*, 366: 429-431

2. See www.rcpsych.ac.uk/pressparliament/pressreleases2006/pr825.aspx

3. Surgeon General (2005). Medical support to persons detained by UK forces whilst on operations. Surgeon General Policy Letter Number 01/05, London.

4. BPS (2005). Declaration of the British Psychological Society concerning torture and other cruel, inhuman or degrading treatment or punishment. *The Psychologist*, vol. 18, no.4: p. 190.

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To cull or not to cull

Defra's public consultation on badger culling and bovine tuberculosis reported in July, 2006. 95 per cent of respondents and half the interested organisations opposed a cull of badgers. The government has not yet responded to the consultation. Here, the Independent Scientific Group on Cattle TB explains the effects of badger culling on bovine TB.

Bovine tuberculosis (TB) raises concerns for farmers, conservationists, and government. The disease can also infect people, and in Britain in the 1930s around 2,500 people died annually, contracting the disease from unpasteurised milk. The post-war government committed itself to eradicating the disease from cattle.

Controlling TB

Cattle testing is the mainstay of TB control. Herds are tested regularly, infected animals slaughtered and the herd quarantined until subsequent tests reveal no further cases.

By 1970, this approach had eliminated TB across most of Britain except for the South West. Infection was discovered in badgers in 1971 and, from 1973, various badger culling strategies of this legally protected species complemented cattle testing. Eliminating badgers from one large area by gassing over several years was associated with a substantial decline in cattle TB; however, despite many years of localised culling on and around infected farms in the region, the incidence of the disease progressively increased and spread to new areas. By 2005, six per cent of cattle herds tested were affected, compared with less than one per cent in 1970.

Randomised trial

Uncertainty about the merits of badger culling continued. An independent scientific review in 1997 described evidence for badgers' role in TB transmission as 'compelling', but noted that the effectiveness of badger culling could not be evaluated because the available data lacked a scientific basis. It therefore recommended that different culling strategies be formally tested under field conditions. The Randomised Badger Culling Trial (RBCT) was launched by Defra (Department for Environment Food and Rural Affairs) the following year; designed and overseen by the Independent Scientific Group.

The RBCT results surprised many. In 10 areas, each covering 100km², all cattle TB outbreaks triggered localised badger culling – similar to control policies that had been practised for over 20 years. By 2003, these areas were experiencing higher TB incidence



The badger: nothing to fear from the science

than 10 similar no-cull control areas: culling badgers was making the situation worse rather than better. In a third set of 10 areas, also 100km², badgers were systematically culled from all accessible land. Here, results up to 2006 showed that, relative to the no-culling areas, cattle TB incidence fell by about 20 per cent – but was elevated on lands immediately surrounding the culled area. This 'edge effect' cancelled out the benefits experienced inside the culled areas.

Explaining the results

These unexpected findings can be explained by culling-induced changes in badger behaviour. Left undisturbed, badgers' movements, and hence disease spread, are constrained by territorial borders. Culling destroys this territorial structure. Remaining infected badgers, and those migrating in to occupy vacated land, range widely, spreading disease to one another and also encountering more cattle herds.

Substantial reductions in badger numbers could minimise these effects, but where overall densities are not greatly reduced – as in localised culling areas and immediately outside widespread culling areas – detrimental effects predominate. As this edge effect cannot be prevented by reasonable means, culling would be necessary over areas very much larger than the 100km² used in the RBCT, to offset its detrimental impact on the overall incidence of disease.

Any culling policy will create the problem of neighbouring farms facing an increased TB risk due to badger perturbation.

Reactions to RBCT results

The results have been published in international peer-reviewed journals, and are now widely accepted in the scientific community. Acceptance by farming interests has been slower, however; partly because it seems 'common sense' to attack a known source of the disease, and the belief that earlier culling was effective, and partly because recent trials in the Republic of Ireland (under very different conditions and extreme culling), showed that culling can reduce the disease in cattle. These trials, however, did not seek evidence of detrimental effects.

The way forward

Accumulated scientific findings demonstrate the relationship between infected badgers and TB prevalence in cattle is complex. The data suggest that, if badger culling is to have net benefits for disease control, and not make matters worse, it would need to be conducted intensively, in a coordinated and sustained manner over very large areas. It is highly questionable whether this would be practicable, economically justifiable, or publicly acceptable.

In the meantime, parallel research suggests that enhanced cattle TB diagnosis and movement control could, alone, substantially reduce TB incidence. This would require an acceptance that some herds will continue to be infected by badgers. A badger vaccine remains a long term strategic objective, but available control approaches cannot eradicate badger TB. A policy focused solely on cattle, justifiable on scientific grounds, would probably meet strong opposition from some groups.

The members of the Independent Scientific Group on Cattle TB are Professor John Bourne, Professor Christl Donnelly, Sir David Cox, Professor George Gettinby, Professor John McInerney, Professor Ivan Morrison and Dr Rosie Woodroffe
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The science and politics of pesticide sprays

David Fisk considers the concept of risk

To protect bystanders from pesticide sprays, the Royal Commission on Environmental Pollution (RCEP) has recommended a statutory 5m cordon.¹ The Advisory Committee on Pesticides (ACP) thinks it unnecessary.² Just another expert dispute? As ever, things are a little more complicated.

In determining the low dose health effects of pesticides we cannot be truly scientific, because the definitive experiments are blatantly unethical. It is a matter of guessing the truth, aided by some scientific insight, and knowing what it is we are supposed to be protecting.

In the event, with relations between the UK government and farmers already at a low ebb, the government had no appetite for more precautionary measures in a sector not famous for precautionary compliance. It concurred with the ACP. Many might see that as a pragmatic, if interim, position.

Calculating the risk

Now suppose, as a worried bystander or farmer, you were to try to re-compute the risk yourself.

You would start with a reproducible effect in the laboratory on a test mammal. You would need a factor to translate that dose to a human scale. You would need another factor for genetic variability in the general population. Then you would need to calculate how that dose comes about.

But if you have got this far, you have had to make several non-scientific decisions. Are you protecting babies or grown men? How far a genetic outlier are you protecting? Fundamentally, were you intending to protect the rights of the neighbours to use their property when and how they like? In that case, the dose is derived from the worse case event – let us say a young child with exposed skin playing on the ground. Or are you reducing accidents associated with farming, effectively giving the farmer a property right up to the boundary? In that case, you would need to know in what proportion of all sprays a small child would be in the path of pesticide when the wind gusts.

Assessment problems

The fundamental property rights are not pre-



Spraying: health effects disputed

established. The RCEP approached the problem with the traditions of urban environmental legislation, ACP with the traditions of worker safety. So different guesses as to what is appropriate precaution are to be expected.

Matters are made worse because legislators are not consistent on the status of psychosomatic reactions. In worker safety you would be advised to take another job. In food standards you spray the crop with pesticides just so customers can avoid eating the odd nutritious maggot. For psychosomatic reactions we have no analogue animal model to set up in the laboratory, so even the first step of the risk assessment is problematic.

Finally, you would also need to compute the likelihood that the government could respond to new evidence of harm. On the evidence presented by the detailed responses to RCEP recommendations, this does not look a very high number.

Government response

The detailed technical responses from Defra (the Department for Environment Food and Rural Affairs)³ to the RCEP read like pure, unreconstructed, pre-Philips-Inquiry MAFF (Ministry of Agriculture, Fisheries and Food). In some cases, as far as I could judge, they do not actually directly answer the corresponding RCEP recommendation.

Indeed, in a response that was supposed to assure us that all-was-well-in-Wiltshire, the Ministry of Defence (MoD) has been allowed to elbow in a critique of a small appendix – itself only a short précis of a Congress Report on the Gulf War Syndrome (which the MoD apparently needs to assure us does not exist). The hapless appendix is not directly related to any of the recommendations and only

referenced twice in passing in the main text. Presumably the critique is either to convince conspiracy theorists that Gulf War Syndrome considerations were relevant to forming the overall response (ouch!) or, much more likely, to demonstrate that the MoD does not believe that Cabinet Office guidance on communicating risk applies to it.

Back at the farm

So what are farmers and their neighbours to do? The Nobel prize winner Ronald Coase pointed out over 30 years ago⁴ that if the land rights are clear, then you could cut out the public sector altogether in cases like this and leave the parties to strike a financial bargain. With a Texan judge behind you (English judges can be a little flaky on restrictive covenants), just buy as much cordon as suits your bill fold. Otherwise wise farmers, facing encroaching urbanisation in an island determined to overcrowd itself, might just leave all this behind and get their spraying contractors to start mugging up on the Green Code and buffer zones.

1. www.rcep.org.uk/pesticides/Crop%20Spraying%20web.pdf

2. www.pesticides.gov.uk/acp_temp/RCEP_Response_vfinal.pdf

3. www.defra.gov.uk/environment/rcep/pdf/rcepcropspray-response.pdf

4. http://en.wikipedia.org/wiki/Coase_Theorem

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The new way of making science policy

In the wake of public controversies involving science, such as the BSE crisis and the MMR debate, the government has started to open up expert advice. How close are we to a new model of knowledge, evidence and expertise? This is the issue posed in a new pamphlet, *The Received Wisdom: opening up expert advice*.* One of its authors, Alan Irwin, answers the question, while Bill Stow and Sue Mayer comment.

Could do better

The hard work may lie ahead, says Alan Irwin

British policy culture has gone through a remarkable transition since what are now widely seen as the bad old days of BSE. Once, talk was of confidentiality, closed systems and expert judgement. Now, policy makers speak enthusiastically of public engagement; acknowledging uncertainty and the need to build societal confidence in decision-making.

