

Science & Public Affairs

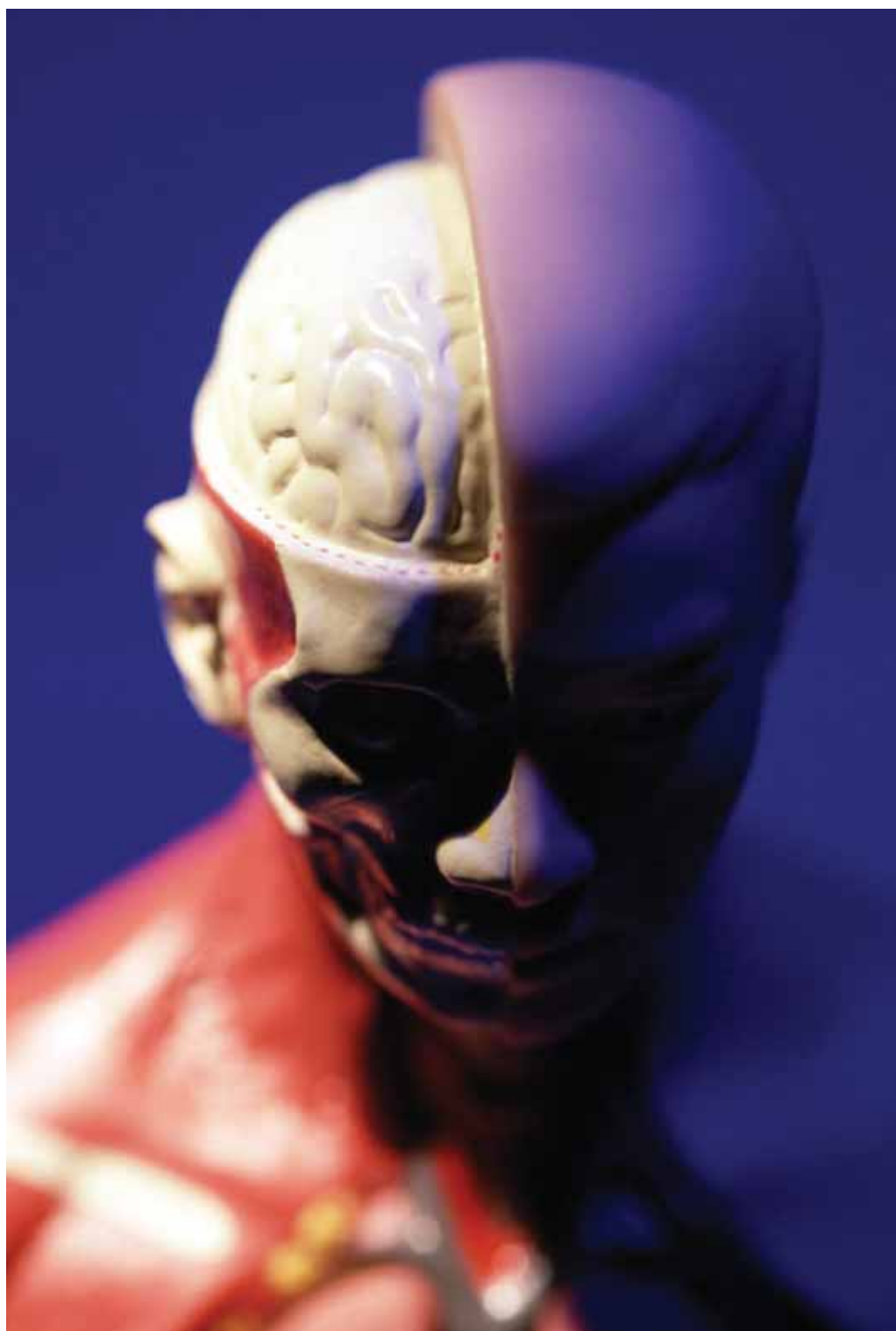
Brin science,
addiction
and drugs



Does medical
research need
animals?



Are we ready
for avian flu?

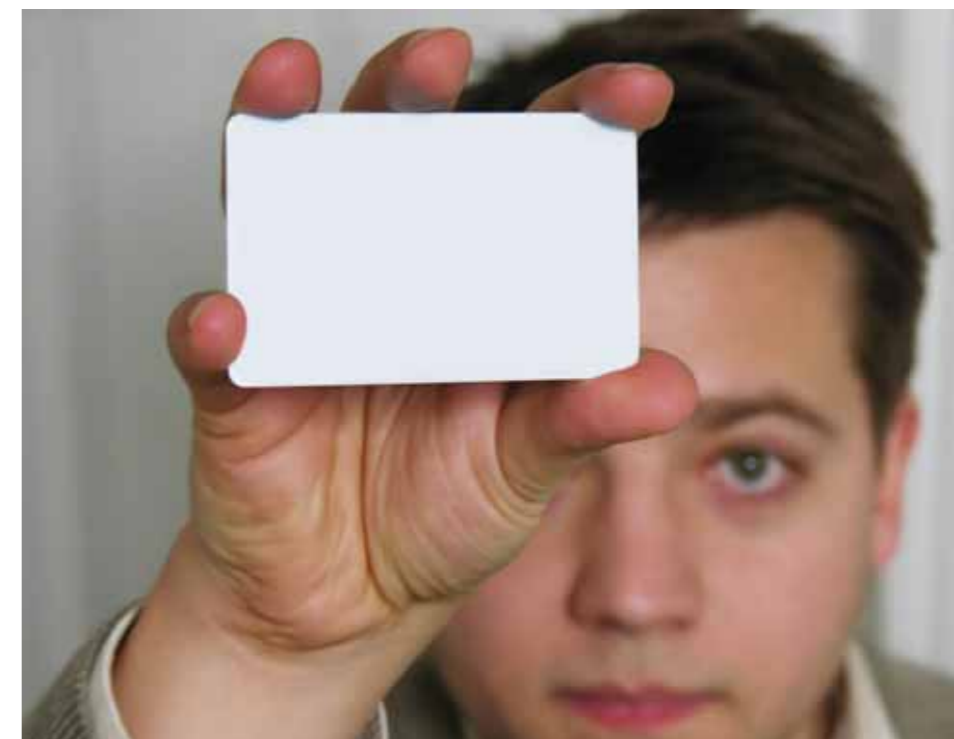


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Dialogue defined

Dialogue is our current mantra. Scientists, government, civil society and members of the public need to get together and discuss the scientific issues of the day. This issue of SPA provides various examples of the genre, and underpins them with an analysis of exactly what dialogue is and how it works.

Helen Haste (p.12) scotches any suspicion that dialogue is simply continued intellectual exchange by a more polite name. (An example of this sort of exchange is the SPATalk, p.4, in which Jan Creamer and Simon Festing debate whether medical research needs animals.)

Dialogue, according to Haste, is actually a ground-clearing process which enables each party to understand where the others are coming from. One of its most powerful tools is surprise: surprise at others' knowledge or lack of it, the facts they consider relevant, the values they associate with the facts, and the frameworks their facts fit into. Surprise is a signal that we differ on the things that others take for granted.

'I once stood in a spectacularly rich fossil field with a palaeontologist,' explains Haste. 'He was beside himself with joy; all I could see' was a pile of rubble. Similarly, he could

make little sense of the work I was then doing on young people's moral reasoning. After these experiences I still couldn't 'see' the fossils and he could not analyse moral text, but both of us could appreciate that there was more than one 'story' in the data.

Dialogue is about understanding those differences so that we can share knowledge which has the same meaning for all parties. Once that is done, participants can pursue routes to agreement, which they may or may not reach.

A majority of the members of the Nano Jury were able to agree on ten recommendations of the twenty they offered at the end of their recently-completed exercise. The independent citizens' jury debated nanotechnology for five weeks, after being presented with information from a wide range of different witnesses.

The Jury impressed co-organiser Mark Welland (p.14), who says the experiment enabled him to look at his own science in a new light. He has, he writes, been 'hugely impressed by the jurors' ability to grasp such a difficult subject and make perfectly reasonable recommendations. We "engaged" with the public and the public showed that they had a real voice.'

The recently-reported Foresight project on brain science, addiction and drugs included the biggest public consultation of any so far. As David King writes (p.6), the message from the public was that decisions on drugs should be personal, not dictated by government. The same project found that – within limits – the public prefer eccentricity over drug-induced 'normal' behaviour.

The kind of world we want for our children is preoccupying Lord May as he steps down from the Presidency of the Royal Society. Climate change and loss of biodiversity are, he writes (p.11), today's critical scientific issues. And, he says, 'while scientists can sound the alarm about these crises, achieving action relies on policy makers and politicians understanding and heeding the warnings.'

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Does medical research need animals?

Jan Creamer and Simon Festing disagree



Most animal research involves rodents © RDS/Wellcome Trust Photographic Library

Dear **Simon**,
Every year millions of animals die in unviable experiments. Each species responds differently to substances and laboratory results not only vary between species but also between laboratories, for the same species. Studies show that these results are affected by the animal's characteristics, its diet and keep.

Examples of such species differences are: morphine calms people and rats, but excites cats and mice; aspirin causes birth defects in

cats and dogs, but not in people; penicillin kills guinea pigs. Animal research also causes delays through misleading information – blood transfusions were delayed over 200 years.

Medical science's progress without animal experiments includes: the inventor of the artificial hip, John Charnley, never using animals; introducing anaesthetic substances; asepsis – understanding sterile techniques; discovering the link between cancer and smoking.

Most research does not involve animals, but

uses sophisticated solutions such as scanning, tissue culture, computer modelling, analysis and databases. These techniques have direct relevance to humans.

The Lord Dowding Fund for Humane Research spends around £300,000 annually, funding non-animal research projects such as the latest neuro-imaging techniques to examine the human brain, instead of placing bolts and electrodes into the heads of terrified monkeys.

Given the choice, which data would you trust –

especially if your life depended upon it?
Yours, **Jan**

Dear **Jan**,
Throughout the world people live longer and enjoy a better quality of life, because of advances made possible through medical research, and the development of new medicines and other treatments.

It is a great success that most research is now carried out in cell-cultures, computers or with patients. But you cannot study a beating heart in a test-tube, nor get your computer to cough! At certain stages of most biomedical studies there is no alternative to using animals, and they remain a small but vital part of medical research.

Leading doctors and medical organisations around the world agree that virtually every medical advance of the past century depended on the use of animals in some way. Numerous independent inquiries have concluded that animal research provides information which can be relevant to humans and does lead to medical benefits - contrary to anti-vivisection claims.

Certainly some drugs behave differently in some animals. That is why scientists choose species very carefully, use control groups in their experiments, and take dose effects into account. If proof of species similarities were needed, up to 90 per cent of veterinary medicines are the same as, or very similar to, those used to treat human patients.

Yours, **Simon**

Dear **Simon**,
To claim that improvements in quality and expectancy of life have relied upon animal research is a gross overstatement. History demonstrates that the real reasons are improvements in nutrition, lifestyle, hygiene and sanitation. Declining mortality was mainly due to a reduction of infectious diseases, which declined before therapies were introduced. The World Health Organisation estimates that diseases related to dirty water account for 30,000 child deaths every day. Such findings have made a huge contribution to the nation's health.

Many medical advances have been achieved without animals – inhalation anaesthetics, drugs for leukaemia and numerous others. Animal experiments can even delay medical progress.

The physiological differences between species flaws animal tests – the wrong body and cells are being used. The drug tamoxifen was designed as an oral contraceptive – it worked in rats, but had the opposite effect in women; it is now a successful breast cancer treatment in women yet causes cancer in rats.

A more modern, scientific approach, such as

the advanced techniques that we fund, is needed: combinations of computer technology, tissue cultures, human data, human and environmental studies. These systems can be based on human data, avoiding the problem of species differences. The way forward in medical research is studies at the cellular level, using advanced techniques – a more intelligent approach.

Yours, **Jan**

Dear **Jan**,

There is much concern about a global epidemic of influenza, a killer disease which strikes down the vulnerable - the young, the elderly and the sick. It killed more soldiers during World War I than died in combat. Mice get influenza. The most recent medicine for the prevention and treatment of this disease was developed in animals and is highly effective.

Of course anti-vivisection groups raise all sorts of spurious pseudo-scientific arguments against animal research. That's their job. But they have no credibility.

We've had three major independent inquiries in the UK into animal research in the past four years (from a House of Lords Committee, the Animal Procedures Committee and the Nuffield Council on Bioethics). None of these committees had a vested interest in animal research. All included people with non-scientific backgrounds.

The reports examined all aspects of the debate, and considered the scientific arguments in great depth. They all concluded that animal research provides information which can be of relevance to humans and does lead to medical benefits. In every case they rejected claims by anti-vivisection groups to the contrary.

The most intelligent approach is to use the best technology available. Sometimes that's cell-cultures or computers. Sometimes it's animals.

