
TECHNOLOGY INNOVATION AND SOCIETY

Published Quarterly for the Information of Subscribers

Winter 1999



FOUNDATION FOR SCIENCE AND TECHNOLOGY

FOUNDATION FOR SCIENCE AND TECHNOLOGY

President

The Lord Butterworth, C.B.E., D.L.

Vice-Presidents

The Earl of Shannon

The Lord Flowers, F.R.S.

Dr Richard J. Haas, C.B.E., LL.D., Hon. Sc.D.

The Earl of Selborne, K.B.E., F.R.S.

Sir Tony Wrigley, P.B.A.

Council

Chairman: The Rt. Hon. The Lord Jenkin of Roding

Deputy Chairman: Dr Geoffrey Robinson, C.B.E, F.R.Eng.

The President of the Royal Society: Sir Aaron Klug, O.M., P.R.S.

The President, The Royal Academy of Engineering: Sir David Davies, C.B.E., F.R.Eng., F.R.S.

Chairman, Science Council: Sir Colin Spedding, C.B.E.

Chairman of the Senate, The Engineering Council: Dr Robert Hawley, C.B.E., F.R.Eng., F.R.S.

Chairman, The Biotechnology and Biological Sciences Research Council: Dr Peter Doyle, C.B.E., F.R.S.E.

Chairman, The Council for the Central Laboratory of the Research Councils: Dr Albert R.C. Westwood, F.Eng., N.A.E

Chairman, The Economic and Social Research Council: Dr Bruce Smith, O.B.E., F.R.Eng.

Chairman, The Engineering and Physical Sciences Research Council: Professor Anthony Ledwith, C.B.E., F.R.S.

Chairman, The Medical Research Council: Sir Anthony Cleaver

Chairman, The Natural Environment Research Council: Mr James Smith, C.B.E., F.R.Eng., F.R.S.E.

Chairman, The Particle Physics and Astronomy Research Council: Dr Robert Hawley, C.B.E., F.R.Eng., F.R.S.

Professor Chris Elliott, (Honorary Secretary)

Mr Roger G.L. Davidson (Honorary Treasurer)

Sir Geoffrey Allen, F.R.Eng., F.R.S.

Sir Walter Bodmer, F.R.S.

Dr Brian L. Eyre, C.B.E., F.R.Eng.

Dr C.A.P. Foxell, C.B.E., F.R.Eng.

Sir Robin Ibbs, K.B.E.

Dr Geraldine Kenney-Wallace, F.R.S.C.

Professor Peter J Lackmann, F.R.S.

Mr David Moorhouse

Sir Richard Morris, C.B.E., F.R.Eng.

The Rt. Hon. Sir Brian Neill

Dr Bridget Ogilvie, D.B.E.

The Lord Oxburgh, K.B.E., F.R.S.

Professor R.T. Severn, C.B.E., F.R.Eng.

Dr Fiona Steele

Professor Sir William Stewart, F.R.S., P.R.S.E.

Sir Richard Sykes, D.Sc., F.R.S.

Honorary members

Dr B.J.A. Bard, C.B.E.

Dr G.B.R. Feilden, C.B.E., F.R.Eng., F.R.S.

Mr A.A.C. Jacobsen

CONTENTS

Volume 15, No. 4

Winter 1999

The Foundation For Science And Technology

Buckingham Court,
78 Buckingham Gate
London SW1E 6PE

Tel. 0171-222 1222
Fax. 0171-222 1225
Internet site: www.foundation.org.uk

Director:
D.N. HALL, OBE, FCIS

Editor:
D. EDDOWES, BSc

Editorial Advisory Committee:
Dr Richard J. HAAS, CBE
Professor Chris ELLIOTT MA, PhD,
CEng, MISE, FRAeS

Technology, Innovation and Society
is published quarterly by the
Foundation at an annual subscription
of £40, including postage. Single
copies £13 each.

It is also circulated to all Learned
Societies and Institutions accredited
to the Foundation as part of the
services provided to them.

We would welcome items of news,
letters and articles, which should be sub-
mitted to the Editor for
publication in future issues.

Neither the Foundation nor the
Editor is responsible for the opinions
or statements of contributors to
Technology, Innovation and Society.

Typesetting by *Light Touch Typesetting*.