Nor is it just talk. New bodies have been created (including Defra and the Food Standards Agency), a nationwide debate over GM food has been conducted, experiments are taking place across the country with consensus conferences and citizens' juries, and lay members have been appointed to key advisory committees. Even the best social commentator would have found all this very hard to predict as recently as the mid-1990s.

Tracking change

In sitting down to write *The Received Wisdom*, we were very conscious of the need to do justice to these changes and the intense efforts that lie behind them. We specifically wanted to track the (admittedly partial) transition from an old model based on closed structures, homogeneous experts and tight managerial control to a new approach which is more open and diverse, trusting of the public and willing to incorporate wider forms of expert knowledge.

This is not a battle with the imagined dark forces of 'anti-science' – nor is it helpful to think in such terms. Instead, the new circumstances are enriching our ideas about what counts as relevant expertise and opening our eyes to the varying ways in which socio-technical problems are constructed. The challenge is to embrace the different forms of expertise on offer: to view these as a resource, not a burden.



MMR vaccination: how far has the fuss changed science policy-making?

More progress needed

Nevertheless, in recognising what has changed, it is important to maintain a critical perspective on the progress that has still to be made.

Lay members may now be incorporated on advisory bodies, but their effectiveness depends very much on the status they are given – and especially on how much they are allowed (and enabled) to challenge scientific opinion. Rather than downgrading lay members to a subordinate status, we argue that the term 'lay' should be abolished. Instead, committees should contain a range of equal but diverse experts. At the same time, we call for 'putting the politics back into policy': widening the space for societal debate rather than hiding it away behind apparently 'technical' discussions. Making science more transparent has revealed how opaque many

parts of policy remain.

Much has changed, but it may be that the hard work lies ahead. Moving from the rhetoric of greater openness and engagement to long-lasting policy change will require more than transparency and self-conscious efforts to build trust. Instead, we need to take a hard look at our institutional cultures and the narrow notions of expertise on which they depend.

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Transparency, consultation and mess

Bill Stow explains how it works at Defra

Defra's environmental policies depend on our understanding of the science, economics and social science behind complex questions of public policy, such as climate change, or air and water pollution.

We obtain advice from research, expert advisory committees and public consultation. The scientists and economists within our policy teams interpret evidence for their colleagues and Ministers. They form networks with others in their field and are often renowned experts. Our Chief Scientific Adviser also challenges and provides independent and top-level advice. He ensures rigorous peer review and quality assurance, and is assisted by an independent Science Advisory Council from a range of disciplines.

Need for engagement

At the heart of this are two related needs: first to assess, manage and engage with the public on risk, and second to influence public and business behaviour to adopt more sustainable behaviour. Without confidence in our ability to do the first, there will be little

trust in what government says about the second. We have a powerful regulatory framework for managing 'classic' sources of environmental pollution, at the centre of which is risk-based enforcement. We also tackle much more diffuse sources of environmental impact: how we travel, heat our homes, and what we eat.

This means we have to engage the public as never before.

Methods

Transparency is a first step. Open meetings of Advisory Committees, published minutes, publishing the research behind policy – all well embedded in Defra practice – open up the possibility of challenge. Lay expertise on Advisory Committees offers a chance to challenge disciplinary thinking.

We also need to go beyond traditional forms of consultation into genuine engagement with the public. The *GM Nation?* debate and the work of the independent Committee on Radioactive Waste Management have been innovative attempts by Defra to do this.

Making Decisions

Government is a messy business. We need many sources of advice. We usually have to deal with uncertainty and ambiguous evidence: there is rarely one 'right' answer. Ministers' political judgement and engagement with the public play a key role in decision-making.

Nor does government live in an ivory tower, hoovering up evidence and following where it may lead. Of course, Ministers will have a view on what is important, and not just be driven by evidence in a narrow sense. And they have to take decisions; they cannot always wait until all the evidence is in, full public engagement has occurred, and a tidy, well-supported path emerges. Wouldn't it be boring if they did?

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Expectations not being met

Sue Mayer argues that citizens must agitate for change

Over the past eight years, there has been a move away from leaving everything to the experts to a situation where engagement with the public is expected and valued. Openness and transparency are the buzz words. The Chief Scientist's guidelines on scientific advice¹ is one example of this progressive new approach. But this new rhetoric is creating expectations that are not, by and large, being met.

No change

Nanotechnology is the new platform technology that is being promoted as the basis of future economic success. Following the controversy with biotechnology, there have been efforts to take forward the new culture of public engagement with nanotechnology. The Royal Society and Royal Academy of Engineering have said unexpected and welcome things, but there is no evidence that the juggernaut of nanotechnology has wavered as a result.

Openness and transparency should also have consequences. At the moment, openness is taken to mean that people should have access to minutes of meetings or papers previously unavailable. If people do not like

what they see, what is to be done? 'Nothing', seems to be the current response.

Government inaction

Public engagement often leads to a broader set of questions than is normally posed. However, experts have a tendency to keep questions to the technical which chimes with political instincts to narrow debate. Rather than allowing this wider base of inquiry, the government disbanded the Agriculture and Environment Biotechnology Commission (AEBC) and failed to replace it with another body. The AEBC was put in place to fill the gap identified by government in the regulation of GMOs that led to a lack of consideration of the ethical, social and wider environmental issues. But its advice was difficult for government, and despite its promise of a strategic body to consider agriculture more widely, it has not emerged.

Trust undermined

The anxiety about experts and public engagement comes from a desire to restore public trust in decision making. The problem

that the new rhetoric has exposed is that if people do not like what they see and do not agree with the values that are being expressed, they will expect change. If the outcomes of public engagement exercises are marginalised, this will fuel cynicism and undermine trust further. So there is a need to turn rhetoric into reality.

However, one positive effect of the new language on experts and the public is that it opens opportunities for public scrutiny and to demand accountability. Experts and policy makers are unlikely to share their power willingly. It is only likely to be as a result of persistent inquiry and pressure from citizens that real change will come.

1. Guidelines 2000: Scientific Advice and Policy Making; www.dti.gov.uk/science/page15432.html

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* The full pamphlet can be downloaded from www.demos.co.uk

The Prime Minister on science

SPA has extracted the main points of Prime Minister Tony Blair's latest speech on science. On the next page the Conservative and Liberal Democrat science spokesmen comment.

'Britain's path to the future – lit by the brilliant light of science'

Tony Blair is optimistic

The economic importance of science

Our challenge is to couple science and economic purpose.

The science budget has more than doubled, from £1.3 billion to £3.5 billion, in less than a decade. The number of science undergraduates in the UK has gone up by a quarter since 1997. The research budget itself has doubled.

Expenditure on R&D has increased by more than 20 per cent in real terms since 1997. But compared to our competitors it is still too low. We have an ambition to increase overall R&D from 1.9 per cent of GDP, where it is now, to 2.5 per cent by 2014.

We have been the first government to set out a long-term vision in science. The Ten-Year Science and Innovation Investment Framework set out our ambition to make the UK the premier destination for science and innovation.

In seven of the ten major areas of research the UK lags behind only the US. We have more entries in the top 50 world universities than the rest of Europe put together. In bio-medical science we have three of the top five universities in the world.

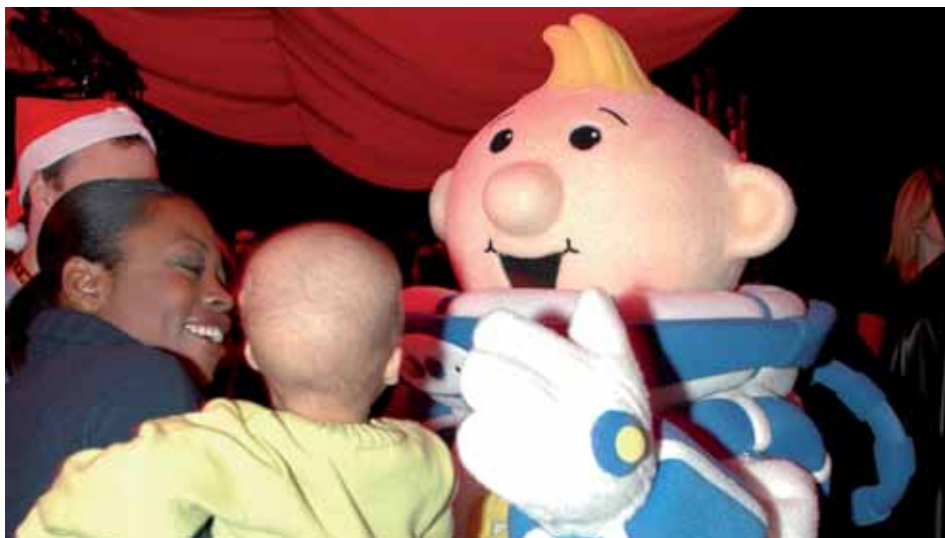
But the competition we face is intense. And we have weaknesses too. The UK has failed to develop any major new technology-based companies in the past decade; total venture capital investment in early stage technology companies is not increasing; business R&D is not rising as a share of GDP.

Government action

We need to push on with initiatives like the Higher Education Innovation Fund and the Technology Strategy Board.

As part of our forward policy process, the government is considering how to use public procurement – amounting to £150 billion per annum – to stimulate innovation and help small companies develop fast. We have concentrated on raising the level of innovation in manufacturing. We need to do the same today for services.