That's the approach of every major research institute in the world. And it's highly successful.
Yours, **Simon**

Dear **Simon**,

Influenza virus does not make your case either - the viruses constantly mutate. The 'pseudo-scientific' comment just reduces the debate to name-calling. If you consider our evidence scientifically unsound you have either not read the subject, or you are claiming that the authors of the papers that we use (published in scientific journals) are pseudo-scientists.

You mislead us about the inquiries; they only drew evidence from a small sector of the community and had a broad remit rather than a detailed examination of the efficacy of animal research. It was inevitable that they would be cautious and not challenge the status quo. However, animal research was criticised by the

House of Lords and development of more advanced techniques recommended. At the Cambridge Public Inquiry, both sides were asked to put the case on the 'need' for tests on monkeys, and after hearing the evidence the Inspector concluded that the need had not been demonstrated.

Like any entrenched industry, animal researchers are resistant to change. Your group even opposed banning cosmetic tests on animals. Researchers use the tools available – if they have an animal house then it will be animals. They are unlikely to transfer the work to another scientist.

Yours, **Jan**

Dear **Jan**,

After consulting widely, the independent House of Lords Committee stated in 2002 it was 'convinced that experiments on animals have contributed greatly to scientific advances, both for human medicine and for animal health. Animal experimentation is a valuable research method which has proved itself over time.' A Royal Society report in 2004 agreed: 'virtually every medical achievement in the past century [was] reliant on the use of animals in some way.'

The House of Lords Committee also took a thorough look at anti-vivisection claims. It concluded that 'sentimental and sometimes misleading information is disseminated by some anti-vivisection groups.' Contrary to your claim, RDS played a major role in achieving the UK ban on cosmetics testing using animals in 1997.

Most animal research is for biomedical purposes and involves rodents. In neuroscience for instance, studies of mice that mimic aspects of Alzheimer's disease have led to human trials of new ways to prevent memory loss. Recent research using rats is now showing benefits for patients paralysed by spinal injury. But sometimes in complex brain disorders we have to study higher animals. Deep brain stimulation, an operation that has transformed the lives of about 200,000 patients with Parkinson's disease, arose directly from research using monkeys.

Yours, **Simon**

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Brain science, addiction and drugs

David King tours the horizon

The Foresight project on Brain Science, Addiction and Drugs reported its findings to government and the wider world in July. The findings themselves are fascinating, and so, I believe, was the way we produced them.

As the project unfolded, it involved the energy of three scientific advisors, experts in psychology, medicine and the sociology of drug use, and over 100 other specialists writing reviews of the state of the art in their field, participating in futures workshops, or advising us as members of the project's steering group.

Group members ranged from an assistant commissioner of the Metropolitan Police to research council chief executives. Perhaps most significantly, the project involved the general public, whom we consulted about their views on the future prospects for licit and illicit drugs.

Purpose of the project

The motivation for this project was the confluence of our increasing knowledge of the human brain, growing problems with neurodegenerative diseases such as Alzheimer's, social concern about illicit drug use, and the emergence of new drugs that may help the performance of the healthy brain.

Like any proper research project, this one had a clear question to answer – how could drug use be managed for the good of individuals, communities and society on a 20-year timescale? As Foresight learned long ago, the way to approach such a complex issue is not to produce predictions – we never do – but to see what the main drivers for change might be, whether scientific or social.

Despite our rule about not trying to predict the future, some things about the world of 2025 can be stated with confidence. For example, every society that history has described has used some form of psychoactive substance, be it coffee or aspirin, and it is likely this will continue.

Neuroscience meets genomics

One project finding is that advances in genomics and neuroscience are likely to alter our appreciation of drugs and the brain. We are already discovering the gene variations in animals and human beings that affect how they react to drugs. After all, most people who drink alcohol do not become alcoholics. A few develop an addiction that damages them and the people around them.



Caption?

Now we are starting to see the differences in brain structure that relate to different drug responses, and the genetic differences that underlie them. Brain imaging is becoming more sophisticated and will allow us to describe the action of drugs on specific centres within the brain more exactly within 20 years.

We do not know how far or how fast this research will progress. As with other advances in genomics, we are sure that it is wise to avoid referring to 'the gene for' drug addiction. But it may be possible to counsel some individuals that their genome might predispose them to addiction and that some temptations are best avoided. On the other hand, we certainly want to avoid giving the rest of the population the impression that it is 'safe' for them to use drugs.

Addiction

Our increasing knowledge also raises the issue of whether drug addiction might be preventable. Although much has been written about the possibility of 'vaccination' against drug use, it will probably never be possible to vaccinate somebody against drugs as one can against measles.

But even if it were possible to do so, the project received a very definite message that it would not be desirable. Our public consultation involved both a sample of the general public and groups with specific knowledge, such as carers for people with Attention Deficit Hyperactivity Disorder, and active users of illicit drugs. The consultation, run by the Office of Public Management, showed that the public want open discussion and choice about these important matters. And they want the choices to be personal ones rather than taken by government.

However, people who treat drug addicts told us that a vaccination that made a drug ineffective, or controlled the craving for it, might be a crucial addition to the therapist's armoury at a tricky point in recovery from addiction.

Better than well?

The public were also cautious about the promise of 'cognition enhancers', drugs which enhance the mental performance of people within the normal behaviour range.

Several such drugs already exist, such as Ritalin, which was originally intended for Attention Deficit Hyperactivity Disorder patients. Ritalin is being used by a small number of students in an attempt to improve exam results and by business people to improve their performance in the board room. In the longer term, the increased focus on neurodegenerative disease could mean a multi-billion pound market for such drugs. Drugs that preserve or enhance brain connections could become big business, and might be especially effective in combination with exercise and other forms of therapy.

However, the public are cautious about the prospects of a society in which abnormal behaviour can be engineered out by behaviour-modifying drugs or by cognition enhancers. They value diversity and like having eccentrics around. After all, some might be the unrecognised geniuses of tomorrow.

Industry caution

We also found that the UK pharmaceutical industry, one of the most innovative parts of the British economy, is unwilling to develop drugs for people who are not ill. The costs and risks far outweigh the potential rewards.

However, there is a large potential market in drugs for the elderly, where depression and sleep disorders are priorities alongside Parkinson's and Alzheimer's diseases.

Illicit drugs

We also found that advances in science offer much to those with concerns about illicit drug use. For example, drug testing is improving as the equipment becomes smaller and the tests more rapid. Here, the needs of competitive sport as well as criminal justice are driving innovation.

The other side of this coin is that the illicit drug trade, too, includes enthusiastic early adopters of new technology. During the 20th century, synthetic drugs sprang up to rival older plant-based ones. The ability to synthesise and test new drugs rapidly might allow them to spread faster than legislators can make them illegal.

In the same spirit, we noted that the web has already started to transform the way in which drugs are bought internationally. A surprising range of drugs is available online, and by no means all have passed the tests which would allow them to be prescribed by doctors in the UK.

Scenario workshops

We looked at the possible world of 2025 via a number of scenarios, played out over several days by a wide range of participants. One key variable was whether future drug control would be based on evidence of harm, or on traditional views of the acceptability of different drugs. The other was whether drug use would be regarded mainly as a defence against illness, or whether it might become more generally acceptable as a lifestyle accessory.

The scenario workshops threw up a wide range of possible future concerns. For example, if drugs are used routinely for performance enhancement, they might become as common as coffee in the office. Indeed, the public seem to support their use for anyone in a safety-critical job such as driving a train or handling nuclear fuel.

In other scenarios, society's tolerance for drug use is lower. In yet others, our capacity to invent drugs – and the ageing population that wants them – has outrun our inclination to pay for them. And at another extreme, molecular science might have made such progress that new drugs can be developed, perhaps customised to an individual genome, by tiny open-source companies. So there are business, social, and economic issues to be grasped as well as scientific ones.

Following the launch of the findings, the government has asked the Academy of Medical Sciences to report on the implications. It is important that the evidence we gathered in this project helps to support our long term thinking within and beyond government for years to come.

Sir David King is director of the Office of Science and Technology, and Chief Scientific Adviser to Government. Details of the Brain Science, Addiction and Drugs project may be found at www.foresight.gov.uk mpst.king@dti.gsi.gov.uk



@ a glance...

The Foresight project on brain science, addiction and drugs asked how drug use could be managed for the good of individuals, communities and society on a 20-year timescale

It concluded that advances in genomics and neuroscience are likely to help us understand how drugs act on the brain

The public value diversity. They are cautious about the prospects of a society in drugs might engineer out abnormal behaviour

New technology for drugs testing is helping both to catch illegitimate users and spread illegitimate drugs

The Academy of Medical Sciences is to report on the implications of the findings

In brief

Pesticide concerns

A report from the Royal Commission on Environmental Pollution has called for more research into the possible links between pesticides and human health. In *Crop Spraying and the Health of Residents and Bystanders* the authors call for a precautionary approach to the use of pesticides and for better arrangements for monitoring human health and informing those affected.

Terror checks for research

The Wellcome Trust the Medical Research Council and the Biotechnology and Biological Sciences Research Council have published a joint policy statement on reducing the risk that any of the research they fund is misused for harmful purposes. A series of changes will be made by each organisation, including alterations to funding application forms and new guidance for funding committees.

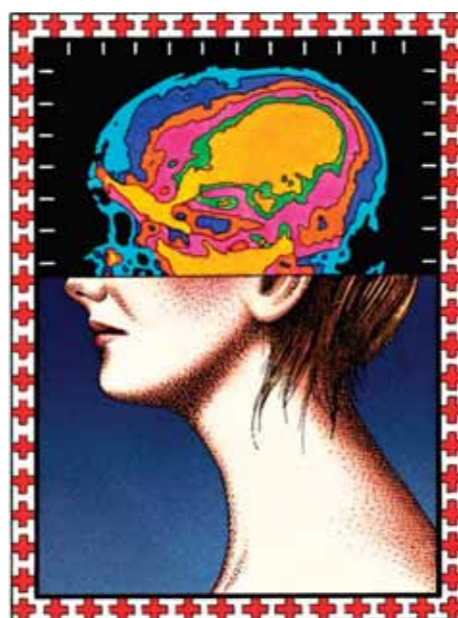
Promise of dialogue

The Government has published its response to the Council for Science and Technology's report *Policy Through Dialogue* (www2.cst.gov.uk/cst/reports/#8), agreeing to introduce changes in culture throughout government so that engaging with the public is seen as a normal part of the policy development process.

Why aren't scientists talking?

The Royal Society is undertaking a study of the potential barriers that may discourage research scientists from taking part in science communication activities. The first phase of the study will see an email questionnaire going to around 4500 science researchers across the UK. See: www.royalsoc.ac.uk/communications.

Business sway over science comes under the spotlight



Neuroscience: Demos wants a Commission on Emerging Technologies and Society

The influence of business over university science has come under fresh scrutiny with the publication of a report by think-tank Demos. In *The Public Value of Science: Or how to ensure that science really matters* Demos argues that ethical considerations and public engagement should become part of everyday scientific practice – and that close ties between business and university science threaten to stifle the potential for this, as well as to distort research priorities.

'Collaboration between universities and businesses is important,' said James Wilsdon, 'but we need to ask who's setting the agenda for science.'

Committee response

The report proposes a Commission on Emerging Technologies and Society, which would support public and policy debate about developments in nanotechnology, biotechnology and neuroscience. It also recommends that the House of Commons Science and Technology Committee investigates the influence of business on academic research.

Phil Willis, the new Chair of the Committee, said it had not yet mapped out a programme of inquiries for the coming year, adding about the Demos research:

'In a personal capacity I am encouraged, rather than concerned, that business and science are forging ever stronger links. [...] I want to see far more research arise out of

business thinking and the challenge we have is how to make that a reality when so much research is generated by the current academic institutions.'

He acknowledged that encouraging transparency about research where possible is also important, since the public 'needs to have faith in science and its inherent societal good'.

Lancaster protest

Such discussions are pertinent to Lancaster University, which has recently seen six of its students prosecuted for protesting at a meeting on campus about the university's involvement with corporations such as BAE Systems, GlaxoSmithKline and Shell. One of them was quoted as saying: 'there is an ethical debate to be had about commercialisation and, if we are to build links, we should discuss with whom to do it,' implying frustration at the current framework for communication about such issues.

It would be absurd not to commercialise research with potential applications that might bring economic, social, health or environmental benefits,

Professor Cary Cooper, Pro-Vice Chancellor of the university, emphasised that all universities are encouraged by the government to undertake 'third mission' activities (i.e. involving partnerships with industry and the community).

The Campaign for Science and Engineering observed that the protests 'confused the need to generate economic benefits from research with the importance of ensuring that universities are free to conduct research according to their own priorities.'