Electronic page assembly by
LPS, London. 0207-394 6920

Printed by *Aztec Press, Cardiff*.
01222-464614

©1999 The Foundation for Science and
Technology

ISSN 0951-2918

The Council of the Foundation Inside front cover

Mobility in the Future

Mr David Fisk CB FEng 2

Professor Stephen Glaister CBE 3

Quality of Life for the Millennium Consumer

Mr David Hatch CBE JP 6

Profile of Council Member

Dr Bruce Gordon Smith CBE FREng 9

Foundation News 10

Seeking Consensus on Contentious Issues

Dr Gunnar Bengtsson 12

Professor Robert M Worcester 14

Sponsored Lectures, Foundation Visits and

Learned Society Seminars 23

Associate Members and Major Donors Inside back cover

MOBILITY IN THE FUTURE

The Foundation held a lecture and dinner discussion at the Royal Society on 9 February 1999 on "Mobility in the Future" in the series on the Quality of Life for the Millennium Generation. The Rt Hon The Lord Jenkin of Roding was in the chair and the evening was sponsored by the Department of the Environment, Transport and the Regions, the Engineering and Physical Sciences Research Council, Railtrack plc and the Foundation's Shared Sponsorship Scheme (Comino Foundation, Esso UK plc, Glaxo Wellcome plc and Premmit Associates Ltd). The speakers were Dr David Fisk CB FEng, Chief Scientist, Department of the Environment, Transport and the Regions, Professor Stephen Glaister CBE, Professor of Transport and Infrastructure, Imperial College, M. Jean-Francois Abramatic, Chairman, The World Wide Web Consortium, and Mr Edward Gillespie, Environmental Development Manager, London Transport.

Mr David Fisk CB FEng*

Introduction

The government published its Integrated Transport White Paper in 1998. The Paper argued that the approach to transport in the 1970s and 1980s would no longer serve the next millennium. I am going to focus on only one aspect of this new analysis. My contention is that the real issue when considering the role of technology is not future *mobility* but future *access*. To the traveller access is not just an issue of the resource cost of travel, but an issue of time and space. If that argument is accepted then I hope to show that a future of gridlock is not inevitable.

... Or Just Turn Up the DVD Player?

The White Paper's analysis was very widely welcomed, both in the response to the consultation paper and the debate that has followed the paper's publication. However, while the patient can be said to have concurred with the prognosis, there seems some nervousness about taking the medicine. When I visited a Japanese car manufacturer I asked him what technology his company had planned to deal with the appalling traffic congestion in Tokyo. He had a long-term plan and a short-term plan. In the long-term he envisaged all kinds of new technologies and advanced telematics. But the short-term plan? Better leather seats, improved air conditioning and a better quality in car hi-fi. If you were bound to be stuck in a Tokyo traffic jam you might as well enjoy it! This attitude of sorrowful resignation is equally common in the UK. I suspect that there are at least two reasons.

- **Elasticities.** Economists describe our response to prices through 'elasticities'. Part of our problem is that the price elasticity for access shows an unusual property. In the very short run our behaviour is almost price inelastic. If the public transport system failed tonight I would pay some exorbitant cost in taxi fares to get back home to the suburbs. But in the very long run our elasticities are virtually infinitely elastic. Otherwise we would be buried where we were born! Long run price response is, then, not just buying a more efficient car but where we live or chose to locate our facilities. No wonder then that some have agreed with the White Paper's analysis but been alarmed by its diagnosis. Isn't talk of congestion charging, losing lanes to buses, and parking levies terrifying when you've still got to pick up the kids, get to work and deliver your products next Thursday? But the Government's White Paper is directed at the longer term. It never proposed to take away car ownership, but recognises that unless we are given more choice on access we will sleep walk into an unsustainable future of gridlock.

- **No gridlock on the Isle of Mull!** We often express transport statistics through national averages, but we do not have a *national*

* Chief Scientist, Department of the Environment, Transport & the Regions

Summary: Dr Fisk contended that the real issue when considering the role of technology in transport was not future mobility but future access. He developed this idea, showing how technologies aimed, for example, at ensuring that multi-modal journeys were at least as reliable as private transport, and bringing services nearer to the customer by Internet shopping and localised delivery, could contribute. Professor Glaister gave consideration to the fundamental inconsistencies in government transport policy which, he argued, were leading to continued under-investment in both road and rail infrastructure. This would be seen as a mistake in years to come. He set out what he believed were the requirements.

problem. Like most isthmus economies the nature of our transport problems vary significantly across the country. What might be a woefully inadequate response in London would be disproportionate and draconian in the Isle of Mull. This is why the Government lays such store on the lead being taken at the local level. It is not passing the buck, but recognising the reality.

More Things in Life than Travel

Why isn't gridlock inevitable? The simplest answer is that increased mobility is not inevitable either. Apart from a ten-minute thrill at a theme park, few people travel for its own sake. The purpose of travel is access. While a good transportation system is an important economic requirement in a developing country, in a developed country transport it is an intermediate good. When we can do without it we are richer. The question for the



▲ Dr David Fisk (seated), Chief Scientist DETR, and Mr Edward Gillespie, Environment Development Manager, London Transport, both of whom were speakers at the event. Behind, Professor Chris Elliott, Hon Secretary of the Foundation, is talking to M. Jean-Francois Abramatic, Chairman, The World Wide Web Consortium.

future is not how to get from A to B, but why are A & B not being brought closer together.