Alistair Darling has announced the Global Science and Innovation Forum Strategy to make the UK the first choice for business investment in R&D, and for foreign universities and scientists.



The next generation: young children interact with Lunar Jim, a BBC pre-school animation that aims to engage pre-schoolers in developing scientific learning skills *Image provided courtesy of Lunar Jim, Alliance Atlantis*

We will be creating stronger international ties with China and India by extending our UK/US Science Bridges schemes to them. The first international UK Research Council office will open in Beijing next year. And we are working with the Royal Society to establish a new, high profile, prestigious international fellowship and alumni scheme to firmly establish the UK as 'partner of choice' for scientific collaboration in the twenty-first century.

So, the basis for world-class science is in place. But nothing in a modern economy is forever. There are two things in particular that threaten the strong position we have attained.

Reject anti-science

The first is perhaps the most difficult issue of all. Government must show leadership and courage in standing up for science and rejecting an irrational public debate around it.

The anti-science brigade threatens our progress and our prosperity. We need political and science leadership that stands up to them. BSE, GM foods, MMR, stem cells – these experiences have given us a template of how to conduct a rational conversation about science. In government, we need to follow it and then trust to the good judgement of the public.

But we must then be honest about the risks. We cannot claim that any new technology is 'absolutely safe'.

The next generation

I have exhorted young people to be alive to the wonder of science. We have a responsibility to make that possible by providing a first-class science education system.

The recruitment of teachers has been an undoubted problem. In 2004, the Ten-Year Science and Innovation Investment Framework included a range of new policies to stimulate the recruitment of science teachers. The Next Steps programme specifies targets for lessons to be taught by subject specialists.

There is already some progress. Science teacher vacancies are already falling. 7,500 new science teachers were hired in 2005 – 70 per cent more than 1999/2000.

The new science GCSE has been developed with the support of many eminent scientists, including the Royal Society. By engaging more young people with science, it will encourage more to continue science at A-level or through the new specialised Diplomas. At the same time, we are giving a new right to students who gain above average grades in the Key Stage 3 tests at age 14 to study triple science – physics, chemistry and biology individually.

Celebrate science

We need our scientists today to be as celebrated and famous as our sportsmen and women, our actors, our business entrepreneurs. Scientists are 'stars' too.

Coupling invention and innovation

Ian Taylor charts the way ahead

The Prime Minister and I broadly agree on the need to turn science to economic use, the need to reject irrational public debate about science and the need to enthuse young people to engage with science.

As global competition intensifies, the UK has to stimulate public and private sector R&D and innovation more effectively. Without the ability to create and retain high-quality, knowledge-intensive jobs and the innovative businesses that develop and apply new technology, we will suffer. We also have to demonstrate a science-friendly environment to attract the top scientists and engineers from other countries.

Taskforce proposals

The Science, Technology, Engineering and Mathematics (STEM) Taskforce which I chair for the Conservative Party argues that the UK must tackle the gap between invention and innovation more effectively. We have so far made three proposals.

First, by making better use of the £150 billion a year government spends on procurement – a point only made by the Prime Minister after nearly 10 years in office (and after our first Interim Report recommending this approach!). The concept is to shift the emphasis of governmental support for innovation from input (subsidising embryonic ideas) to output (procuring effective solutions to society's needs).

Second, we would be much more radical than the PM by transforming the Technology Strategy Board (TSB) into a more effective Innovative Projects Agency that uses targeted resources on specific projects. It would have five times the TSB's budget by consolidating other government R&D/innovation funds which are currently poorly co-ordinated and thinly spread.

Third, as the Prime Minister points out, scientists need to think not only intellectually but also commercially. Therefore the recognition and reward system should be

shifted to raise the esteem of those who engage in exploitation of discovery.

My taskforce is now turning its attention to analysing the anti-science culture in Britain including concern about scientific literacy and the lack of awareness about what scientists and engineers do. Many of the problems with poor outputs in science education derive from cultural barriers that discourage young people from studying STEM subjects. We still undervalue the efforts of scientists and engineers.

What can be done to change this?

Ian Taylor MP

is Chair of the Conservative Party's STEM Policy Taskforce and was Science Minister 1994-97. Details of the STEM task-force proposals are at <http://tinyurl.com/2n6tb9> taylori@parliament.uk

'It was a roller-coaster ride'

Evan Harris spies contradictions

I cheered inwardly when the Prime Minister praised the scientific method and evidence-based analysis.

I had just helped the Science Select Committee produce a report on this very subject. But in the very next sentence came the same old spin and statistical trickery that is the opposite of what he had just called for. He claimed that the number of science undergraduates had increased by a quarter since 1997. But everyone in science knows that when Information and Communications Technology and new courses, like Forensic Science – which are short on 'hard' science – are excluded, the situation in the key core subjects like physics and chemistry is far worse.

The PM talked about the urgent need to take on the forces of anti-science (and by implication pseudo-science), and the government did a good job on MMR, for example. But in an interview the same day for

New Scientist, he said that he was intending to tackle creationists in our schools, or those who seek to claim a scientific evidential basis for homeopathy.

The PM was rightly clapped when he boasted about the UK's record on stem cell science, since we are both permissive and properly-regulated – a unique combination. But within a few weeks, the government White Paper on embryology proposed a new ban on hybrid embryo research with no good reason and all the appearance of conceding to a largely religious lobby.

We all agree with Mr Blair that it is vital for young people to choose science careers, but in education the Prime Minister's own policies undermine his good intentions. He has presided over the imposition of massive debt on science graduates, a failure to provide specialist science teachers in our schools, and allowing the closure of university science departments by imposing a free market on

higher education, which values media studies ahead of physics and chemistry.

Low attainment in schools, high graduate debt, poor post-doctoral career progression – our brightest and best are not going into scientific research and you can't blame them. It's not rocket science but the government barely sees the problem and has not yet begun to solve it.

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Space tourism

An adventure on the horizon, reports John Loizou

Current studies estimate that there will be approximately 1,000 space tourists per year by early in the next decade. The market for sub-orbital travel may reach nearly £500m by 2021, but it is still some way from an immediate business opportunity offering affordable space travel to all.

It is currently feasible only for the very wealthy enthusiast, and activity is occurring predominantly in the US. The success of space tourism (or personal spaceflight, the industry's preferred name for it) depends upon a mass demand from potential travellers and the participation of industrial and financial partners throughout the world.

Orbital space tourism, for which there is presently only the option of a £10m trip to the International Space Station, demonstrates continued demand. However, it is personal spaceflight at the lower end of the cost scale which is likely to develop significantly over the coming years.

Sub-orbital flight

In October 2004, *SpaceShipOne* met the challenge of the \$10 million (£5.4m) Ansari X Prize¹ to produce the world's first affordable and re-useable spacecraft for sub-orbital flights. It was followed by Sir Richard Branson launching Virgin Galactic, a company looking to build and profit from the new space tourism industry.

Virgin Galactic are currently charging approximately £100,000, whilst Space Adventures are marketing trips for a mere £55,000. These consist of short-duration sub-orbital flights which give passengers a brief experience of weightlessness. Unlike Virgin's offering, passengers on Space Adventures' Russian-developed Explorer vehicle will not be able to leave their seats. Virgin Galactic's market research identified that the full experience of weightlessness is vital to the majority of their potential customers and so their approach is designed to allow passengers to float free for five minutes, before being automatically returned to their couches for the re-entry and return to land.

To become a feasible commercial venture, sub-orbital space tourism requires technological breakthroughs that improve safety to at least the level of early commercial aviation, which is at least 100 times safer



SpaceShipOne: the beginning of the end of the children's inheritance? Courtesy of Scaled Composites, LLC

than current spaceflight. Whilst the required technologies do not exist for human orbital spaceflight, they do exist today for suborbital trips, as demonstrated by *SpaceShipOne*.

Legal barriers

As well as the technical hurdles, there are a number of other barriers. Personal spaceflight throws up legal issues that have never been properly considered before. Where does the regime for aviation law end and space law begin? Is a vehicle carried aboard an aircraft and launched at 50,000 ft to climb out of the atmosphere powered by a rocket before gliding back to land on a normal runway an aeroplane, a spacecraft or just an extreme form of fairground attraction?

Even if the legal definitions can be clarified, the insurance industry doesn't yet know how to handle such a hybrid creature. Aviation and space launch vehicles have entirely different approaches to insurance of the craft itself, while third party liability and passenger liability issues have never been seriously considered previously for trips into space.

What's the point?

If it's technically incredibly challenging, legally complex and astronomically expensive, why is anyone seriously considering personal spaceflight as a commercial opportunity?

The best answer has come from Brian Binnie, test pilot of *SpaceShipOne* and one of only three people ever to have earned gold 'Astronaut Wings' by flying themselves into space, rather than being strapped onto a rocket flying under automated control. Mr Binnie is currently supporting development of the 'VS Enterprise' rocketplanes ordered by

Virgin Galactic, and he gave an impression of how it would feel to be a passenger on such a craft, when the rocket motor shuts off after two minutes of powered flight:

...You literally step across a threshold into another realm, where beauty and blessed peace and quiet reign, graced by the instant karma of weightlessness. And, my God, that view! The black, foreboding void that is space is magically revealed as if someone has pulled back a stage curtain for your eyes only. This vast presence, looming and yawning through the windows, offers both menace and mystery.

Below is a reassuring comfort — a 1,000 mile horizon that reveals a magnificent splendour of mountain ranges, coast lines and weather patterns normally only seen on the evening news. And separating space from Earth is an improbably thin, bright, electric-blue ribbon that is the atmosphere...