'It would be absurd not to commercialise research with potential applications that might bring economic, social, health or environmental benefits,' CaSE said. 'Whether or not universities are independent, and thus free to choose which scientific questions they seek to answer, is another matter.'

Could distributed generation solve the energy crisis?

Evidence is mounting in support of small-scale, distributed electricity generation, termed microgeneration, as a means of addressing the climate change and energy crises caused by our fossil-fuel dependency. The concept entails households and other buildings generating their own heat and electricity and linking in to 'microgrids' – local power networks that supply the community. Microgeneration involves technologies such as solar panels, rooftop wind turbines and micro-CHP (combined heat and power) and government favours its expansion. Now, two separate research groups have concluded that the concept offers much potential, providing the government supports it with regulations and funding. The reports have come as MP Mark Lazarowicz has taken up the challenge of lobbying for such support.

Sussex group

One of the research groups, headed by Dr Jim Watson of the University of Sussex, has submitted a response to the government's Microgeneration Strategy consultation, and also to the House of Commons Environmental Audit Committee inquiry 'Keeping the Lights On: Nuclear, Renewables, and Climate Change.'

Watson's group, involving academics from the Sussex Energy Group, the University of Southampton and Imperial College London, is engaged in an ESRC-sponsored project, *Unlocking the Power House*, which is examining the economics of microgeneration and barriers to implementation. Their submissions to Parliament argue that microgeneration will only be attractive if the cost to consumers is reduced significantly.

Watson said: 'These technologies hold great promise, but they are fighting on an uneven



Microgrid at Croydon Central
Acsolarcentury.com www.solarcentury.co.uk

playing field. Our research shows that some basic changes in regulations could make a significant difference. People should be given the sort of help that energy companies receive through tax breaks when they invest in new power stations.'

Southampton group

Meanwhile, Dr Tom Markvart and colleagues at Southampton University's School of Engineering Sciences are also advocating the development of microgrids, 'to provide a stable and reliable power supply from various energy sources'. Their recommendations are based on research published in *Ingenia* (published by the Royal Academy of Engineering). 'In the long term, microgrids offer the promise of substantial energy savings and reduction in emissions, without a major change in our lifestyle,' said Markvart.

Parliamentary moves

The case in Parliament is to be presented as a Private Member's Bill by MP for Edinburgh North & Leith Mark Lazarowicz. His Bill, 'Climate Change and Sustainable Energy', includes measures to promote renewable energy sources, national targets for microgeneration, and a requirement for the government to produce a fiscal and economic strategy to assist with microgeneration and energy.'

Watson, who has sent his submissions to Mark Lazarowicz, commented: 'I get the impression that microgeneration targets (as Mark Lazarowicz advocates) do not have a great deal of support within government – and even some in the industry are approaching the issue with some caution.' Asked whether he would support the Lazarowicz Bill, Energy Minister Malcolm Wicks said: '...we are currently assessing the detailed clauses before coming to a definitive position.'

References

1. www.dti.gov.uk/energy/consultations/microgen.pdf and www.parliament.uk/parliamentary_committees/environmental_audit_committee.cfm
2. www.marklazarowicz.org.uk/bill/billo8.0511.htm

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In brief

Foreign students aid at-risk subjects

Universities UK has highlighted the support provided to 'vulnerable' subjects by international students. Its report, *Patterns of Higher Education Institutions in the UK*, shows total income from international sources at just over £1.5 billion. The organisation is concerned that recent changes to the visa regime for international students is making it more difficult for them to enter the country. It has called on the government to make the UK more attractive as a study destination.

Reed Elsevier called to arms

Reed Elsevier has responded to a letter to the *Lancet* in which scientists, medics and other groups asked the journal's advisory board to 'respectfully ask Reed Elsevier to divest itself of all business interests that threaten human, and especially civilian, health and well-being' in response to concern with its involvement with the arms trade. The publisher responded by saying that much of the equipment displayed at its DSEI arms fair is designed for life-saving activities and that 'the defence industry is necessary for upholding national security'.

Europe's views on science

The latest Eurobarometer surveys on European public perceptions of science and technology have revealed a 'positive and optimistic perception of what science and technology can do for humanity,' according to the European Commission. The data were drawn from two surveys interviewing 32,000 people across 32 countries. http://europa.eu.int/index_en.htm

Changing global science

ICSU, the International Council for Science, has published its Strategic Review for 2005. *Science and Society: Rights and responsibilities* pinpoints key areas in which changes in the practice of science affect the international science community – particularly regarding the growing challenge of maintaining scientific integrity and responsibility. The report proposes a new international initiative in science and society.

Are we prepared for avian flu?

Hugh Pennington hopes our luck will hold

Avian influenza is bad news for birds. A virulent strain can kill a chicken within a day.

First, it shows signs of paralysis, because the virus attacks the brain, and it gets diarrhoea, because it grows in the gut. It has been feared by poultry farmers for three quarters of a century.

A bird flu outbreak started in Hong Kong in March 1997 in rural chicken farms. A three-year old boy died from flu in May. It took till August to work out the connection, because it had never been made before. He had been killed by the bird flu. The virus was subtype H5N1. There were more human cases in November; by Christmas 18 had been infected and six had died. This was very frightening. The virus was as lethal – and probably more so – than the most vicious smallpox. On 28 December Hong Kong started to kill all its chickens. All 1.6 million had perished by the end of the year.

Evolution

When I was starting my scientific career I worked on bird flu. We cared not at all about protecting ourselves because the strains we worked on only attacked birds. Hong Kong and evolution changed all that.

What makes influenza such a difficult adversary is that it mutates often (and has no proof-reading mechanism to correct errors in genome replication) and has the ability to swap its genes with ease. A strain specializing in killing birds can pick up genes that enable it to infect humans while keeping the virus proteins recognized by the immune system. So when it moves into the human population, it behaves like a brand new virus; our immune systems have never seen it before. This is why influenza causes pandemics, world-wide outbreaks. The big worry about H5N1 is that it might mutate and do the same.

The slaughter in Hong Kong in 1997 did not eradicate it. It continued to circulate in China. Since then it has spread to poultry in most countries in the continental Far East. So far it has only killed humans who have had very close contact with chickens – in them, mortality rates have been about 60 per cent. But the most worrying developments have been mutations which have helped it to infect migratory geese in China, and its spread westwards into Siberian chickens. Now it is in Europe.

Will H5N1 come to Britain? Nobody knows. There is no convincing evidence that the mutations necessary for it to turn into a virus



Bird flu: from poultry to people

that can spread easily from person to person have happened – yet. So if it does, it is much more likely to come as an efficient killer of birds than of humans.

It is much more likely to come as an efficient killer of birds than of humans.

Protecting the population

What is being done to protect us? As with any impending disaster, good intelligence is crucially important.

The World Health Organisation has had long experience of influenza surveillance and it is doing its best in the countries where H5N1 is known to occur. Sick wild birds in Britain are being tested through our own veterinary surveillance system. Traditionally, avian influenza outbreaks in poultry have been controlled by slaughtering the infected flocks. This policy would be put into effect if H5N1 came.

For humans, the main option in the past has been immunisation. Influenza vaccines protect – but are not as good in practice as the live virus vaccines such as MMR. And because influenza virus evolves rapidly, new vaccines have to be made at frequent intervals.

Particular problems

For H5N1 there are additional problems. The

virus is difficult to grow because it kills eggs quickly (embryonated eggs are the system of choice for vaccine production). It also needs very careful handling because of the threat it poses to people working with it. And it appears to be poor at stimulating an immune response. But at the end of the day, even a feeble immunity will be better than none at all.

Antiviral drugs are also available. Ones like tamiflu work against a wide range of influenza viruses and don't have the disadvantage of specificity like a vaccine. The UK government has ordered millions of doses. Whether antivirals could nip an epidemic in the bud is not absolutely certain, because they have never been used on any scale. Mathematical modelling suggests that they might – but they would have to be used early, soon after the arrival of the virus in the population.

So readiness to meet H5N1 is not perfect. We have been fortunate so far in that H5N1 is still primarily a bird virus. Let us hope our luck holds.

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Climate change and biodiversity loss

At the end of his Presidency, Lord May reflects on the most urgent challenges

During my five years as President of the Royal Society I have had the opportunity to become involved in many important scientific issues.

I think none is so critical as climate change and the loss of our planet's biodiversity. And while scientists can sound the alarm about these crises, achieving action relies on policy makers and politicians understanding and heeding the warnings.

So, how do we take a complex issue like the science of climate change and explain it in a way that is useful for policy making?

Incorporating dissent

A unique model is the Intergovernmental Panel on Climate Change (IPCC) – the world's leading authority on climate change and its impacts. Its first assessment report served as the basis for negotiating the United Nations Framework Convention on Climate Change (UNFCCC) and ultimately the Kyoto Protocol.

The Panel's role is to assess on a comprehensive, objective, open and transparent basis the best available scientific, technical and socio-economic information on climate change from around the world. IPCC reports seek to ensure a balanced reporting of existing viewpoints, which means incorporating the views of scientists that may differ significantly from the majority.

In this way the IPCC is able to build a consensus view of the current state of the weight of opinion on climate change, which is why its work is strongly supported by the Royal Society and other national science academies. However, the scientific consensus is sometimes misunderstood to mean that scientists have some kind of compromise position which, in effect, silences all dissenting voices. But in fact dissenting voices are incorporated into the IPCC's reports by explicitly expressing the degree and nature of uncertainty involved in specific aspects of the scientific understanding.

Open to questioning

In the early stages of studying a new phenomenon, many ideas usually contend, each attracting supporters who form a kind of many-hills landscape of opinion. As observation and information accumulates, some ideas fail experimental tests, and the landscape simplifies. Eventually, as in the understanding

that HIV causes AIDS or that smoking is a major cause of lung cancer – one peak dominates the scientific landscape. Even so, some adherents of earlier ideas cling doggedly to their original views: you can still assemble a handful of 'deniers' who assert that HIV does not cause AIDS, that smoking does not cause lung cancer, or that climate change is not human associated.

One of the targets that came out of the World Summit on Sustainable Development in Johannesburg in 2002 was to achieve 'a significant reduction in the current rate of biodiversity loss by 2010'

All this being said, it is hugely important that scientists do not convey a false sense of certainty, for example by attributing extreme weather events entirely to climate change (even though such change may play a significant part in changing the likelihood or severity of such an event). Above all, science should always be open to honest questioning.

However, because of this process of building knowledge, let us be clear that the science of climate change is now certain enough for us all to demand that our leaders take prompt action to cut emissions of greenhouse gases.



The Corroboree Frog (*Pseudophryne corroboree*) is a spectacular but Critically Endangered frog that has declined dramatically in distribution and abundance. It is now restricted to a few fragmented populations in subalpine and montane areas of New South Wales, Australia. Fewer than 250 mature individuals are thought to survive in the wild © Harold Cogger

Off targets on biodiversity

In contrast to climate change, the loss of biodiversity on our planet is an issue where there is less controversy about the nature of the problem (although here too, there is a denial lobby, involving many of the same characters who deny the reality of climate change). Even here, however, this has not generated the kind of action that we would hope for.

The living world is disappearing before our eyes. According to the Millennium Ecosystem Assessment, published earlier this year, approximately 60 percent of the ecosystem services that support life on Earth – such as fresh water, exploited fisheries, air and water cleansing and regulation, and the regulation of pests, climate, and natural hazards – are being degraded or used unsustainably.

The living world is disappearing before our eyes. According to the Millennium Ecosystem Assessment, published earlier this year

One of the targets that came out of the World Summit on Sustainable Development in Johannesburg in 2002 was to achieve 'a significant reduction in the current rate of biodiversity loss by 2010'. The EU has set the challenging target of halting biodiversity loss by 2010. Despite the scientists' warnings it's not clear what progress, if any, we are making towards the targets – and not just because, as the Royal Society warned in its report in 2003, no appropriate measures of progress have yet been agreed.

The big events which caused previous waves of extinctions demonstrate the long-term resilience of life on Earth. However while advances in science and technology may allow humans to survive in a Bladerunner-esque kind of world with depleted natural resources and an uncertain climate, we must ask ourselves if this is the kind of world that we want our children to live in.

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The anatomy of dialogue

Helen Haste dissects the way we find common ground

The case for dialogue has been well made, and the science community is increasingly involved. Much thought has gone into how to set up the structures for communication, but much less attention has been paid to the realities of dialogue itself.



Dialogue: Where are you coming from?

What do people bring to dialogue? What are the obstacles, blocks and resistances? What happens as people begin to connect to the issues, and to each other? What do people gain from the experience?

Though there is considerable research on natural dialogue, as yet there is relatively little detailed data about public engagement. One example is the BA/OST Foresight exercise in 2004, in which scientists and laypeople considered scenarios and implications of cognitive sciences.¹ The report by Nick Hillier is rich in details of the processes of dialogue. It contains many surprises.