Time is Money. As a rough rule of thumb we will waste about 10% of our working day moving to where we really wanted to be. The figure is reasonably constant across incomes, cultures and history simply because even the rich have only the same 24 hours in a day as the poor. Time spent travelling is time lost. The only difference is that the Third World poor walk and multinational Chief Executives use helicopters.

Km/year. Technology has continued to increase the distance that we can find time to afford to travel. France has one of the longest time series of average travel time, beginning in Napoleonic times. Roughly speaking, the distance travelled per year by the average *cityeon* has doubled every twenty.

City Size is Travel Size. The consequence of this technology can be seen in the increasing maximum size of cities. If a city's limiting diameter is about 2 hours travelling before it becomes socially dysfunctional, then as new transport technologies arrive we should not be surprised that cities expand. The arrival of railway technology expanded Victorian London to the LA basin of the 19th century. The internal combustion engine inside a car created the LA basin, inside a bus the third world megacity.

Do you know you are renting a large Roman villa? The consequence of how we have allowed transport technology to interact with land use has been dispersion. We can average out the land use employed for the services provided by schools, hospitals, hotels, offices, factories, shops and warehouses amongst UK households who have paid for the services they provide. The result is a floor area 'owned' by each household that would make up a very respectable Roman Villa. The only difference is that the Roman gentry did not have to travel an average of 12,000 miles a year for the advantages. However, even that is a short distance compared with the 15,000 miles estimated by SMMT that have been travelled by the ingredients of a full British Breakfast!

Good Roads Breed More Journeys. A further consequence of our universal habit of setting aside an hour of our life for travel is that speeding up journeys frees up time for more travel. If we build a further lane to speed up a road, we should not expect the new road to carry the same volume of traffic as before, just at a higher speed. If our planning systems are not appropriate the road will generate even more traffic as new land uses move in to exploit the time freed up by the reduced travel time. There is nothing illegal in that, of course, provided that new development had paid its fair proportion of the road expansion costs.

Slow Buses Breed Slow Roads. The thrust of the new White paper is that sustainable future transport solutions cannot be a monolithic convergence on the car and truck as the only possible transportation mode. Curiously enough, choice brings a better deal for the motorist. Indexed prices show differences between the 'cost' of public and private travel. But they tell only part of the true story, since it is the total cost of the total journey that really counts. That cost includes the total travel time. Walking to the bus stop, waiting for the bus and waiting for connections. That journey speed will define the mean speed of private traffic at which congestion chokes off demand. Measures that reduce total mass tran-

sit journey times are likely to increase parallel road speeds. Hence the White paper's new emphasis on local travel plans that include bus lanes and other priority measures.

Home working from St Tropez. While using a time budget for total travel is a useful ready reckoner to check off options, it also provides one warning. Working to Home working using IT is often advanced as a solution to traffic congestion. Probably the outcome is more enigmatic. But if you can work for a London company from home, why not live in St Tropez instead of Guildford, and commute only for the important meetings? IT makes distant contacts, but opens up opportunities for profitable journeys.

Technology's role

These examples all show that adapting access is an important, though often forgotten, part of the story of future mobility. The internal combustion engine, like the steam engine before it, has become so successful that its land take becomes self-defeating where its use is most intensive. Once land take becomes a constraint the flexibility and speed of private transport begin to limit. Mass transport ceases to be an economy of scale for the less well off and becomes a technology for directed time-reliable transport. As before, technology will need to come to our aid. So, using some of my earlier arguments, it is possible to judge where some of those pinch points might be.

- Road Pricing technology. Promises to introduce the same market disciplines as apply in other distribution grid networks.
- Journey Reliability Technology. Promises to ensure that a multi-modal journey involving mass transit is at least as reliable and punctual as private transport.
- Better travel information. Promises to ensure that planning a journey on mass transit is as easy as spreading out a map in the car. Ensuring that car travellers can improve the use of road space by avoiding congestion.
- Better journey integration. Relating services to total journeys through technologies such as single ticketing, and real connections.
- Bringing services nearer to the customer. Using techniques like Internet shopping and localised delivery to bring services nearer to the consumer.

None of these technologies is going to take us into a gridlock-free future on its own. But developed and applied in a package the White Paper argues that they could lead to a future where we can access what we want without falling over or choking each other.

The Environmental Gain...

I have not mentioned the environmental implications of our current forms of transport. After all, transport emissions are the major determinant of air quality in much of the country. The transport sector is the largest growing sector of developed country greenhouse gas emissions. The White Paper makes it clear that the transport sector will have to pay its fair proportion of externalities. But the argument here suggests some of these goals would be met in any case by transport that was more suited for the twenty-first century. With the right technology a reluctant resignation to gridlock could be turned into a win-win situation.