That's the point. That's why hundreds of people have already paid huge sums of money to book their seats. In the next few years more and more of us will be facing a difficult dilemma: children's inheritance, or a trip into space?

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1. See www.xprizefoundation.com/prizes/xprize_ansari.asp

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Getting to grips with violence

Medical scientists are crucial, reveals Jonathan Shepherd

A great deal of violence which results in medical treatment never comes to the attention of the police. Since the mid 1980s, medical science, with its focus on injury, epidemiology and risk factors, has made increasing contributions not just to understanding violence, but also to reducing it.

Traditionally, understanding and tackling violence has been the responsibility of social scientists, lawyers and criminal justice agencies – the police, the courts and the prison service, for example.

Pooling for prevention

Studies in Bristol, Swansea and Cardiff have shown that, overall, only a quarter of violence which results in treatment appears in official police records. Evidence from National Crime Surveys in the UK and other countries shows that this lack of police knowledge extends across national boundaries.

These findings have resulted in the formation of more than 350 crime and disorder reduction partnerships across the UK, in which data about violence and other crime from hospitals, police and other sources can be pooled to give a much more accurate picture of violence in particular cities and regions. Accident and emergency (A&E) and other NHS consultants can make influential contributions to these partnerships. Evaluations have established that this partnership approach results in more prevention than is achieved from police working on their own. These partnerships are now statutory under the provisions of the UK 1998 Crime and Disorder Act and the 2002 Police Reform Act.

Practical measures

Evaluations, including a randomised experiment in an A&E department, show that the best way to collect evidence in health settings is electronically, by hospital reception staff. Following this, data are anonymised and shared with crime analysts who produce summaries of violence hotspot locations, trends and other characteristics of violence which are essential for targeting police resources.

A systematic review shows that targeted police patrols reduce violence more effectively than other police strategies. A&E data can identify violence hotspot nightclubs and streets, previously not identifiable by the police. This combination of A&E and police

data have prompted changes in the routes of police patrols to include them. It can also target overt and covert operations at violence hotspots, and reallocate police resources from the suburbs into town and city centres where violence is most likely. In other strategies, it can pedestrianise entertainment thoroughfares and relocate fast food outlets, to reduce the chances of drinkers colliding with each other and with vehicles.

The crucial contributions of the health sector are intelligence about the locations of violence, and participation of medical consultants in partnerships. This research has also resulted in reforms to General Medical Council ethical guidance to doctors on prompt police reporting in the public interest where the victim or others remain at risk.

International dimensions

This new, epidemiological approach to violence prompted the publication of the World Health Organisation (WHO) report on Violence and Health in 2002.¹ WHO prevention activity is being developed globally in the WHO Violence Prevention Alliance (VPA).² VPA Partners include the Centres for Disease Control and Prevention in the United States, the Medical Research Council of South Africa and the Public Health Agency of Canada. Previously, the health sector contributed passive audits of violence-related morbidity and mortality, however it has not been realised until recently how powerful public health interventions to prevent violence can be.

These new, unique contributions of medical science stem from UK research and are helping to put the victim at the centre of criminal justice systems around the world.

Clarifying statistics

This science-based approach is also bringing clarity to crime trends in the context that government crime statistics have often produced conflicting and confusing messages. In the UK for example, this new injury measure has confirmed that violence has decreased since 2000, and that apparent increases identified from police records simply represent greater ascertainment rather than any true increase.

Here, a controlled study of closed circuit television in city centres found that greater surveillance increased ascertainment from



Medical staff record violence the police don't see

the police standpoint, but decreased numbers of victims going to hospital for treatment of their injuries as a result of prompt police intervention. Clearly, police records are not a reliable measure of violence, even in a developed country like the UK.

Furthermore, increased detection of violent offences by the police, far from signalling an increase in violence, is essential if violence is to be prevented. These findings are influencing national violence strategy in the UK: there is now much greater emphasis on violence resulting in injury.

The science of violence was discussed at a recent symposium organised by the Academy of Medical Sciences

1. See www.who.int/violence_injury_prevention/violence/world_report/en/

2. WHO ISBN 92 4 159313 X 2005; see http://whqlibdoc.who.int/publications/2005/924159313X_eng.pdf

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Future access to digital materials

Roderic Parker lays out the British Library's strategy

Digital materials present a challenge to all libraries and archives. The British Library is not alone in looking for answers in this rapidly changing area. We are looking for solutions to a wide range of problems; both on our own and in co-operation with others.

The problems of changing technology are epitomised by the BBC Domesday project. The BBC's electronic Domesday project, a survey of British life in the eighties, was released in 1986 but was nearly unusable 15 years later. The hardware and operating system were obsolete, and the videodisks were deteriorating. It needed concerted preservation efforts by the Universities of Leeds and Michigan, and the National Archives to rescue it and make it publicly accessible. Another five years and it would probably have been too late. By contrast, the original Domesday Book written in 1086 is still readable today, although written in Latin, and has recently been digitised and moved online to allow greater access.

Current problems

First, digital storage is not stable. We know that even the best managed, best quality media will deteriorate over time, a 'time' measured in decades. Print on paper also deteriorates, but the timescales here are more likely to be centuries. Can we be sure that, despite careful storage management, we can guarantee access to today's files tomorrow?

Second, digital materials always need a device to 'read' them: a computer, an MP3 player, or something else. This runs yesterday's software on yesterday's hardware, and will inevitably be left behind by tomorrow's technology. Will we be able to read today's materials tomorrow?

Third, all library processes need to evolve to handle digital items. The very intangibility of digital items means that traditional library methods need to change.

There is little point in planning long-term services unless we can guarantee that the materials we hold will continue to be available into the future. The British Library is doing many different things to ensure that this will be so.

British Library activities

Our secure storage system is now deployed on our two main sites, with planning for a third site at the National Library of Wales at



Domesday Book, 1086: still readable *The National Archives*

an advanced stage. Under this system, we can take in a digital file or a set of related files, and 'sign' it so that at any future time we can guarantee that the file is the same as when we received it. We will regularly check all the files stored so that we will be able to recover a clean version if we do detect any changes.

Our secure storage system will preserve the original sequence of digital 'bits', but to keep this data useful we need to look at other strategies. One is transforming data files into more modern file formats that can be read by newer application software. Another is using new software that behaves on current systems like old software did on now-defunct systems. These strategies are part of our Digital Preservation Strategy Framework.¹

We are also the lead partner in the four year EU-funded Planets (Permanent Long-term Access through Networked Services) project: a 15-member consortium working on the long-term preservation of digital text, images, audio, and dynamic data sets.

The British Library is one of a dozen or so bodies which has recently helped turn the proprietary document format developed by Microsoft into an international standard. Microsoft's customers, using this standard, should soon have more confidence that they can store and manage their data for the long term.

We have also, jointly with the US Library of Congress, announced our support for managing the content of electronic journals, and its description, according to a widely-respected standard. The widespread use of

this standard should help ensure long-term access to e-journal content.

The innate ease of copying and transferring digital items does not relieve the Library of the responsibility to protect the rights of their producers. This involves more than the digital equivalent of copyright on printed publications. We have commissioned work on the very difficult issues around establishing and applying access policies.

Overall strategy

The British Library's current strategy was expressed in *Redefining the Library*, published in July 2005.² One strategic priority for 2005 to 2008 is to develop the National Digital Library as a key part of the UK's research e-infrastructure, to work with others to shape this e-infrastructure, and to continue our innovative digitisation programmes.

In these and other ways, we are ensuring that we can keep today's electronic heritage for tomorrow's users.

References

1. See www.bl.uk/about/collectioncare/hbookframework.html
2. See www.bl.uk/about/strategy.html

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Jolly good fellows

Iain Cameron on shaping the research culture

Let's imagine the perfect researcher in five years' time.

Naturally we would hope that he or she (hopefully more shes) will be undertaking research of international significance. We can have a certain amount of confidence here, since analyses show UK research to be globally competitive. But we would also like our researchers to have fulfilling careers that enable them to plan their professional and personal lives. And we would like them to have the skills to derive the maximum impact from their knowledge, skills and experience.

The Research Councils have a particular responsibility to see that this vision is realised, since we provide the funding for around 30,000 researchers in the UK. Indeed, all eight Councils have been undertaking activities to see that they are as well-equipped as possible to do their research or undertake their studies. Recently, Research Councils UK (RCUK), the partnership of the eight Councils, published a research careers strategy which for the first time brings these activities together within a common framework.

New fellowship scheme

An activity that symbolises our approach is the RCUK Academic Fellowship Scheme. Conceived by Sir Gareth Roberts in his 2002 report *SET for Success*,¹ the Scheme will create up to 1000 fellows, part-funded by higher education institutions. The participating institutions have an obligation to employ the fellow as an academic at the end of the five-

year fellowship, thus providing a route into permanent employment for researchers.

So far, so good, but leaving it at that would be a missed opportunity. RCUK fellowships are highly sought after by the best of our early career researchers. In short, the winners are future research leaders and prime targets if we are to try to shape the research culture. We also have a responsibility to ensure that our fellows are prepared for an academic career.

Impact through outreach

So what impact would we like our researchers to have? UK scientists have been accused of two main failings in recent years.

First, they have failed to engage the public in their work. While surveys suggest high public support for science and scientists, lack of trust in the governance of science is said to have contributed to public anxiety over MMR and BSE, and concerns over the take-up of science at A-level and university suggest that there might be value in bringing researchers into schools.

Second, it has been suggested that they have failed to exploit their research, not just in the economic sense but in promoting its value in shaping public policy and services.