Treasuring surprises

What is dialogue? It is not a simple conduit of information, flowing from me to you without hinder. Dialogue is the series of processes which make it possible to understand what we need to know, so we can share knowledge

and that it has the same meaning to each of us. The task of dialogue is to find common ground. Common ground is not agreement. It is about exploring common cultural territory, as a prerequisite to pursuing routes to agreement. It is understanding where each party is coming from.

One outcome of successful dialogue may be that such a conduit might be possible. But the main objective of dialogue is to understand how we bring assumptions to the discussion.

What kind of assumptions are we talking about? Some depend on level of knowledge: 'I did not include this in my thinking because I did not know it.' More important for dialogue, are questions about what is relevant: 'I know this information but it is not important to me in dealing with this issue.' Here the assumptions – shared or differing – are about how to put data together in making a decision or evaluation.

Dialogue makes such assumptions explicit. In

practice it is through the other party's miscomprehension that we see – often much to our surprise – where we do not share assumptions. We are surprised precisely because we take these assumptions for granted – it seems 'obvious' to us. Good dialogue is about treasuring and using those surprises.

Also, when others resist our use of certain terms we see that these terms have different value connotations, not just different meaning. For example, a term like 'thinking' may seem self-evidently positive. Yet if it is seen to be in conflict with 'feeling', this has a negative connotation for some. For others who worry that feelings 'get in the way' of 'true' reason, 'thinking' has positive value because it contrasts with feeling.

One outcome of successful dialogue may be that such a conduit might be possible. But the main objective of dialogue is to understand how we bring assumptions to the discussion.

Whether something should matter in a decision may be more of a stumbling block to dialogue than what that 'something' is. Scientists and lay people in fact come from the same cultural and moral universe. In the Foresight exercise, scientists and lay people had remarkably similar ethical concerns and worries about the scenarios, and similar moral priorities – about control, equality of access, dependence on technology, and individual versus societal needs. The differences – largely resolved through the dialogue – lay in where and how to bring these considerations into the decision-making process.

Facts in dialogue

Understanding how we use fact is important to dialogue. Facts only have meaning in context.

An observation of any sort, in ordinary life or in scientific investigation, only makes sense if it is in a frame, and relates to our expectations or hypotheses. Getting a handle on the other participants' frames is a crucial part of finding common ground; it also makes us aware that we must take account of more than one.

I once stood in a spectacularly rich fossil field with a palaeontologist. He was beside himself with joy; all I could 'see' was a pile of rubble. Similarly, he could make little sense of the work I was then doing on young people's moral reasoning. After these experiences I still couldn't 'see' the fossils and he could not analyse moral text, but both of us could appreciate that there was more than one 'story' in the data.

The story that makes sense of the fact also frames how we interpret information. The American linguist George Lakoff argues that the debates between liberals and conservatives in the US cannot be explained simply by different values. Those values fit into two core stories, about causes and consequences. The conservative story is the 'Strict Father' who has an obligation to control (and chastise) his wayward offspring – including members of recalcitrant nations. The liberal story is the 'Nurturing Parent' who fosters the growth of the young (or dependent) by caring.

We cannot win a rhetorical battle unless we anticipate how the opposition will frame 'our' facts – and use them on their terms. The optimistic 'nurturing' liberal who hopes that the data on numbers of people in welfare will move the conservative to provide better services for the unfortunate impoverished will be disappointed; the 'strict father' will, naturally, argue for strengthening the independence of such people by minimising support.

It is part of finding common ground to unpack the stories that frame the facts.

Narratives in dialogue

There are also 'grand narratives' which set the larger picture; these frame not just the fact but the whole agenda for telling the story. I see four grand narratives in current issues around public engagement and especially around responsibility. Different groups will access them differently.

- **The grand narrative of 'discovery'**

Science and technology explain our world and this is self-evidently valuable; more knowledge, per se, is 'good'. Scientists rarely

@ a glance...

The task of dialogue is to understand how we bring assumptions to the discussion and where each party is coming from

Dialogue makes explicit assumptions about knowledge, its relevance and value connotations

Surprise often shows us where we do not share assumptions

We can only understand what other participants mean by facts if we understand their frames of reference and their broader narratives

Successful dialogue needs this groundwork so that both sides are able to see where they are located in the landscape

question the value of 'discovery' and indeed are fearful that pressure for public engagement may be a threat to this narrative.

- **The grand narrative of 'progress' and benefit to humanity**

To be an agent of progress is to benefit others. To the recipient, the 'benefit' is also a good, but it is easier for recipients to weigh up the benefit against costs, or against other competing benefits. Engineers may solve problems they define as technological; the human benefits are only apparent when the new development is used in ways undreamt of by the innovator.

- **The grand narrative of 'risk'**

We all agree that developments may have risks. But who is the cause? The scientist-engineers may deny responsibility, because their obligations are only to discovery – in which case the debate is, who should carry the can? (Politicians and industrialists are likely candidates.) From the point of view of lay people, the core question is the extent of their own vulnerability; the agenda is assessing the risk.

- **The grand narrative of ethical obligation**

No-one denies that progress involves ethical considerations. Even if scientists and engineers 'cause' – directly or indirectly – problems, does this mean they have an ethical responsibility, and if so, must they acquire a better understanding of ethics? Or does the situation require ethical experts, so freeing the scientists to get on with discovering?

The vulnerable public, in this narrative, have

the 'right' to complain and blame, as well as to have their fears taken seriously. However, increasingly the public has a responsibility to assess the risks and to take action; it is no longer enough to blame external forces. It is in this grand narrative that much of the current debate takes place.

We can see the interweaving of these four grand narratives in most discussions about scientific and technological progress, and in many arenas of public engagement. Addressing them has been the agenda of both 'downstream' and 'upstream' engagement. When dialogue breaks down, it can often be seen to be due to failing to recognise the underlying narratives (and stories) and where they need common ground. Where dialogue is successful, it can be seen that this groundwork has been done, and both sides have been willing to see where they are located in the landscape.

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Nano Jury

Mark Welland reflects on an experiment

On September 21st this year, four members of the public stood up in front of a crowd of press, government, non-governmental organisations and interested members of the public and pronounced their judgement on nanotechnologies.

After five weeks of detailed deliberations and quizzing of witnesses, the Nano Jury members provided largely lucid, informed and insightful recommendations. More remarkably, by their own admission, their previous knowledge of nanotechnology was virtually non-existent and they collectively had little scientific experience.

The process itself and the success of this particular public engagement exercise serve to do more than simply explore public perceptions of nanotechnology; it also provides some useful lessons for scientists, non-governmental organisations and government in defining how such activities are managed and what the role of the different stakeholders should be.

The process

A meeting with Doug Parr from Greenpeace in the lobby of a hotel in Stockholm sparked the idea for Nano Jury. The process brought together twenty randomly-chosen people from different backgrounds who heard evidence about a wide range of possible futures, and the role that nanotechnologies might play in them. In a singular alliance, the Interdisciplinary Research Collaboration in Nanotechnology at the University of Cambridge, Greenpeace UK, the *Guardian* and the Policy, Ethics and Life Sciences Research Centre at the University of Newcastle instigated and managed the process. We drew on a wide range of advisers so as to formulate and execute a transparent and rigorous public engagement process.

Science in a new light

For all of us, this was an innovative and essentially experimental grouping. Personally I found the experience challenging but rewarding. I have learnt considerably from interacting with the various groups involved in the process, have been able to look at my own science in a new light and ultimately, have been hugely impressed by the jurors' ability to grasp such a difficult subject and make perfectly reasonable recommendations. We 'engaged'

with the public and the public showed that they had a real voice. And the government took the jurors' views seriously and have promised to follow up on their recommendations and report back to them.

Scientists must engage

Nano Jury must be followed up by other types of engagement processes and even repeats of the one we used involving different population groups. This is already happening and the government is playing a strongly supportive role in this respect.

I am convinced that at some level there is a responsibility incumbent upon scientists and technologists to ensure that they involve themselves in some form of public engagement. I note that about ten per cent of any one National Science Foundation grant in the USA has to be spent on engaging with the public.

Scientists need to take a strong lead in the public engagement agenda. It is our science that will shape the future and it would be irresponsible not to ensure that science is represented accurately in the public arena and that its consequences, both positive and negative, are openly and inclusively debated.

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The public has a real voice.



The jurors gave majority support to these ten recommendations:

- A committee of public and representatives of a range of social groups and faiths should decide when, at key stages in technology development, public juries should be set up to look at public research spend. Public juries should also have a roll in private research money to look at the ethical and social/environmental impacts.
- If public money is spent, it should go on solving longer-term issues such as health and environmental problems. There should be incentives and strings attached for the private sector.
- More openness on spending of public research money on nanotechnology.
- Government should set up partnerships with nations leading in technologies that can improve health. New safe and effective nano-medicines should be available without discrimination.
- Government grants for development, manufacture and use of solar energy technologies.
- More consultation and information in plain English.
- Support for nanotechnologies that bring jobs to UK.
- Nanotechnologies will only be good if they lead to more quality leisure time.
- Manufactured nanoparticles should be tested as if they were a new substance, labelled in clear English, and tested in controlled environments before release.
- Scientists should improve their communication skills and encourage schoolchildren into a career in science.

More at <http://tinyurl.com/74cu9>

Flying quietly

Paul Collins reveals a new sort of aircraft

The Brunel Lecture at the BA Festival of Science in Dublin was a chance to find out more about the Silent Aircraft Initiative, an exciting project aimed at designing a new concept aircraft that is radically quieter than anything flying today.

The Initiative, funded by the Cambridge-MIT Institute (CMI), is a joint research program between the University of Cambridge and the Massachusetts Institute of Technology. The multi-disciplinary project requires a much more extensive collaboration with industry than in the past. In addition to its long-term objective of laying the groundwork for the next-generation-but-one of commercial aircraft, the project is unusual in that it is trying to change the way engineering is taught, as well as inspiring the next generation of engineers.

Hands-on

The lecture involved a lot of hands-on audience participation, with several demonstrations to illustrate the science of acoustics and the technologies being developed. There were many eager volunteers for one of the demonstrations, which centred on a microphone and ten hairdryers. Not, it turned out, for perfecting the elegance of the audience, but for demonstrating the scale of the noise reduction challenge facing the engineers.

'The way we perceive noise is not at all what you would expect – it takes a big reduction in noise level before we hear an appreciable difference,' said lecturer Dr Tom Reynolds. The hairdryers were used as miniature noise sources. Cutting from ten to five, one would

think, would sound half as loud. In fact, the difference was barely audible. It was not until nine out of the ten sources were switched off that it sounded quieter. 'Tests on different groups of people have shown that it takes this ten-fold reduction in noise for the sound to be perceived to be just half as loud,' he said.

How quiet is quiet?

The engineers on the Initiative are aiming for an aircraft that is inaudible above the background noise outside the perimeter of an urban airport. This requires taking the noise down by half not once, but twice and then by a bit further still.

It is not just the engines that need to be treated. About half the noise from a landing aircraft today comes from the body of the aircraft itself as it flies through the air. So the engineers have to reduce the noise from devices like flaps and slats, as well as from a major noise source on approach – the landing gear.

Noise reductions can also be achieved by changing the way the aircraft is flown and the Operations Team is looking at the way aircraft come in to land.

New trial

The Silent Aircraft Initiative has recently announced plans for trials of new arrivals

procedures at Nottingham East Midlands Airport. The trial is the result of eighteen months' work with the large number of partners. It has to meet all the standard industry requirements and go through all the approvals processes, as it will be flown in controlled airspace using commercial aircraft.

'What is unique about the trial,' says Dr Reynolds, who is leading the operations research for the team, 'is that we will provide advanced modelling tools in the design process that will predict the noise "footprint" of a landing aircraft as well as its emissions, allowing the environmental impact to be minimised. During the trial, we will be monitoring arrivals to check our predictions.'

The trial is a ringing endorsement of CMI's idea of the benefits of increased industrial engagement. It is based on a continuous descent approach, which keeps the aircraft higher for longer and at lower thrust settings than the approach procedures used now. In the traditional stepped approach there are segments of level flight where the pilot has to increase the throttle settings to stop the aircraft descending. This transition itself can cause annoyance, as well as increasing the level of noise.

Some airports are already flying a basic type of continuous descent approach, but are constrained by the congested airspace around many airports. The advantage of the trial at Nottingham is that there is more flexibility, giving an opportunity for more of the aircraft to use the quieter procedure. The research team are hoping to demonstrate that even in busy periods, the new procedure can reduce pilot and air traffic controller workload and do so without reducing the efficiency of the airport.

A DVD resource for teachers and students based around the Brunel lecture is now in preparation.

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Trials of the silent aircraft are about to begin. Courtesy of the Cambridge-MIT Institute

Identity theft and the internet

Emily Finch analyses the clash of real and virtual worlds

The apparent rise of identity theft in recent years has been well charted by the media. The government has used the problem as part of its justification for the introduction of identity cards.