Our scientist of the future is therefore one with the skills and confidence to share their knowledge and ideas with a range of audiences. Currently, the terms of the grant require fellows to spend up to 15 per cent of their time on outreach activities. We do not specify what those activities should be,

since the research, the individual, their department and even the location of the institution will have a bearing on the most effective form of outreach.

Some might take an opportunity to work with local schoolchildren; others may work with local or central government, or explore the relevance of their research to business.

Supporting public engagement

We recognise that outreach has to be effective and that fellows require support and guidance for these activities. They should not be undertaken solely to fulfil contractual requirements.

In January this year, we held our first national conference for RCUK Academic Fellows in Birmingham. The aim was to share experiences and best practice in many areas, but with a particular focus on outreach. We learnt that much of the outreach activity undertaken so far has been in schools. The success of the event was such that we will probably repeat it next year, and this might be an opportunity to encourage a broader range of outreach activities.

There are in the region of 150,000 academics working in UK higher education institutions. On the face of it, the fellows funded through the first phase of the scheme will not drive significant cultural change, and indeed this is just one of a number of Research Council initiatives with this goal. The Beacons of Public Engagement – funded jointly with the Higher Education Funding Council for England and the Wellcome Trust – and the RCUK Business Plan Competition are two notable examples.

Nevertheless, culture change is effected through people and not schemes, and our vision is that the RCUK Academic Fellows become exemplars in their departments, inspiring others by words and deeds.

1. Available at <http://tinyurl.com/8bh7x>

The Research Careers and Diversity Strategy can be found at www.rcuk.ac.uk/rescareer/strategy.htm



The recent RCUK Academic Fellowships conference brought together over 100 fellows together to share ideas and best practice

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Engineering sporting performance

Claire Davis forecasts who will benefit at the Olympics

Materials developments and engineering technology have long been known to have a major impact on sporting performance.

Pole-vaulting

In pole-vaulting, the International Association of Athletics Federation (IAAF) rules state that 'the pole may be of any material or combination of materials and of any length or diameter, but the basic surface must be smooth'. The sport has seen a huge change in the materials used for the pole, and in the world records achieved.

When it first started, rigid solid wood poles were used. Then in the early 1900s, lightweight bamboo poles were introduced along with a 'box' to receive the pole. In 1957, an aluminium pole was used by Bob Gutowski to set the world record height of 4.78 m. Later that year, Don Bragg used a steel pole to increase the record to 4.80 m. The next development was the introduction of glass fibre-reinforced polymer composite (GFRP) poles, which are flexible, allowing a different athletic style (feet first, vertically upside down approach) and a more energy-efficient vault. In 1994, Sergei Bubka set the current men's world record of 6.14 m using a GFRP pole.

Tennis

Other sports have also seen major changes in the materials used for the equipment, and in subsequent performance. Tennis racquets have moved from wood and wood laminate frames to aluminium, and now GFRP and/or carbon-fibre-reinforced polymer composites. These can also contain Kevlar fibres, boron nitride ceramic fibres or, more recently, titanium fibres. The power of the racquet has increased, which results in the serve speeds being greater. The serve speed on fast courts, such as the grass courts of Wimbledon, was getting so high (the current record of 153 mph is held by Andy Roddick) that the response time of the receiving player approached an athletes' reaction time and the game was becoming serve-dominated.

Spectators complained that tennis was changing and was not so interesting to watch. The International Tennis Federation introduced new fast, medium and slow balls for use on different court types. The 'slow' ball is six per cent larger, giving a 12 per cent increase in drag and hence a 10 per cent increase in response time for the receiver. The

nature of the game has therefore changed again, partly in response to spectator wishes, and more rallies are being seen during tournaments on fast surfaces.

Other sports

Some sports are less sensitive to these changes. Track athletics can see moderate improvements in performance with the introduction of aerodynamic Lycra clothing or specialist running surfaces for fast times. But the influence of training, physiology and, unfortunately, chemical stimulants have had more significant effects. Other sports are heavily equipment-dominated; perhaps none more so than Formula 1 racing where the engineering technology can outweigh individual driver performance.

Is the influence of materials and engineering technology fair? The regulatory bodies for each sport limit equipment development to minimize differences between top athletes. A sport like Formula 1 racing is designed to showcase the teams' different technological developments, although the



Pole-vaulting has benefited greatly from materials science

Fédération Internationale de l'Automobile has introduced rules to limit differences, for example engine capacity limits or a single tyre manufacturer for the 2007 season.

It is interesting to compare performance in sports that could be said to be 'equipment and technology reliant' or 'athlete reliant'. In the 2004 Summer Olympic Games, the top eight countries in track cycling and rowing were Australia, Great Britain, Germany, Netherlands, France, Spain, Russia, and Italy. In track athletics, the top eight were USA, Russia, Ethiopia, Kenya, Greece, Cuba, Jamaica, Great Britain. The developed world dominates the former list, whilst quite a few developing nations are included in the latter. There are physiological and cultural influences on this data (success breeds success, and so on), however, the ability to invest in the infrastructure and equipment clearly brings results.

Implications for the Olympics

China has invested heavily, not only in the infrastructure for the Games in 2008, but also in the training and development of athletes and the latest and best equipment. I think we can expect to see Chinese athletes take many of the honours in Beijing.

In recent years, UK Sport has invested particularly in cycling and rowing to support the athletes and develop a competitive edge in equipment, and this has borne its reward in performance.

Investment to support athletes, improve training methods and facilities, develop and support new talent, and conduct equipment R&D are all required to provide that competitive edge.

This is an edited version of C. Davis (2007), Gaining a competitive edge, *Materials Today*, 10, Issue 1-2, p 60. It is reprinted with permission from Elsevier.

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Heritage science

It's at a turning point, says Margaret Sharp



Stonehenge: even stone erodes © English Heritage Photo Library

When we launched the House of Lords Committee on Science and Technology's enquiry into heritage science early in 2006, we knew that we would be tackling a subject in which the arts and humanities overlap.

This should not in itself be a problem: science and technology contribute hugely to our experience of cultural heritage, not just through the development of new conservation strategies, but through the many new applications of information technology. However, what we quickly realised was that what we have called 'heritage science', the diverse range of scientific research that supports the heritage sector, was in danger of falling between two stools. Neither quite an 'art' nor a 'science', it appears to be suffering increasing neglect, to the extent that the UK's long-standing reputation for excellence in the field is at risk.

We had to begin by getting back to basics. We took the view that our cultural heritage is a legacy left to us by our forebears, which we in turn have a duty to pass on to our descendants. That heritage is in large part composed of physical artefacts — buildings, works of art, books, landscapes — which exist but also change (degrade) over time. Even stone erodes! Conservation may be defined as a cautious approach to the management of this change.

Accessibility means degradation

Conservation of cultural heritage is thus important to current enjoyment and also contributes directly to the government's

sustainability agenda. Yet the Department for Culture, Media and Sport appears not to have grasped this. Not only is there no mention of sustainability or conservation in its departmental objectives or Public Service Delivery Agreements, but the Department has instead imposed upon the major museums and heritage organisations demanding targets for increasing public access.

We applaud the widening of public access, but the government has to realise that increased access means increased wear and tear: surface erosion, disfigurement from dust accumulation, flaking and cracking from fluctuating humidity and temperature, along with the risk of more immediate and catastrophic damage to precious objects.

The more you promote public access, the more you must invest in heritage science and in conservation.

In addition, heritage is a major and ongoing contributor to national wealth, through cultural tourism. It is estimated that the tourism industry provides employment for over two million people, some seven per cent of all employment; it generates at minimum five per cent of GDP. It is only common sense to invest in the scientific research and practical conservation that are essential if these economic benefits are to be maintained in the long term.

Government should lead

So this is our central recommendation: there needs to be leadership from the top. The Department of Culture, Media and Sport

(DCMS) should adopt the need to conserve our cultural heritage for the benefit of future as well as existing communities as a fundamental departmental objective. This objective should then cascade down through the sector as a whole, in particular through funding agreements.

We see this as an essential prerequisite if the heritage sector — fragmented and underfunded as it is — is to come together in developing a more coherent approach to scientific research and new technologies. In particular, we are anxious to see the sector develop a broad-based national strategy for heritage science. We would like to see this championed at departmental level by the newly-appointed DCMS Chief Scientific Adviser, and suggest that it might be coordinated administratively by English Heritage.

Bottom-up

We believe it is crucial that any such 'strategy' should not be a top-down bureaucratic exercise. Rather it should be built from the bottom up, by the 'doers' of heritage science, the researchers based in the conservation laboratories of major national museums or in our universities, and by the 'users' of that science — those who care for our heritage, such as conservators working in museums and galleries, or in non-governmental organisations such as the National Trust or Historic Royal Palaces. Only if they all participate in developing the strategy will priorities for research be identified, projects developed and collaborative teams put together.

If the strategy is to be successful, then the sector will need more resources. We also suggest that there should be a directed programme of research, funded jointly by the Research Councils, but also bringing in outside funding, which we see as essential to renewing the sector and attracting new blood into it.

We are at a turning-point. Science and technology present a host of exciting opportunities to the heritage sector. They must not be wasted.

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Minorities in science

Pooran Wynarczyk describes new initiatives

Women make up around half of the population in the UK. Ethnic minorities account for some 7.9 per cent (4.6 million people in 2005, up from one million three decades ago). However, participation of both groups in Science, Engineering and Technology (SET) education and employment remains low compared with their white male counterparts.¹

Concerns about the under-representation of women in SET have been expressed by researchers, policy makers and practitioners since the seventies. However, it is only recently that the government has recognised that ethnic minorities are also under-represented in the scientific workforce and has begun to show some commitment to tackle this problem.