However, before we can evaluate how successful its proposals will be in tackling the problem, we need a more complete understanding of the nature of identity theft and what it means for one's identity to be stolen.

Components of identity

Identity has three inter-related facets; personal, social and legal. Personal identity relates to how an individual views themselves; it is based on self-reflection and has a symbiotic relationship with social identity. This second facet is based on how individuals are viewed by others. Each person has numerous social identities that correspond to the multiplicity of roles they have in the social world. Personal and social identity cannot be the subject of identity theft, as they cannot be assumed or appropriated by others.

Legal identity is an amalgamation of a spectrum of personal information that begins at birth, is expanded as the individual journeys through life and ends at death. However, legal identity goes beyond the mere collection of documentary and factual information about an individual; its principal concern is to establish an indelible and unmistakable link between this information and the individual to whom it relates.

In general, the preoccupation of legal identity is to answer the question: 'Is this person who they purport to be?' This question has two components: firstly, to establish that the personal information used by any individual is accurate, i.e. that individuals do not mislead or misrepresent in relation to aspects of their legal identity; and secondly, to ensure that the information is not assumed by the incorrect person, i.e. to prevent the misappropriation of another's identity by impostors.

Role of information

Legal identity is, in essence, a collection of information about an individual that may or may not be supported by documentary evidence. As most of this (excluding most biometric information) can be known and acquired by others, it is legal identity that can

be assumed by another; so it is legal identity that is crucial for identity theft.

Information, then, is the currency of identity theft. Without it, the impersonation of another would be impossible. Part of the reason that identity theft has emerged as a pressing social problem in recent years is the ease with which one person can have access to personal information about another.



Virtual identities will still escape
Agnieszka Moryc/iStockphoto

Real and virtual worlds

The huge rise in the use of the internet provides unparalleled opportunities for the acquisition of identity information. Fraudsters have perfected the art of compiling a complex mosaic of individual components to construct a complete legal identity using information from many different websites. This information-gathering process always existed, but has been made infinitely faster and easier as the internet has obviated the need for physical searches of archives and records.

Moreover, fraudsters use the informality of internet chatrooms to induce a false sense of intimacy and trust in which they can harvest the personal information others disclose.

Paradoxically, as people become more guarded with their personal information in the real world, the virtual world – with altered rules of social interaction – creates a forum within which people freely exchange personal information. This paradox is echoed in the

current proposals for identity cards, which aim to fix each individual with one single and inescapable identity. Online, however, the shielding of identity and the use of multiple identities is commonplace and accepted.

Government proposals

It is within this context of ready access to the personal information of others that the government seeks to impose a single and durable legal identity on each individual by introducing identity cards.

How successful this measure will be, particularly given the framework of the current proposals contained in the Identity Cards Bill, requires close scrutiny. It is questionable whether measures to cement legal identity in a physical environment can address the challenges of the fluidity of identity in a virtual environment, especially given the ongoing growth of transactions as a distance.

The recent growth in identity theft can, in part at least, be attributed to the ease of accessing information online, the changed nature of personal interaction in a virtual environment and the (relative) anonymity provided by online transactions, in which people do not meet in space or time. Any attempts to counteract identity theft that focus exclusively on the fixity of physical identity are only partly addressing the problem. They will inevitably result in an incomplete and imperfect solution.

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I have a robot who sings

William Gosling on a transitory love



Propaganda against the coming of steam circa 1800, probably sponsored by coaching interests. Artist unknown.

In the solar of my mediaeval house a robot sings to me.

The arrangement is recent; for years past she perched on my study desk, stylish and beautiful, the love of my life. I communicated with her mainly by touch, as she preferred, confiding my innermost thoughts.

But let me confess: inseparable though we were, I am incorrigibly fickle with her sort. The day came, as I knew it would, when a younger, prettier model took her place. What then for my old love? I might have sent her into the world to make a new relationship but the thought grieved me, and besides nobody out there valued her at her true worth. So I taught her to sing.

I found her new software and effortlessly she got the hang of it, memorising the music from my CDs, nearly four hundred of them. I will long remember when she first sang; I asked for the Bach *Chromatic Fantasia*, and hearing the seductive sounds fell for her anew. Now she sits in my solar, murmuring her songs to a fine Japanese audio amplifier which sends them on again to four loudspeakers.

And how she sings: sometimes in Spanish with the voice of Victoria de Los Angeles, sometimes it is Welsh and Siwसानne George I hear. She emulates a piano at need, a harpsichord, a Renaissance band, even the Berlin Philharmonic, and I hear them as I have never heard recorded music before, the sounds clear and perfect, instruments easily distinguished, their locations not in doubt.

Treasured CDs have no employment now; the up-market CD player lies in my barn. Meanwhile I have a robot who sings. No longer young though still maturely elegant, her name is iMacG4.

Successful technology?

Not all technology revolutions succeed like this of course. Once airships seemed destined to provide intercontinental travel, but today aircraft descended from kites, not balloons, take us round the world. Failed technical revolutions are legion, so what is the key to success?

New technology must cross many hurdles before it can triumph, but above all innovation must be socially acceptable. In 1840 the London and Birmingham Railway needed to communicate between Euston and their Camden Town engine house. Offered the new electric telegraph, they preferred a super-powerful steam whistle at Euston, clearly audible all the way. It enraged people who lived nearby and soon was gone. Environmental, political and moral problems all lead to definitive social rejection. In democracies we get the technology we can tolerate. Yet leap all the obstacles and new technology becomes indomitable, eliminating forerunners and competitors with terrible finality.

Technical revolutions

Iron Age smiths in lake villages forged new swords of power, the legendary Excalibur,

transforming war, politics and society. Norman invaders eclipsed Saxon England thanks to harness makers who empowered fighting men to strike from the saddle. Twelfth century horse-collars made deep iron ploughs practicable. Along with drainage by new post windmills, they greatly extended Europe's cultivable lands, establishing the economic foundations of the Renaissance. Artillery made castles useless, barbed wire ruined cavalry; between them they ended a social system. Nineteenth century electric telegraphs began the telecommunications revolution which is sapping the autonomy of nation states and transforming our world into one community.

'Only engineers create social revolutions uncorrupted by compromise,' said Buckminster Fuller 'but they do it blind to what they are about.' Technical revolutions are ruthless, irresistible, working through market forces that grow, relocate or kill an industry without anybody willing it.

Arming against evil

What is the origin of this awesome power to shape kings and cultures to a new pattern? In a way, I am. It is by my choice, mine alone, that my CD player languishes. My infatuation with a singing robot sanctions the destruction of her rivals.

The implication is clear: the awesome dynamism of new technology ultimately comes from us, the users. We fear what technology brings if we fear what we see in human hearts. The machines are innocent; we alone have a capacity for negligence or evil, and must arm ourselves against it by insight, by scruples, and through the elaboration of an informed and compassionate civil order. That is what the BA is all about.

As for my singing robot, with power comes vulnerability. I am bewitched, yet her spell will break someday. She will vanish when I love again, and that I surely will, for her technology is in a headlong charge with a long way still to go.

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Water shortage in the UK

Current water shortages in the south-east of the country underline the fact that the UK, with its densely-settled population, has less water for each person than Spain and Portugal. Ian Barker, Teresa Evans and Barrie Clarke diagnose the problem and suggest solutions.

We need sustainable development

Barrie Clarke is optimistic

Apocalypse soon – the message of many anguished reports – is increasingly focused on ‘the UK water crisis’. Any equivocation is called complacent, but we humans have always faced shortage; overcoming it is the mark of our success. This will continue.

We are facing shortage in some areas because, however unnecessary to point out, demand has increased, while supply has not – especially this summer, after 10 months of below average rainfall. The growth is a function of our higher standard of living, which has many watery links: personal health and hygiene, enjoyment of gardens and nicer cityscapes. We could be more efficient, but the rise in demand (1 per cent a year for the past half century or longer) is less than half the GDP figure.

Problem explained

Changing expectations have led demographic change. The atomising national family is pushing up demand – average per capita consumption moves from 124 litres per person per day to 201 litres as household size falls from 6 to 1.1. And population shifts – notably to the south-east where settlement is comparatively dense and rainfall comparatively low – compound the problem. London will welcome up to 800,000 new citizens by 2015.

Meanwhile, supply has been hit: by pollution (from farms and industry); disappearance of natural storage (as wetlands are drained); planning policy allowing more concrete (faster run-off = lower recharge of groundwater); more intense weather (ditto); and relative under-investment (as government, regulators and water companies prioritised more pressing problems).

A problem then, but the very human wish to disappoint the doomsayers has provided an answer: sustainable development. We shall overcome by collaborating to deliver economic and social goals within environmental limits, as government proposes.² We need a twin-track commitment to sustainable demand and supply. Sustainable development



Depleted: Haweswater reservoir. Environment Agency

We already have effective short-term demand strategies. The Water Act 2003 makes water companies' drought plans statutory by 2007. In the longer term, we must waste less.

Waterwise, a new group funded by the companies, is making the economic case. Houses and businesses can be more water-efficient; revised building regulations and a sustainable building code will help. With regulatory agreement, the companies are investing more in maintaining and renewing leaky infrastructure.

This will be matched by increased supply. Crucially, development and water resources plans will be made side by side. The result will be more natural storage – wetlands renewed or created; less pollution through better river catchment management; new reservoirs gaining public support to improve supply (and recreation and biodiversity); and efficient desalination to meet peak time demand.

Sustainable water policy can help us achieve a secure supply without compromising the development that has made us so successful a species.

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It rains all the time, doesn't it?

No it doesn't, says Ian Barker

Our temperate climate certainly brings enough rain in most years, but even in the UK we experience occasional drought. Not, of course, the intensity of drought that wreaks havoc in sub-Saharan Africa, but real drought that stresses both the environment and our systems of water supply.

Here at the Environment Agency we are responsible for managing water resources in England and Wales, making sure there's enough water for people to use without damaging our valuable environment. This year's drought in southern England reminds us that water can be scarce and that we mustn't take it for granted. We have experienced the driest winter, spring and summer since 1976 – after only two-thirds of average rainfall.

Each of us uses 150 litres of water every day – five litres more than a decade ago. Every drop of water comes from our rivers and wetlands that support internationally important plant and animal communities, and improve our quality of life.

Managing supply and curbing demand

The Environment Agency encourages water

companies to adopt a twin-track approach: managing water supply and encouraging people to save water. New reservoirs are part of the solution, but we cannot just build ourselves out of water shortages. We must make better use of the water we have.

Making better use of water includes both technological improvement and changing people's attitudes. A quarter of water supply still leaks away. Leakage will never be zero, but water companies must reduce leakage still further. New buildings must use water more efficiently – we estimate that good design with proven, existing technology could give us new homes that use a quarter less water than today's standard new house. Industry and commerce can make even bigger water savings – savings that will pay for themselves in a few years.

We are taking climate change into consideration in the planning of future water resources and flood defences by proposing all new developments be built with water efficient devices, such as low-flush toilets, water efficient appliances and low flow showerheads. We

would also like developers to consider innovative approaches like rainwater harvesting and water recycling at the design stage of new developments. This way environmental damage is kept to a minimum.

Attitudes

Technology is part of the solution, but people's attitudes are the key to real improvements in the way we use water. Three-quarters of households are still without a water meter and so are not aware of their water use. We need a rapid growth in household water metering, but we must also help people to understand how they can save water. The question is not whether we can save water but how we can all work together to make the best use of water – our most precious resource.

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The south-east has real problems

Don't panic – plan, advises Teresa Evans

There are very significant regional variations in water supplies over England and Wales. We must not be carried away by the national (and south-east based) media's temptation to treat the current water shortages in the south-east as a national crisis.

Fortunately, supplies in Wales, the Midlands, and the north of the country were relatively healthy and there was no need for a restriction on the amount of water used.

South-east problems

There are real problems in the south-east. Every day, Thames Water alone loses water equivalent to 366 Olympic swimming pools (915 megalitres) from its supply pipes. Water companies are losing 3,609 megalitres (3.6 billion litres) of water per day from their supply network. This is unacceptable in the long term, but it would be wrong to blame leakage as the main cause of the problems the south-east of England faced in summer 2005.

The Consumer Council for Water accepts that the largest single factor behind this summer's shortages was dry weather, including one of the

driest winters in the past 100 years. In fairness, those water companies which were quick to impose hosepipe bans in June and July, such as Southern Water and Sutton & East Surrey Water, have a very good track record on controlling leakage. We support these companies' restrictions on use.

However, supply problems from low reservoirs such as Weir Wood in Sussex acted as a timely alarm bell for the potential consequences of planned large-scale development in the south-east, where this summer's restrictions were concentrated.