Ongoing initiatives

As a key part of the Department of Trade and Industry (DTI) Science in Society Programme, for example, the government has developed an initiative to enable schools with a high proportion of Afro-Caribbean and Bangladeshi/Pakistani pupils (the most under-represented groups) to bid for funding to be used for extra-curricular science learning activities. The government has set aside a total of £1.5 million for the next three years for this programme, which will be managed by SETNET. To date, some 38 schools around the UK have been awarded almost £900,000 to set up their own projects.

The UK Resource Centre for Women in SET was launched in September 2004. This DTI-funded body aims to provide practical support to encourage more women to take up a career in SET, including those with a career break.

New developments

A recent publication reveals that research, policy and practice generally tend to focus on SET occupations.¹ The roles performed by women in these occupations are left largely to conjecture. There is also a particular paucity of research, data and information on the parts SET women play in the public and private industries and organisations outside of the educational sector.² Women may, therefore, be behind the creation of a much greater number of scientific activities and discoveries than given credit for.

Considering this, the Small Enterprise Research Unit (SERU) at Newcastle University

is in the process of establishing an International Research Forum on Gender and Ethnicity Issues in SET. The Forum will aim to develop and undertake more detailed and rigorous collaborative action and policy research at international levels in this field. We anticipate that the Forum will enable the identification of good practices and will facilitate their exchange amongst countries and regions.

New platform for women

Data also show significant regional differences in the level of participation of women in SET in the UK.³ The opportunities for participation in scientific activities depend on the country and the region in which one is located, and sadly these opportunities appear to be particularly low for women in regions with low research and development (R&D) intensity and scientific activities, such as the North East of England.

In order to encourage greater participation of women in science in this region, an Economic and Social Research Council Impact Grant has provided funding for SERU/Newcastle University to establish the North East of England Role Model Platform for Innovative Women, which began last month. The platform will focus on promoting scientific activities and discoveries amongst women and girls in the North East, to aid their entry and career progression beyond the 'glass ceiling' in scientific fields.

The initiative will include the creation of a web-based directory of local female role models, and the establishment of a platform for women scientists and innovators upon which successful local women role models can act as mentors and coaches.

A comprehensive package of workshops will be designed; including a virtual directory of role models, presentations by role models, and analysis of their experiences in R&D and innovation. Career progression, confidence building and solutions to personal and professional barriers will feature, as will a practical introduction to intellectual property rights issues such as patent searching and design, and subsequent 'ownership'.

The platform will also investigate the unique challenges of developing a business for a new product, flexibility in the workplace, creative thinking and leadership, skills and training needs, and sources of



Women and ethnic minorities are an untapped pool of scientific labour

innovation funding. The workshops will include sessions on major EU, UK and regional SET and innovation-related initiatives, bursaries, and awards.

Women, and members of ethnic minorities, remain the most obvious and untapped pool of human resources in science and technology in the UK. Achieving full and equal participation in all scientific disciplines, and at all levels, will enhance diversity, promote further progress and excellence, and will help to overcome the shortage of highly-skilled labour that the UK currently faces.

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People should determine the future

Jack Stilgoe introduces sciencehorizons

Julia is feeling run down. She's also in a hurry.

She doesn't have time to see a doctor, so she heads for a clinic to pay for a remote diagnostic. It's expensive, but time is money. In the waiting room, Katie is waiting with her child, who has had trouble with her back since a car crash in 2018. Katie doesn't see why all the new therapies cost so much. She can't afford to make her daughter well, or 'better than well', as the adverts promise. On the chair opposite, George is waiting to see a real doctor. It takes longer, but he needs to talk. He's in good shape for a man his age, but he's worried that his Alzheimer's drugs aren't doing their job.

Predicting the future

Science and technology point forwards. Their currency is the future. And as they play a bigger role in our everyday lives, society has become more forward-looking. However, as sociologist Anthony Giddens reminds us, it is also worrying: 'The world in which we live, rather than being a world of increasing certainty, is much more one of increasing uncertainty.'¹

Governments and businesses direct more and more energy and money towards foresight, scenarios, horizon-scanning, call it what you will. They invest more and more in prediction so they can prepare better for what's coming.

At the same time, it has become recognised that debates about science, technology and the future need to include a wider range of voices.

Over the last five years, the UK has seen a move towards 'upstream' public engagement in science.² Scientists and members of the public are coming together to ask new questions about the role of science, the future and the sort of world we would like to live in. The time is now right to think about how we can bring these conversations together into a programme of democratic deliberation about the future.

Need for democracy

Until now, the future has not been very democratic. It has been the preserve of experts and companies.

This 'great man' view of the future is driven by technology. It is an extrapolation from what technology does for us today to what future technologies will do for us tomorrow. And though it advertises itself by its predictions, its track record is not great.

We have all heard the stories in which technologists have been let down by their foresight (*I think there is a world market for maybe five computers* – Thomas Watson, founder of IBM; *Some day, every town in America will have one of these* – Alexander Graham Bell talking about the telephone; and many more).

As well as being unreliable, visions of the future that are driven by technologists and technologies normally exclude any sort of discussion of what people might want.³ It is

no coincidence that many pictures of the future leave out people. Monorails and hovercars fly facelessly beneath cloudless skies. When people are included in utopias, they tend to be homogenised. The slogan of the 1933 World Fair, *Science Finds, Industry Applies, Man Conforms*, makes sense only in the realm of sci-fi.

The question is: how can we put people back into the future?

Sciencehorizons project

The sciencehorizons project looks to do just this.

Working with the government's Horizon-Scanning Centre and science centres throughout the UK, the project is asking people what their hopes and fears are for the future of science, with the aim of feeding it back directly into government policy. The Centre needs not only foresight (an ability to see what might be coming) but also insight – an ability to make sense of what might be coming. These are not tasks that can be achieved by a group of experts sitting in a smoke-filled room. They require new perspectives and new approaches.

Scenarios such as the one above will prompt the public discussions. But instead of saying to people, 'This is the future, what do you think?', we will be asking 'This is one future, what do you want?' Rather than starting with technologies, we will be starting with people.

One of project's aims is to reach as many people as possible. If you're interested, and would like to get involved – as a participant or in running a discussion event – visit www.sciencehorizons.org.uk or send an email to contact@sciencehorizons.org.uk.

References

1. Transcript of Anthony Giddens's 1999 Reith Summary lecture, <http://tinyurl.com/h8cag>
2. See Wilsdon J, Wynne, B and Stilgoe, J (2005). *The Public Value of Science*, Demos <http://www.demos.co.uk/publications/publicvalueofscience>
3. For example, see Alan Cox (June 2006), Where did texting come from? *Science & Public Affairs*, p.16, www.the-ba.net/spa



Sciencehorizons: listening to people

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Scientists should speak out about animal research

They have good stories to tell, proclaims Corina Hadjiodyseos

In December last year, we saw the results of the Weatherall report¹ supporting the use of non-human primates in research of biological or medical importance.

Led by Sir David Weatherall, the study was commissioned by the Academy of Medical Sciences, the Medical Research Council, the Royal Society and the Wellcome Trust.

'There is a scientific case for careful, meticulously regulated non-human primate research, at least for the foreseeable future, provided it is the only way of solving important scientific or medical questions and high standards of welfare are maintained,' said Sir David Weatherall.

The results, welcomed by the scientific community, were predictably condemned by antivivisectionists who deem the use of non-human primates in medical research unnecessary.

Scientists responsible

This reaction was not a big surprise. Indeed, the idea of using monkeys for medical research makes many of us feel uncomfortable. Does that, however, mean that it should be banned as the antivivisectionists demand? Can primate research be deemed unnecessary if studies on relatively few animals lead to vaccines or treatments for diseases that affect thousands or even millions of people?

As with any debate, it is easy to get carried away by emotion and loaded slogans: something that antivivisectionists do well. In fact, it is even easier to get carried away from the main issue, which is whether or not research using any animals is necessary.

The scientific community is partly responsible for this. By keeping their heads down, many scientists have not only given the

impression that they have something to hide but they have neglected those who would be their greatest supporters: the general public that benefits every day as a result of their work.

Opinion polls show that most people take a balanced approach and want to know more before making a decision about the issue. Recent surveys carried out by MORI² show 90 per cent of the public accept the need for animal research provided that suffering is reduced as much as possible, the research is for serious medical purposes, and there is no alternative.

Necessary research

Let's return to the primate example. According to the Weatherall report, non-human primates are necessary to address particular research questions related to the immune, nervous and reproductive systems where rodents and other animals can be too different from humans. The report stresses that research and testing on non-human primates provides the only means of insuring against the failure of therapies in humans in areas such as Alzheimer's or Parkinson's disease and vaccines for infections such as HIV. Is this not necessary?

The report states that three diseases – malaria, HIV and tuberculosis – which combined kill 800 people globally per hour, would best be tackled with vaccines that could only be developed using monkeys. Last year, medical procedures carried out on monkeys in the UK represented 0.16 per cent of animal tests (most use rodents) and a total of 3,115 monkeys.

Just take a look back through the years on all the medical advances that were achieved by using monkeys: modern anaesthetics,

kidney dialysis, hepatitis vaccines, life support systems for premature babies, to name just a few. Necessary?

Challenging the necessity of animal research is like challenging the necessity of the medical treatments and methods that we now have and those we will have in the future.