Plan needed

The Government, regulators and the water industry should heed the warning, and develop a coherent plan to minimise wastage, extend metering to conserve resources and look at effective value-for-money options to meet future demand – including alternative sources such as new reservoirs, where appropriate (and environmentally acceptable). More sophisticated, 'smart' meters would also help both future consumers and the industry to keep track of use.

Metering has an important part to play in encouraging water conservation, minimising wastage, addressing leakage and reducing demand for water, especially at peak times. It also helps to concentrate customers' minds on how much water they are using for everyday activities (although the evidence base for how much impact metering has on consumption needs vast improvement). Yet only about one in four customers (26 per cent) use a water meter.

Any proposals to press ahead with more widescale metering must be subject to an assessment of the costs and benefits, and supported by robust evidence. It would be premature and costly to introduce universal metering across the country. Consumers must be confident that security of supply is delivered at a price they can afford and is supported by a sustainable water charging system.

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Is homeopathy good for anything?

Recent surveys have come to different conclusions. Edzard Ernst, Michael Hyland and Pamela Stevens argue their corners.

No value beyond placebo

Edzard Ernst weighs the evidence

This question receives vastly different answers depending on who is being asked. A leaked draft report commissioned by the Prince of Wales recently claimed that up to £480 million could be cut from the bill for prescription drugs within the NHS if only 10 per cent of British GPs were to offer homeopathy as an alternative to standard drugs.'

Such optimism is also supported by a widely circulated draft WHO report on homeopathy which states that the 'majority' of research shows 'that homeopathy is superior to placebo in placebo controlled trials and is equivalent to conventional medicines both in humans and animals'.²

At the same time as all this is being reported, a *Lancet* editorial signals the end of homeopathy: 'Now doctors need to be bold and honest with their patients about homeopathy's lack of benefit, and with themselves about the failings of modern medicine to address patients' needs for personalised care'.³

Hardest evidence

Confused? I can't blame you! Emotions have always flown high in the 200-year history of homeopathy. But emotions are rarely productive; what is needed is evidence which avoids double standards and convinces all concerned.

Perhaps the hardest evidence so far comes from a comparison of all placebo-controlled randomised trials of homeopathy with matched studies of conventional medicines.⁴ The authors concluded that the results were 'compatible with the notion that the clinical effects of homeopathy are placebo effects'.

Surely we cannot pronounce a final verdict over homeopathy on the basis of one meta-analysis! I would agree with this sentiment, but the fact is that a recent overview reviewed 11 further independent systematic reviews.⁵ Collectively they failed to provide strong evidence in favour of homeopathy.

In particular, there was no condition which

responds convincingly better to homeopathic treatment than to placebo or other control interventions. Similarly, there was no homeopathic remedy that was demonstrated to yield clinical effects that are convincingly different from placebo.

For too long, a politically correct laissez-faire attitude has existed towards homeopathy, but now there are signs of enlightenment

Weaker and weaker

The reliable evidence that homeopathic remedies are any different from placebos seems to get weaker and weaker. It has reached a point, I think, where we have to seriously doubt their value beyond placebo. The *Lancet* sums it up well: 'For too long, a politically correct laissez-faire attitude has existed towards homeopathy, but now there are signs of enlightenment'.³

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Homeopathy works

Pamela Stevens has no doubts

Homeopathic medicine can easily be demonstrated to have an effect over and above placebo (on the assumption that patients who are babies or animals are not susceptible to the notion of placebo); and its biological effects have been measured in laboratories across the world.

A series of studies conducted on farm animals has demonstrated that homeopathy is effective in the treatment of mastitis in dairy cows.¹

A recent meta-analysis ostensibly comparing homeopathy with conventional medicine, published in the *Lancet* in August,² used an inappropriate measure with which to assess the efficacy of homeopathy. The study makes a basic scientific assumption that cannot be applied either to homeopathic research or to homeopathy in practice: it has been established beyond doubt that the placebo-controlled trial is not a fitting research tool with which to test homeopathy.

Support for homeopathy

However, many previous meta-analyses looking at both randomised controlled trials and individualized research methods have demonstrated that homeopathy has an effect over and above placebo.³

Current pragmatic research in the NHS, into the homeopathic treatment of patients with severe menopausal problems, demonstrates an 81 per cent clinically significant improvement across a range of symptoms.⁴ The service has been running for eight years. Other NHS-provided homeopathy services reported a 95 per cent improvement in the patient's main symptom.⁵

In her research on this subject, Dr. Elaine Weatherley-Jones (University of Sheffield SCHARR) states, 'it is time to halt the misguided task of conducting placebo-controlled random controlled trials to test the efficacy of individualised treatments'. What is urgently needed, however, is pragmatic research that reflects what actually happens in homeopathic

practice. Such research would provide useful evidence for clinicians on which to base their decisions and referrals.

Therapeutic effect

Homeopaths acknowledge the powerful therapeutic effect of homeopathy, which is removed under placebo controlled trial conditions. Whilst it is probably true that patients experience well-being and a sense of being listened to, in the exhaustive and lengthy consultation process involved, we nevertheless assert there is a medicinal effect from homeopathic medicine which can be measured, given the correct trial design.

It was recently reported that depressed patients on Seroxat are up to seven times more likely to kill themselves than if they took a placebo. Pragmatic research into the homeopathic treatment of mild depression would be a good place to start!

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Echinacea purpurea, used to stimulate the immune system Greg Nicholas/iStockphoto

Homeopathy is useful

Accept psychological effects, urges Michael Hyland

Modern medicine is based on the assumption that there are specific causes of disease, and that specific treatments have a therapeutic effect by 'correcting' that specific cause.

Any treatment has a specific effect (e.g., the biochemical effect of a drug) and a non-specific effect (e.g., the psychological effect of knowing that you are taking a treatment). In medicine this non-specific effect is termed a placebo and, at least from the perspective of research, is treated as a kind of nuisance variable.

The relative contribution of the non-specific (placebo) effect and specific effect varies substantially in conventional medicine. Whereas placebos are ineffective for setting broken bones, 80 per cent of the effect of modern anti-depressants is placebo mediated and only 20 per cent due to the active effect of the drug.

Non-specific effects

Homeopathy has been tested as though it were a conventional medical treatment using the randomised controlled trial (RCT), and results have by and large been equivocal. The lack of clear RCT evidence to support homeopathy must lead to the conclusion that homeopathy is working in some different way to conventional medicine, i.e., that it is primarily a non-specific effect.

The conclusion that homeopathy is effective due to a placebo effect often leads to the unwarranted conclusion that homeopathy is useless. Because conventional medicine has nailed its colours to the mast of specific effects, it often fails to appreciate the importance of

non-specific effects.

The conventional psychological view is that placebos work through expectancy. However, expectancy does not seem to explain outcome well in the case of homeopathy. In my own research, I have found that spirituality is a better and independent predictor of outcome compared with expectancy in flower essences (which are related to homeopathy in that there are normally no 'active' biochemicals).

Mechanisms

Two possible mechanisms underlie the effectiveness of homeopathy. One is that it works through some conventional psychological mechanism that is yet to be understood. The other is there is some other 'unconventional' mechanism, such as quantum entanglement or electromagnetic radiation. In either case, the best evidence is that it is a non-specific effect, and one which is particularly helpful for many diseases and not just those which have psychological symptoms – but homeopathy will not set broken bones.

Homeopathy is useful – but we need to stop pretending that it is a specific treatment, and we need to accept that there is role both for specific and non-specific treatments in medicine.

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The problem of prejudice

Political, racial and religious prejudice causes conflicts on all continents. Miles Hewstone, Ed Cairns and Rhiannon Turner describe their latest research.



Ingroup/outgroup: prejudice persists Copyright: iStockphoto/Ireneusz Skorupa

From neighbourhoods to neurones

Miles Hewstone unpicks the connections

It is an exciting time to be studying prejudice because modern methods of research can tell us something about people's prejudice even when they won't own up to it.

So-called implicit measures of prejudice tap unconscious expressions of bias, beyond the perceiver's awareness or intention. Prejudice – an unjustifiable negative attitude towards a group and its individual members – may be out of sight, but not out of mind. For example, the 'implicit association test' (IAT), has consistently shown stronger mental associations between 'black' and 'bad', and 'white' and 'good'. This is not necessarily prejudice, but it may lead to it, and it seems to be a bias that we should be made aware of, so that we can control our responses accordingly.

Contact between groups

We can study prejudice at the neighbourhood level by investigating the extent to which members of different groups live apart or together, and whether this matters. Extensive research shows that contact between members of different groups is typically associated with a

significant reduction in prejudice.

Positive, high-quality contact is associated with a reduction in anxiety, an increase in empathy and the ability to take the perspective of people in the other group. Somewhat paradoxically, contact is most effective when members of both groups involved are aware of their respective group memberships; they are then more likely to generalize from the positive encounter with one or two members of the out-group to the out-group in general.

Brain activity

We can also study prejudice using the neurone approach, which looks at activity in people's brains when they display prejudice. A number of recent studies have reported findings linking prejudice and activity in the amygdala, a brain structure which has a clear role in response to stimuli that signal danger or threat.

One study found a correlation between activation of the amygdala in white participants, in response to unknown black faces, and their implicit racial prejudice, measured by the IAT. When participants viewed

faces of famous and well-liked black and white individuals, however, there was no consistent pattern of amygdala activation to the black vs. white faces, and no relation between the IAT task and amygdala activation. These findings suggest that social learning shapes the activity of the social brain.

A necessary combination

Combining the two approaches is the best way to advance our understanding of prejudice. Some of our own recent work at Oxford has compared white people's reactions to different-race faces showing positive, negative or neutral emotions. We found that white participants who reported experience of getting to know blacks as individuals showed less pronounced neural responses to the combination of black face + angry emotion. Neighbourhood really did affect neurones!

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Prejudice in Northern Ireland

Ed Cairns suggests remedies

Despite recent positive headlines about Northern Ireland, society there is still largely segregated along Catholic/Protestant lines. This is surprising, because during the last 20 years the government in Northern Ireland has spent money to encourage contact between the two communities.

It would appear that this policy has been less than successful. For example a recent *Young Life and Times* survey of 16 year-olds in Northern Ireland revealed that some 29 per cent of these young people, who have spent their most formative years in the post-Good Friday era, reported that they had no friends from the other community.

In a series of studies, based mainly on random sample surveys of the adult Northern Irish population, we have begun to explore when cross-community contact works, why it works and how it impacts on intergroup attitudes

Threats and emotions

We distinguish between realistic threats, which may endanger the very existence of the in-group, and symbolic threats, which may spell danger to

the in-group's value system, belief system, or worldview. We have found that those who identify strongly with members of their own group are more concerned with symbolic threats (such as clashes over the flying of flags, the painting of kerbstones, or exactly which route should be followed by a march) rather than realistic threats, such as issues like job opportunities.

We have also begun to explore for the first time in Northern Ireland what researchers call 'secondary' emotions (e.g., nostalgia, guilt) and which are seen as more unique to humans compared with 'primary' emotions (e.g., anger, pleasure).

Evidence suggests that individuals attribute more specifically human secondary emotions to their ingroup compared to the outgroup. Currently we are beginning to accumulate evidence that that more effective contact with members of the other community in Northern Ireland means that people are more likely to see members of the other group as nuanced human beings with a fuller range of emotions.

Fostering trust

We are not, of course, claiming that community

relations schemes that embody our findings will lead to the members of Northern Ireland's two traditions becoming friends for life.

What our evidence does suggest is that intergroup contact, which embodies our findings, has the potential to ensure that people in conflict understand the other group's perspective, feel less anxious when interacting with the other community and regard 'them' as equally as human as members of their ingroup. This, in turn, can lead to greater intergroup trust and even perhaps to a measure of intergroup forgiveness for past wrongs.

Our work is supported by the Templeton Foundation, The Russell Sage Foundation, The Office of the First Minister and Deputy First Minister (Northern Ireland) and the Economic and Social Research Council (UK).

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Cross-group friendships combat prejudice

Even when they're someone else's friendships, explains Rhiannon Turner

People often assume that simply bringing together members of opposing groups will result in more harmonious relations between them. Social psychologists argue, however, that intergroup contact will only lead to reductions in group-based prejudice if the conditions are right.

Our recent research has investigated which types of intergroup contact best reduce prejudice and produce intergroup harmony, what positive consequences they have for intergroup relations, and how and why they work.

Cross-group friendships

We found friendships that cross group boundaries to have a number of positive implications for intergroup relations. Asian and white British primary school children, secondary school children, and university students who had friends in the other community held more positive attitudes towards the other community and believed the other community to be more trustworthy.

In addition, the more friends people had in the other group, the more heterogeneous that group was perceived to be; rather than seeing

Asian people as 'all the same as one another', having Asian friends led white people to believe that there are lots of variations among Asians. This is important because the more variable we see a group as being, the more difficult it is for us to apply a stereotype to that whole group.

We found that cross-group friendships led members of different groups to disclose more personal information to one another, increasing intimacy, trust, and liking. Cross-group friendships also led to greater empathy towards the opposing group, and reduced anxiety about interacting with them

Knowledge of friendships

Despite these benefits, cross-group friendship is reliant on there being the opportunity to meet members of the other group. So how can prejudice be reduced in segregated settings?

Our recent research has shown that 'extended contact', the mere knowledge that other group members have cross-group friends, can reduce prejudice and increase perceptions of the variability of the opposing group. Observing members of one's own group interacting positively and successfully with a member of

the other group allayed fears and negative expectations about that group, resulting in more positive attitudes towards them.

Encouraging empathy

These findings indicate that where members of different communities can be brought together, through community- and school-based schemes, practitioners should encourage close ties between members of different groups.

Interventions that encourage discussion of personal information, generate empathy and reduce anxiety may be particularly effective at reducing prejudice. When there is no opportunity for direct intergroup contact, simply learning about group members whose initial fears and preconceptions about the other group were broken down, as a result of having close cross-group friends, may be an effective antidote to prejudice.

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A national technology strategy for the UK

The government's Technology Strategy Board is one year old. It aims to foster research and development in UK business and identify technology priorities crucial to the growth of the economy. The Board, Ian Cridland and Ian Wilding explain its strategy and comment on progress so far.

The Technology Strategy Board

Supporting R&D in UK business

The Technology Strategy Board is a business-led decision making body with members that are business leaders and venture capitalists with a range of technology, regional, and investment expertise.

Its authority stems from the DTI Innovation Review and the Ten Year Science and Innovation Investment Framework published jointly by DTI, Treasury and DFES. The Board looks at the co-ordination and effectiveness of support for innovation across government and how such support can be best used to stimulate innovation and investment in R&D in UK business.

More investment needed

The UK is widely recognised as a global hub of innovation. MITI, the Japanese equivalent of the Department of Trade and Industry, point out that 55 per cent of the world's inventions over the past century have come from British ideas. We have a world leading research base pushing forward the boundaries.

But at the same time, many sectors of the UK economy are investing in R&D at levels below our competitors. We are facing extraordinary challenges from emerging economies such as China and with ten new countries having joined the EU with wage costs far lower than ours; it is imperative that we respond to globalisation through building a strong knowledge economy.

In developing a national technology strategy, the Board has gathered evidence and developed an understanding of the challenges as well as the mechanisms and levers at its disposal to influence change.

As part of the strategy, two broad approaches are being proposed:

Research into new and emerging technologies

This will be done through the £370 million Technology Programme, which shares the risk of investing in new and emerging technologies

with businesses. The Programme is already supporting over 260 projects and brings together funding from DTI, Defra, the Research Councils, Regional Development Agencies and Devolved Administrations

Tackling major challenges

This second approach brings together government policy makers and funders with academia and business to tackle challenges including traffic congestion, the growth of cyber crime and cost-effective healthcare in an ageing society.

The Board considers that the major challenges facing society also provide some of the biggest opportunities for business innovation and technology exploitation. Such challenges will provide a focal point for cross-government action.

The opportunities identified may be met in a number of ways and it will be for the Board to decide which levers will deliver substantial benefits. Research will always be one of the options, but more innovation-friendly regulation as well as innovative public procurement also possess the ability to provide significant benefits.

The Technology Strategy Board published its first annual report in November. It has a key role to play in giving the research and development needs of business an influential voice within Government.

The Technology Strategy Board can be contacted at enquiries@dti.gsi.gov.uk www.dti.gov.uk/technologystrategy/tsbintroduction.html

Could do better

John Cridland wants a national technology strategy

The government's 10-year investment framework for science and innovation is an important step forward, but we need to go further.

Science, technology and innovation are of national importance and as such demand serious attention by both the public and private sectors. But that attention must be complementary and strategic, support basic and applied research, enable both science base push and user pull and foster multidisciplinary working and knowledge exchange.

Government and business have a somewhat symbiotic relationship, in large part dependent on each other for their ability to deliver. Government is reliant on business not only for wealth creation, but also for the design and delivery of solutions to major policy challenges, although this latter does not rest solely with business.

Supporting business

While business is largely market driven, it is also heavily influenced by the choices that government makes. Business will invest, locate and commit in those countries where the supporting infrastructure will best enable them to maximise the achievement of their objectives. The science base is a critical part of that supporting infrastructure both in the delivery of highly skilled people and basic and applied research.

The government's investment in the science base should not only support the delivery of solutions to major policy challenges, but can also help to underpin business development and the creation of new markets and competitive supply chains.

This is not about government picking winners, but about government using its spending power through its investment in



Traffic congestion: an opportunity for exploiting technology © European Community, 2005

science, technology and innovation and through public procurement to maximise leverage to satisfy three key objectives:

- to identify solutions to major challenges
- to develop capabilities and
- foster the capacity to deliver.

Importantly, the government's 10-year investment framework for science and innovation tackles these in an integrated and co-ordinated fashion, rather than in isolation.

Need for expansion

There remains a need for an overarching national technology strategy, developed jointly by government, business, higher education institutions and other stakeholders. It should provide the rationale for all public sector investment in technology, regardless of the government department or other agency through which that investment might ultimately be administered.

We hope that the newly established business-led Technology Strategy Board (TSB) will be the focus for such a strategy. Indeed, reports suggest that one year on, having focused in the first instance on the DTI's own Technology Programme, the TSB is now gearing itself up to expand its sphere of influence. We look forward to helping them succeed.

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Not enough consistency

Ian Wilding is increasingly anxious

The recent publication of the DTI Innovation review, along with the ten year science and innovation investment framework, demonstrate the commitment of government to see a quantum change in the role of science and innovation as a driver of economic prosperity.

In fact, it might even be argued that we are the envy of Europe for our early adoption of the knowledge based economy. The establishment of the Technology Strategy Board (TSB) in 2004 to identify the technology priorities critical to the growth of the UK economy has to also be warmly applauded. A high level forum, such as the TSB, to provide for interaction between business, government and other relevant organisations on technology issues has to be in the national interest.

Therefore, as a stakeholder, committed to the importance of science and innovation for business growth, why I am becoming increasingly anxious about policy direction?

What business wants

There are 5 Cs that business stakeholders require from government policy in building our knowledge based economy: **Clarity**, **Consistency**, **Connectivity**, **Customer Focus** and **Critical Mass**. It is perhaps useful to consider progress to date against these loose objectives.

First of all the good news. We have real **Clarity** in government intent to make science and innovation the cornerstone of future economic growth for UK plc. In addition, at face value we score good marks on **Customer Focus**; there is engagement with the business community on several levels via the TSB, regional Science and Industry Councils, governance committees for the six Science Cities and perhaps even via the embryonic Core Cities.

However, you can have too much of a good

thing! There is a marked lack of **Consistency** in terms of direction and funding within these individual science and innovation initiatives. We have a bewildering array of projects, schemes and programs but due to the lack of cross departmental government **Connectivity**, we run the risk of failing to achieve **Critical Mass** in any one initiative.

What are the current challenges?

More connectivity

A growing percentage of science and innovation funding is distributed by the regional development agencies with regional priorities being established by business led Science and Industry Councils. However, not surprisingly, each region tends to believe it is world class in the majority of technology areas! As a consequence, the substantial national funding in science will be distributed relatively homogeneously across the regions to be spent sub critically in each of the regions perceived world class clusters.

Establishing national and regional (and now Science City) priorities are a significant unmet need. Greater integration of cross-department science and innovation government initiatives is essential if **Critical Mass** in our investment is to be achieved. Management and leadership of such **Connectivity** has to come from a strong business led body; should this not become an urgent short term priority for the TSB?

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SET and petulance in Parliament

Dear Editor,

Probably few would question a desire for scientists to influence strategy in all areas of public life – and especially in Parliament. So it is worrying that a biochemist of some renown (Ian Gibson), who quit a senior university post for Parliament, has quickly slipped into the political mould.

That he should use his regular page in the September issue of *SPA* to pour contempt on the workings of Parliament (workings that ended his Chairmanship of the Select Committee on Science and Technology) tells us more about

Dr Gibson than about SET in Parliament.

For him publicly to vent his spleen at treatment which he regards as unjust (and which may indeed be unjust) is inappropriate and calls into question his judgement. Indeed, on the sole basis of this petulant and vainglorious article (admittedly an invalid basis) I begin to understand why a change in Chairmanship might have been sensible.

As Dr Gibson concedes, the government has done a lot for science. So can he not concentrate on that (silently taking some of the credit) and continue to press the case for science, rather

than publicise personal discontent?

We need more scientists in Parliament, but only if they retain a professional and scientific approach to debate, an approach that appears generally to be lacking and is perhaps in danger of extinction.

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Ian Gibson replies...

Dear Editor,

Professor Case argues that I used up my allocated space in this fine publication as a platform to express my discontent at being removed from the Chairmanship of the Science and Technology Select Committee.

I agree with the Professor. But it was not because I am some vainglorious whinger as he implies, but rather simply because I was asked by the editor to write the piece, and more importantly I wanted to expose how suspect political bargaining can hinder the scientific agenda in this country.

Professor Case makes a strong point that we need more of a scientific presence in Parliament. Precisely. That is why I was very disturbed by the political machinery which seemed to disregard the work of the Committee for cheap political points. Mr Phil Willis will make an excellent Chair, he is an upstanding politician who has sterling credentials as a teacher and an advocate for children with special needs. But he has no strong background in science.

That puzzled many and infuriated some Labour MPs who were informed by the Chief Whip that her decision was based on the need to

redistribute the chairmanships of the committees following the results of the election in May. Her reasoning seemed to suggest that Science and Technology was the least painful concession she could make (and it is an open secret that I am a trouble maker, so she killed two birds with one effective stone). It goes to show how highly science is rated by some in power, and why we as scientists and interested public figures need to rally against this form neglect.

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Technology and its uses

Dear Editor,

So, we are doomed to be populated by a generation who will not understand how a mobile phone works ("Self-limiting technology", *SPA* September 2005, p. 27). Frankly, so what. Explain to me why it is important to know and I'll make it my duty to share that information with the population. Could it be that by understanding the minutiae of the device we become enlightened as to the beauty of science? Doubt it. What matters to people, especially young people, is what a device can do – how it benefits their life and enables them. They all enjoy communicating and some even enjoy exploring their machines to find out what else they can do – Bluejacking, for example. Others still seek to exploit the

potential of what a device such as a modern phone can do in classrooms, public spaces, museums, or nightclubs.

It doesn't matter whether it's phone, PDA, laptop, or Sony's new PSP, there are three broad groups of people (at least): those who ignore a technology or use it minimally, those who seek to explore its functionality in any number of creative ways, and a minority who understand the device implicitly and push it beyond limits even the manufacturer could not have foreseen – the PSP homebrew community being an example.

What we do with technology will always be more important than how it works. But let's not ignore the incredible power of exploring the limits of technological functionality – even in the absence of understanding how it works.



Playstation portable: what it does, not how it works
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Science and uncertainty

Tim Radford on a still small voice

Uncertain Science ... Uncertain World by Henry N Pollack (Cambridge University Press, 2005)



Tasty mushroom or hallucinogenic toadstool?
iStockphoto/Gertjan Hooijer

The public expects geologists to tell marble from micaceous schist, mycologists to know a tasty mushroom from a hallucinogenic toadstool and dendrochronologists to date the cathedral rafters accurately, or at least more accurately than a chorister could.

Inasmuch as science has a social function, it is to provide a certain level of expertise: to know better, or at least know better than the rest of us, about some chosen aspect of life, the universe and everything, and to assert so with more confidence.

The richness of scientific uncertainty has often been unappreciated and /or misunderstood by the general public, people not regularly engaged in science

But is that what we get? 'The richness of scientific uncertainty has often been unappreciated and/or misunderstood by the general public, people not regularly engaged in science,' observes Henry Pollack. For 'people not regularly engaged in science' read religious fundamentalists. For 'the richness of scientific uncertainty' read Darwin's theory of evolution and see how far up a gum tree that line of thinking can get you. Creation scientists for instance 'can conceive of no experiment, no observation that might disprove Genesis. Therein lies the reason that the practitioners of "creation science" are not really scientists,' he writes. So, does that mean they are wrong? Or just not really scientists? And is there something wrong with not really being a scientist?

Horticultural tour

On its own terms, Pollack's book is a terrific *vademecum* to the business of science: what you can reasonably expect from science, what scientists have to do to be more sure of being right, what other scientists have to do to make sense of the latest evidence. He takes the reader through what he calls 'the garden of uncertainty' to deliver little homilies on this or

that bit of herbaceous border, shrubbery, thicket or thorn bush along the way.