Scientists must talk

Now is the time for the scientific community to start meeting another necessity: that of more and better communication and openness with the public. Indeed, they have a responsibility to do so. In the past, people have had far more information from antivivisection campaigners than from biomedical researchers. This imbalance has to stop if the public are to get the information they need to decide for themselves whether they agree with the use of animals in medical research.

While committed antivivisectionists will never be persuaded, the general public needs to understand what is being done on its behalf. Scientists and their institutions have a responsibility to present the facts about their work and how necessary it is.

The Research Defence Society Resource Centre is rolling out a communications handbook that outlines measures that research institutions can take to improve communications on the use of animals in research without attracting unwanted attention. It includes general advice and guidelines on how to prepare a proactive communications strategy about the use of animals in medical research and demonstrates through examples that academic institutions can be more proactive in their communications with minimal risk.

1. Sir David Wetherall (December 2006). *The use of non-human primates in research*. Available at www.acmedsci.ac.uk/images/project/nhpdownload.pdf

2. *The use of animals in medical research*. Available at www.ipsos-mori.com/polls/2002/cmp.shtml



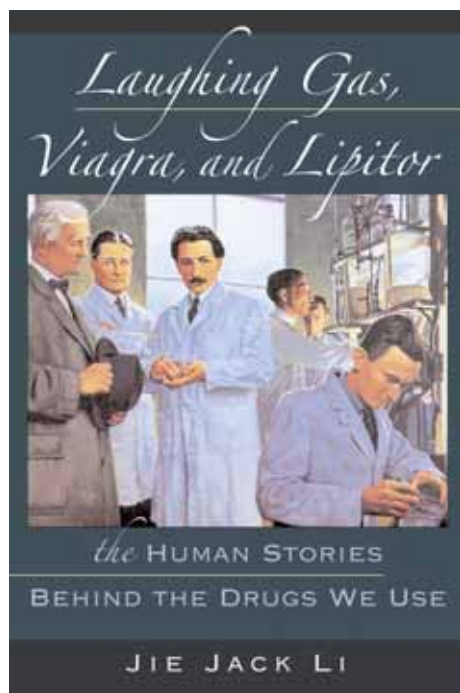
Most animal tests use rodents RDS/Wellcome Trust Photographic Library

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Not only men in white coats

Susan Aldridge surveys a story of drugs discovery

Laughing Gas, Viagra, and Lipitor: The Human Stories Behind the Drugs We Use, by Jie Jack Li (Oxford University Press, hardback, 2006)



Who discovered what and when

Most of us have gained some benefit from medicinal drugs: a course of antibiotics to clear up an infection, painkillers, or maybe even a lifesaver such as a 'clotbuster' after a heart attack or stroke. The modern era of drug discovery stretches from penicillin and aspirin through to statins, Viagra, and the newest anti-cancer drugs like Herceptin.

Drug discovery can be an exciting and challenging business. Of thousands of potential 'lead' molecules entering a research programme in cancer or infectious disease, it is likely that only one or two will ever reach the clinic, but these may have the potential to save millions of lives or greatly improve their quality.

The stakes in the pharmaceutical industry are very high, both in terms of money and time invested, and for human health. And the industry gets some bad press; it often seems in need of people to give an inside view to the public that they will listen to and learn from. This book goes some way towards providing that balance.

Role of chance

Jie Jack Li is a medicinal chemist; in the

opening to *Laughing Gas, Viagra and Lipitor*, he says, 'I strongly believe that man, if given enough time, can overcome any medical problem'. He backs this optimistic view by describing how medicinal chemists went about the discovery of antibiotics, anaesthetics, anti-inflammatories, the Pill, and drugs for cancer, diabetes, AIDS and mental illness.

Louis Pasteur said: 'In the field of experimentation, chance favours the prepared mind', and this is as true in medicinal chemistry as in any other field of scientific endeavour. Luck and insight played a huge role in the discoveries of lithium for manic depression, Viagra, which has turned out to be a real 'blockbuster' of a drug and, perhaps the best known example, penicillin.

The chapter on anaesthetics reminds us of just how much we have to be grateful for

More history than human

The pharmaceutical industry is short of medicinal chemists, and it would be nice if a book about their achievements inspired a few young people to take up the challenge of finding a drug to treat Alzheimer's or a vaccine for malaria – both of which the world desperately needs. Li promises to tell us the 'human stories' behind the drugs we rely on.

A good example is the story of Gertrude Elion, who discovered no fewer than six of the early anti-cancer drugs and was the first woman to reach the Inventor's Hall of Fame. An impressive achievement, and it is touching to learn that what really made her happy was receiving letters from patients and their families who had benefited from her medicines. Then there was the battle between Horace Wells, William Morton and Charles Jackson in the nineteenth century over who should have credit for the discovery of the anaesthetic properties of ether – a struggle which destroyed the lives of all three.

But apart from these few gems, the book is actually rather short on real human interest, being more of a detailed historical account of

who discovered what and when.

Strengths and weaknesses

The two best chapters are those on anti-cancer drugs and anaesthetics. The first gives some excellent descriptions on how the latest anti-cancer drugs – such as Tarceva, Iressa and Gleevec – actually work, which is very useful reading for anyone affected by cancer. The second reminds us of just how much we have to be grateful for, with some grim detail of what life was like before effective analgesia. It is also good to get a balanced view on the background to Vioxx, the arthritis drug that was withdrawn in 2004 because a clinical trial showed it increases the risk of a heart attack.

But Li sometimes takes too much for granted on the part of his readers. For instance, talking of rosiglitazone – an important new drug for diabetes – and its molecular relatives, he says, 'It was only recently that they were all found to be peroxisome proliferator-activated receptor- γ agonists, without any further explanation.

Li is right to point to the valuable contributions that medicinal chemists have made to humanity. However, he says little about where future medicines are going to come from. Small molecule drugs – the domain of the medicinal chemist – will continue to be important. But they will, increasingly, be matched by the products of the biotechnology industry: DNA vaccines, gene therapies, recombinant proteins like human insulin, monoclonal antibodies for cancer, and stem cell therapies. These will be as revolutionary for human health in this century as penicillin was in the last one.

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No 'supernaturalism' at the Festival of Science

Rupert Sheldrake objects to the term

Bruce Hood's article, 'Science and supernaturalism at the Festival of Science' (SPA, December 2006, p11), gave a misleading impression of the symposium entitled 'Beyond the brain: making science personal'.

In his article, he told us, 'I was concerned that the symposium would overshadow my presentation the day before on the origins of magical belief in adults. It would directly contradict my conclusions by arguing that the supernatural was a real phenomenon and not a delusion.' He revised his opinion because his own theory received considerable media attention and because some science journalists 'questioned the wisdom of allowing such a platform at a science festival'. But he wrongly portrayed the symposium, at which neither he nor the sceptical science journalists were present, as dealing with 'supernaturalism'.

Evidence-based discussion

The symposium was actually concerned with the scientific investigation of little understood but widely reported phenomena.

The research by Dr. Peter Fenwick described deathbed experiences as reported by people around the dying person. This is surely a legitimate field for scientific enquiry.

Professor Deborah Delanoy described a long series of laboratory experiments involving physiological measurements of people when others were concentrating on them in a different room. The data implied that there was a measurable response to other people's thoughts and intentions at a distance.

My own work on telephone telepathy investigated whether people really could tell at above-chance levels who was calling them. Many people believe that they know who is



Do people know who's calling them?

on the phone in a way that seems telepathic, and my research explored this experimentally.

The BA symposium involved an evidence-based discussion, including comments from Professor Chris French, Editor of *The Skeptic*.

A balanced discussion of questions of widespread public interest was surely more in accordance with the advancement of science than an emotive display of dogma and prejudice.

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Intelligent design

Science it isn't, asserts Philip Walker

Dear Editor,

I was pleased to read the intelligent feature article by Rachel Ankeny in the December 2006 issue of *SPA* (p16), about intelligent design.

I wish to emphasise the important point, not explicitly stated, that 'intelligent design' is not 'science'. Science is based on a methodology that assumes natural causes. Any invocation of supernatural causes is outside science.

This does not mean that supernatural causes do not exist, but it does mean that they are not part of scientific enquiry. The ideas of intelligent design may be very insightful and thought provoking, but if they are to be taught in schools, they should not be part of the science curriculum.

Many professional scientists apparently believe in supernatural causes, but they

cannot invoke those causes to explain their scientific discoveries – for then they would not be practising science.

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Jacuzzis and global ecological resources

Adam Corner spies denial

Dear Editor,

I read with astonishment Viv Regan's factually inaccurate and irresponsible opinions about whether environmentalism is 'good' for the developing world (*SPA*, December 2006, p4).

Environmentalism is not simply some puritan ideal that the affluent world seeks to enforce on developing countries. Rather, some of us are gradually waking up to the idea that the lifestyles we currently lead are unsustainable and constitute a grossly unfair allocation of the world's ecological resources.

This point is crucial: the resources available

to us are finite and, like a child who must learn to save their pocket money if they want to make it last through the month, we have a moral obligation to preserve the resources we do have for future generations – that is, our children.

Read George Monbiot's latest book and note that it is not developing countries who must cut back on their emissions – at least, not yet – but the USA and the UK who bear the obligation to rein in their use of ecological resources.

I would like to think that, deep down, Viv Regan realises that writing 'but people want jacuzzis' as a response to a global political issue that requires urgent and considered action is extraordinarily shortsighted, and an example of denial on a staggering scale.

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‘But we did consult...’

Tracey Brown asks what consultations are for



Tracey Brown

To consult or not to consult? That seems to be the question facing government departments and executive agencies daily. They had issued 583 public consultations – and counting – at the last annual performance report.¹

Well, actually, it's not the question. Instead we need to ask, what do all these bodies think their consultations are for? Are they to find out whether a policy move will be popular? To take the sting out of a difficult proposal and share around a bit of the responsibility? To find out something in earnest or a delaying tactic to avoid a decision? Make everybody feel listened to? Pass the departmental review with all boxes ticked?

Beyond challenge

The urgency of these questions has been thrown into sharp relief again at the beginning of 2007, with the publicity about the government's proposed changes to the Human Fertilisation and Embryology (HFE) Act. These changes include a proposed ban on the mixing of human and animal genetic material *in vitro* for research – a ban that has taken scientists, and many people in public life, by surprise. They had assumed, since they had no reason not to assume this, that the same regulatory regime for human embryos in research would be applied to those with 95.5 per cent human genetic material.

What they hadn't reckoned on was the consultation. Or, more precisely, the Department of Health's (DH) reaction to the consultation. The DH has given no scientific or ethical reasoning for its proposed ban. Instead, it has blamed it on the public's

alleged 'unease' at such 'unnatural' procedures. This unease has been revealed in a consultation, so it apparently puts the Department beyond criticism or challenge because, according to the case they present, they are only doing what the public want them to. Nobody at DH, it seems, expects to explain the uncritical use of the term 'unnatural' (or why that wouldn't include everything within the remit of the HFE Authority). It's the consultation, stupid.

‘Didn't you respond to our consultation?’ Er, no, actually, somewhat busy with a day job and the other 582 consultations

Unrepresentative views

If the DH had paid more attention to their consultation responses they would have noted that, discounting the approximately 200 people claimed as respondents but who didn't actually comment on the proposals, many of the remaining 300 respondents turn out – don't faint with surprise! – to oppose embryo research completely. That doesn't make those views vanish or irrelevant, but it does make it surprising that the DH is so sure of the public's view from this very particular set of objections.

The DH is not alone. I have encountered several situations in the past year when a government agency has, when criticised for the deficiencies of its decisions, waved its arms in the direction of the consultation (the Medicines and Healthcare Products Regulatory Agency on efficacy of homeopathic medicines, the Food Standards Agency on traffic light labelling, and the Health and Safety Executive on MRI scans, if you're interested).

The Commons Science and Technology Committee identified this problem with impressive subtlety in its report on the government's use of evidence last October, when it recommended that the purpose of consultations should be more explicit and that a distinction should be drawn between seeking technical advice and soliciting public opinion (in which case, opinion surveys might give clearer results than invitations to stakeholders).

Group hug

Unfortunately, this fails to recognise the dislike of accountability. Keeping consultations vague makes them more susceptible to whatever interpretation is preferred. Later questions about gaps in evidence or unintended consequences can be waved away with that other increasingly popular line: 'Didn't you respond to our consultation?' Er, no, actually, somewhat busy with a day job and the other 582 consultations, not to mention the European ones and the 'horizon scanning' for new legislation.

Objections, you see, are only eligible within the 'consultation period'. Thereafter, you are the subject of raised, 'you've only yourself to blame' eyebrows. It's another way to hold inconvenient problems at arm's length – a kind of big, civil service group hug, swallowing and muffling criticism in its stakeholder love while keeping it at a safe distance: 'we would have loved to have heard from you *back then*, when the consultation was *open*'.

It's another way to hold inconvenient problems at arm's length – a kind of big, civil service group hug

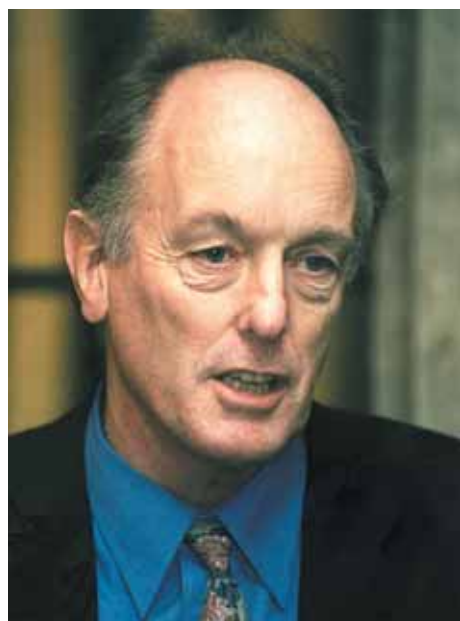
The contribution of science is particularly damaged by this use of consultations to parry and contain critical scrutiny. Although often treated as such, scientific scrutiny is not a stakeholder position: its value is, in policy terms, as one set of criteria by which an option can be evaluated. Criteria that, on scientific and medical matters in particular, should surely pertain throughout the policy process.

1. *Annual Report on Consultation 2005*, Better Regulation Executive, The Cabinet Office, 2006 (www.cabinetoffice.gov.uk/regulation/documents/consultation/pdf/2005.pdf)

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Things look up for science

Ian Gibson extends the wish-list



This year, the government has a new Minister for Science (Malcolm Wicks MP) in the House of Commons, and therefore available for questions from MPs.

This is a hugely important step towards making science policy accountable and making science policy count. There is now no need for the special select committee cross-questioning with a minister from the Lords. Every MP who cares about science should attend the Department of Trade and Industry (DTI) Questions. Outside Parliament, please lobby your MP, ask them to table questions, and help make the science debate in the Commons vibrant, interesting and relevant.

Science ministry

I welcome a science minister in the Commons but what we also need is to remove science, technology and engineering from the DTI and put it in its own science ministry.

Please lobby your MP, ask them to table questions, and help make the science debate in the Commons vibrant, interesting and relevant

We cannot deny the massive contribution science has given and still gives to our modern world. If we are to build a knowledge-based economy for the twenty-first century, we need

to enshrine the contribution of science. The importance of science in economic development and policy determination in matters of health, education, energy, climate change, development, and so on, is clear. In fact, it is hard to see where science and technology will not be a major component in the national programme for prosperity. It is essential that knowledge, information, its application and communication, be accompanied by sound political judgement.

It is time for us in science to resist the tendency to think that scrutiny and supervision through the odd inquiry is the best way to deliver science. The parliamentary process suffers from the lack of serious input from scientists and technologists, is caught by the laws of parliamentary procedure and is often short term and not very cerebral. How could it be anything else? The training process itself fails to incorporate serious discussion of how policy involves scientific evidence, and young scientists rarely discuss how science takes place in a social environment.

There are several wishes I have on my list for 2007, which would advance science in the national consciousness.

Science wish-list

A Ministry of Science would co-ordinate science policy across Whitehall. There would be a Cabinet Minister always there to ensure policy has a scientific, technological and environmental input.

Within the Department of Science, the Secretary of State for Science would have a team specialising in climate change, science education, science and health, science and industry, scientific innovation and scientific research. Think tanks would also be an extremely useful resource to the Ministry of Science.

I remain surprised at the failure of individuals in politics to engage the whole picture when looking at an issue. The role of the Ministry would be to coordinate the science and the application of science with long-term national and global interest.

House building

For example, house building and its associated planning permission has failed to recognise the reality of saving energy and climate change for years. Only at the stage when it is potentially too late to reverse the

effects of climate change, are we seeing action taken in the form of carbon neutral new-build homes by 2016.

A specialist in climate change would work closely with the Department for Communities and Local Government, the Department for the Environment Food and Rural Affairs and the Treasury, ensuring all new builds incorporated climate change strategies immediately. All buildings would be required to use energy saving light bulbs or energy efficient lighting systems. The planning law would also be reformed to make energy savings easier and government-supported schemes would explain how to make your home carbon neutral.

We need vocational science degrees to run alongside the more traditional research-based option

Science cities

Next, we need to see Regional Development Agencies working closely with each branch of the Science Ministry to formulate a strategy for the creation of science cities and policies involving science at all stages; from school to the work environment. We must also address the issues of equality of opportunity when it comes to science: if you come from an area or a school with less or poorer quality equipment, you will be at a disadvantage.

We should have a fast track for civil servants with scientific training. And the entire training process for science technology and engineering needs rethinking. We need vocational science degrees to run alongside the more traditional research-based option, giving the student more scope for personal innovation.

Meanwhile, we proceed in this Parliament with Trident missiles, climate change, renewable and nuclear energy, drug funding, biobank and hybrid embryos. It is an important and exciting time for science.

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The Science Communication Conference

Institution of Engineering and Technology, Savoy Place, London
Monday 14 and Tuesday 15 May 2007

The first day of the conference will focus on generic and varied aspects of public engagement, while the second day will discuss engagement in the context of climate change.

Conference sessions will run in three strands:

engaging to inspire and educate, engaging to involve and engaging through the media and PR.

The conference aims to support those engaged in science communication by:

- demonstrating and discussing the contribution science communication activities are making to the various broadly-shared strategic aims for public engagement
- exploring how we can increase impact towards those aims in the future
- raising awareness of new developments
- promoting greater understanding and cohesion amongst those working in science, technology and engineering communications
- providing opportunities to network, share ideas and good practice

The conference recognises the contributions made to science communication by a broad range of stakeholders. It seeks to include, and be enhanced by, a diverse range of opinions and experiences.

A bursary scheme is available to students, freelancers and microbusiness, campaigning groups, BME community groups and full-time scientists.

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or contact the BA *Science in Society* team:

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