He is, I think, refreshingly right about the media: journalists like to be serious, fair and accurate, and they certainly like to be read, but they do not see themselves as part of the machinery of science education. He puts a very good argument for more emphasis in the schools on the methodology of inquiry, rather than facts, although I have always thought that facts had much to be said for them as well. He uses some of the investment in science – climate research, energy supply and demand, social security and so on – as texts around which to weave a series of short sermons on how scientists arrive at their conclusions and what the tricky bits are.

Climate complexity

He is pretty sharp about the Bush Administration's slippery use of weasel terms such as 'sound science' and 'uncertain science' to discount the avalanche of alarming environmental data now routinely emerging from weather, ocean and glacial observatories the world over. His explanations of the complexity and uncertainty and difficulties of measurement that geophysicists and climate scientists must deal with every day with are models of their kind.

The message, of course, is that researchers really have thought through the uncertainties, looked at 64 different factors that could confound their reasoning, and have still come to the big conclusion that global warming is happening, and that humans have a role in it.

Sadly, this kind of thoughtful meditation will not convince the powerful, the greedy or the unscrupulous forces that resist the pressure to change, because of course they will choose not to hear. The voice of reason is soft-spoken. A quiet insistence on the truth, especially accompanied by a rider that it might be wrong, may be just too quiet to be heard. Which would be, in the case of this rewarding book, a great pity.

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Biologists have real jobs

Alan Malcolm punctures some myths

'A real job is one that makes things,' an experienced business friend told me. Even I could tell that this was nonsense!

The percentage of the UK's Gross Domestic Product attributable to making things has hovered around 20 per cent for over a decade and diminishes slightly year on year.

Digging coal was clearly a real job. The high death rate of coal miners and the pollution caused by the product was an unfortunate by-product. Building motor cars is obviously a real job. The deaths and pollution caused by the product once again must be overlooked.

Real jobs and economists

One characteristic of a real job seems to be that it pollutes the atmosphere, causes death either to producers or consumers or both, and is in decline. Yet, our younger generation is supposed to seek such jobs, and the government is supposed to use taxpayers' money to create and subsidise them.

Britain excels in the theatre, film making, pop music, and rowing, as well as winning Nobel Prizes in the life sciences. None of these causes much pollution, so I suspect that serious economists would shy away from calling them real jobs. They would certainly not advocate that they be given subsidies (except perhaps from the National Lottery).

Biology is where most of the major advances in science are likely to be found in the next half century, but does it create real jobs?

Definition deficient

Those working in the pharmaceutical industry make real products with high market values, but many people in the industry are working in research to develop future products, rather than manning the factories that are turning out today's pills. Biologists find jobs in the medical area whether as doctors or as scientists in hospital laboratories. By my friend's definition, neither of these holds down a real job.

Teaching biology in schools is a growth area, but the production of a better educated work force and society does not feature in such narrow definitions as 'making things'.

The huge concern about possible degradation of our environment has led to the appearance of some highly important jobs for biologists: monitoring the problem, analysing



Preserved skeleton: a real job *Natural History Museum*

the causes, producing a solution. Much of the Thames is now well stocked with salmon thanks to the efforts over decades by biologists to clean the river of pollution which was usually caused in the first place by 'real' (wealth producing) industries.

What about cleaning up the beaches after an oil slick? While chemical solvents can be used, the increasingly preferred approach is to develop micro-organisms which can metabolise the hydrocarbons involved. There is a need to analyse nitrate (and phosphate) run off from fields to reduce possible damage to wildlife in the streams and rivers of the countryside, but is it a real job?

Eating words

Being a caterer certainly isn't a real job since it involves the destruction of the products of the farmer. Yet the proportion of catered meals is expected to rise from 25 per cent or so at present to at least half over the next two decades. Nutrition and food science contribute to the only sensual pleasure that consenting adults are allowed to have in public (and three times daily!). At least my learned colleague would admit that food processing is a real job, since its turnover dwarfs that of pharmaceuticals by a factor of three.

Horticulture is marginal because while flowers,

fruit and vegetables are clearly products, the first has a ludicrously short life, and has little function other than to give transitory pleasure. Fruit 'n' veg are only slightly better.

Preserving a dinosaur's skeleton comes nowhere near being a real job, but South Kensington tube station is regularly jammed with eager children longing to see such things at the Natural History Museum.

Move on

The conclusions are obvious. Jobs which have their origins in biology – conservation, improving the environment, encouraging biodiversity, scientific research, feeding the masses, ministering to the sick – are all expanding, are in great need, and improve the quality of life.

When will our politicians and business men realise where the 21st century is heading, and leave the industrial revolution and the 19th century behind?

If you want a *real* job, train as a biologist.

Professor Alan D.B. Malcolm is Chief Executive of the Institute of Biology. The views are his own, and may not reflect those of IOB

Democracy and innovation

Tom Wakeford spies tender shoots



Tom Wakeford

'I've still no idea what you are all talking about', proclaimed a commissioning editor in a Whitehall meeting the other day. She was trying to inject a broadcaster's perspective in the dialogue, but after listening to two hours of discussion between the assorted experts she felt none the wiser.

Yet the subject was not nuclear physics, molecular biology or atmospheric chemistry, but rather the simple matter of how scientists and non-scientists could talk to those making policies about technological research – the so-called 'engagement' agenda.

Upstream from PUS

During the 1990s, science policy-makers became increasingly aware that non-scientists had grown wary of boffins, and responded with the 'public understanding of science' (PUS) movement. It failed miserably, with a journal of the same name being its last remaining artefact. However, around the same time that policy-makers have begun to worry about nanotechnology, a new phrase has emerged – 'upstream public engagement'.

The trouble with such engagement is that, once in the mouths of most policy-makers, it seems to mean nothing more than having a chat, whilst leaving the assumptions of the PUS movement untouched. Rather than making decisions about science more accountable, it seems to be about nothing more than finding better means of explaining already-made decisions to the voters in an attempt to avoid the public opposition that we saw during the GM debate.

Conservative thinking

While an important milestone in some ways, the UK's first government-sanctioned attempt at upstream engagement, the 1994 UK Consensus Conference, heralded the thinking that remains at the heart of Whitehall. The Science Museum designers then proclaimed the Conference's mission as 'promoting the public's understanding of the contemporary practice of science'. Ignoring recommendations that were critical of aspects the new technology, the organisers suggested that the lay panel had 'given the field of plant biotechnology its qualified support'.

Whitehall and the Research Councils lapped up the apparent conclusion that an information-deprived public, when given the full facts by the relevant experts, would overcome most of their concerns about new technologies. Even now they assume that GM foods were only rejected because of the 'irrational' fears of non-scientists that followed the BSE crisis. The *Guardian* and *Nature's* recent coverage of the NanoJury UK process (see www.nanojury.org) made the same assumption, a reminder of the essentially conservative nature of mainstream media.

Democracy stirring

For our team of facilitators, the most exciting development in the NanoJury was the acknowledgement by those individuals in science, NGOs and research councils who funded the process, that people deserved a say not only on the issue that mattered to the funders, but on an issue that mattered to them. Having developed a political space in which they could discuss an issue of urgent local concern – young people becoming excluded from schools and involved in crime – they were more interested in the otherwise obscure topic of nano-scale futures.

Science Minister Lord Sainsbury admires what he assumes to be the supreme rationality of science, but on the issue of upstream engagement he maintains an irrational belief that all scientific knowledge must be a good thing, and he will be able to sell it better if he's funded a few chats with the public.

His smarter advisers have supported pilot projects under the *Sciencewise* programme that could see the beginning of a new

democratically accountable model of innovation. However, lacking the political clout of small circle with the ear of Downing Street or even the DTI Minister, *Sciencewise* is unlikely to be able to act as an effective counter-weight to the inner clique's starry-eyed enthusiasm for any laboratory artifact that can make a quick buck for UK plc.

Will the Prime Minister heed his own spin doctors, or instead trust processes that aim to allow people to explore all sides of the argument before leaving them to make their own decision?

Nuclear next

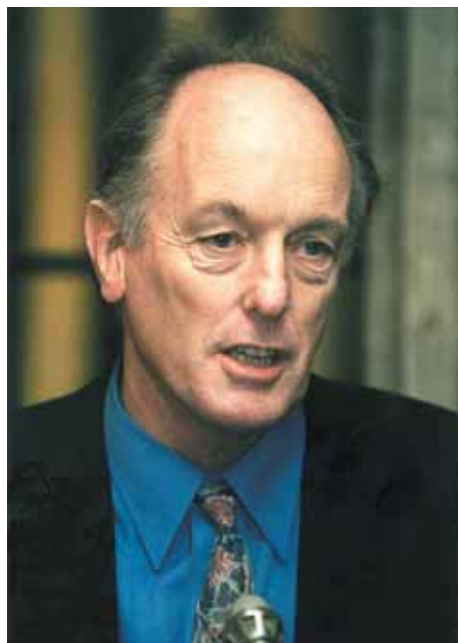
Faith in nuclear power is for Blair as strong as his faith in the Lord. This leaves us in the Yes Minister scenario of Downing Street holding private focus groups about how to sell atomic energy at the same time as officially backing *Sciencewise*, some elements of which are about to begin to open up a grassroots-based political space on that very same hot topic.

Will the Prime Minister heed his own spin doctors, or instead trust processes that aim to allow people to explore all sides of the argument before leaving them to make their own decision? Answers on an e-postcard and I'll send them to the poor television executive who is still waiting to hear what 'upstream engagement' really means.

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Science cities

Ian Gibson surveys the map



The phrase 'science city' instantly conjures up Hollywood images of robots manically policing the streets, or if we are to believe the recent BT networking solutions ad, science cities are places in which people get around by somersaulting onto flying circuit boards.

Our prudent Chancellor, possessing neither the flair of an ad man nor the cheesiness of Hollywood, meant something more tangible when he named York, Manchester, Newcastle, Bristol, Birmingham and Nottingham as science cities.

In his last two budget speeches he persuasively argued the need for the UK to rediscover its 'scientific genius' and warned that unless it did so, it would lag behind its competitors in the global economy. And just in case anyone doubted the seriousness of his intent, Gordon Brown earmarked a substantial amount of the national purse (£2.5b) for investment in science, and produced a 10-year plan to strategically push through the investment.

But what does this all mean?

According to the Chancellor, to qualify as a science city a city must have 'strong science-based assets – such as a major university or centre of research excellence – which have particular potential to use these assets as the basis for generating business success.'

The chosen six are believed to have these assets and are therefore the lucky recipients of

extra research grant funding for the universities and businesses in their areas. The treasury believes that supporting 'university-business collaboration' in science cities will lead to the growth of 'knowledge-intensive industries, such as skills, transport, finance and infrastructure' which in turn will attract innovative businesses and drive economic growth in the regions where the science cities are based. Gordon's formula is simple: Investment in Science = Economic Growth.

Let's hear it for Norwich

Call me biased, but I would argue that a city like Norwich is more than ready to join the Big Six. It surely does tick many of the boxes needed to qualify. It has 'strong- science based assets'.

True, UEA may be dragging far behind Oxford and Cambridge in developing spin-out companies, but it is also far younger than they are and has come a very long way from its humble beginnings in the early 1960s. It has gone from just offering English and Biology in 1963 to offering a whole host of humanities, social science and many scientific disciplines such as medicine, pharmacy, computer science, environmental science, nursing and midwifery amongst others.

UEA graduates are raising the pulse of business activity in Norwich and the city is supplying the NHS with some of the best trained health professionals in the world. In addition, its environment department is said to be one of the best in the country.

'strong science-based assets – such as a major university or centre of research excellence – which have particular potential to use these assets as the basis for generating business success.'

Potential for success

There is no doubt that much work is needed to make Norwich a science city, but surely that is the point of the Chancellor's idea. The cities he has chosen so far have shown that their greatest asset is their potential, and cities like Norwich have that in abundance.

For example, with some investment, the Environmental Sciences department could set up partnerships with sustainable energy companies and could well be on its way to making every household in Norwich more environmentally friendly. The city also has the brain power to put itself on the map by developing an ecologically sound transport system. If this does not serve as the basis of 'generating business success', nothing will.

Norwich is not the only candidate. Since the Chancellor announced the first six science cities, Dundee and a miffed 'why didn't you include us in the first place' Leeds have also been asking for science city status.

The city also has the brain power to put itself on the map by developing an ecologically sound transport

Science education

So how do we get the Chancellor to sit up and notice aspiring science cities?

Education would be a good start. No science city can thrive if its younger residents lack access to good science education. We need to nurture an interest in all things scientific at an early age. It is therefore heartening to know that there are plans to set up specialist science and technology schools in the near future. But we need to go beyond this and develop our country's wild life gardens and improve school trips.

Outside the classroom we have to make the public keener on science, and what better way to grab the public imagination than the idea of a science city in their locality?

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