Professor Stephen Glaister CBE*

Introduction

This paper is about fundamental inconsistencies in Government transport policy and the way they are leading to continued underinvestment in both road and rail infrastructure. This will be seen as a mistake in years to come.

Two or three decades ago a policy which favoured public transport at the expense of the car was likely to find an easy majority of supporters. Now such a policy risks being seen as an attack on the daily lives of the majority: three adults in four live in a household with access to at least one car. This change in balance has made

the development of a coherent and generally acceptable transport policy extremely difficult.

Inconsistencies in policy

Taxation on motoring is being increased as a matter of policy on the part of the Department of Environment, Transport and the Regions (DETR) and the Treasury. Meanwhile, the Department of Trade has responsibilities for promoting the motor industry. The Government is once again contemplating subsidising the motor manufacturing industry. Meanwhile, other parts of Government investigate alleged anti-competitive practices that are said to keep

* Professor of Transport & Infrastructure, Imperial College, London

up the prices of new cars to the UK.

There is little in the current "Integrated Transport Policy" that will cut the long-term growth in road or rail traffic, yet financial provision for national roads and rail infrastructure has been severely cut.

The worldwide growth in mobility.

As travel becomes faster or cheaper people will generally take advantage by achieving more mobility. Fig. 1 is taken from the Government's Consultation Paper on transport policy. It shows a quite extraordinary growth in mobility by cars and vans: passenger kilometres have increased by a factor of thirteen since 1952.

This Figure shows that it is quite unrealistic to expect a favourable policy towards public transport to make much of an impact on the overall level of mobility. For most people mechanised mobility is to do with the car and public transport is hardly relevant. Outside the centres of the big cities those who now have access to it have exploited the car's unique advantage – go anywhere on demand. Trip patterns have now developed to be suited to the car but unsuited to public transport. It would be extremely difficult and costly to reverse this situation.

The reasons for increasing car traffic

This has come about principally because standards of living have risen and the costs of owning and running cars have not risen as fast, as illustrated in Fig. 2.

Note how public transport fares have broadly kept pace with real incomes – as one would expect since public transport relies so heavily on labour for its major input – whilst the cost of car purchase has fallen markedly. This last is a reflection of the technical progress in design and manufacture of motor vehicles over the decades. Not only are they cheaper, but they are better quality items and they last longer.

The tendency to spend increased wealth on mobility seems to be universal. Fig. 3 shows a worldwide relationship between Gross National Product per head and a measure of individual mobility. A large portion of this extra mobility is motorised. This figure has disconcerting implications for those who worry about the future growth of world level of motor travel and its emissions.

In the UK there is little in current policy that will stop the trend and this is reflected in the official forecasts. These forecasts have a good scientific foundation and I see no reason to question them in the large.

Demographic factors

Another factor is the striking growth in the number of households – especially one-person households – as people chose to live in smaller households, on average.

We can expect an increase in the number of active older persons, especially women, living on their own. At the moment only 7% of women on their own and over the age of 75 have a driving licence[†]. Many of them never learned to drive. But 70% of today's women aged between 40 and 49 hold a driving licence and young women are learning to drive just as often as young men. As the decades pass the older generations will wish to own and use cars in much higher numbers than their predecessors.

The benefits of mobility

Older persons will be able to stay self-sufficient to a greater degree and their quality of life will be enhanced. Anybody who asserts that the growth in the number of cars should be stopped should be willing to say whether and how growth of mobility amongst the older population is to be accommodated.

The extraordinary growth in mobility for the population as a whole represents an important improvement in the general quality of life. The average household that spends money on motoring

[†] S. Glaister and D. Graham, *Who Spends What on Motoring in the UK?* Automobile Association, December 1996, ISBN 0 75530 09315

[‡] See Glaister and Graham

now spends over £50 per week – the same order of magnitude as other "necessities of life": housing and food[‡]. This is people's free choice and the fact the figure is so high is a reflection of how many other goods and services they are willing to sacrifice for the privilege.

What is "essential"

In statements by those concerned to reduce the use of cars one often hears exhortations to cut out "inessential" car journeys. Often these are identified with short car journeys, such as trips to take children to school. Quite apart from the fact that this cajoling has very little real effect on behaviour, I can see no justification for the attitude. It is for individuals to decide this for themselves, taking into account the costs and the benefits of their actions as they see them. But this is subject to an important qualification.

The need to recognise damage to others

The decisions made by individuals should take proper account of the costs they impose on others. Congestion, air pollution, noise, visual intrusion and the collapse of town centres can all pose this problem.

To address this sensibly we require the best available estimate of magnitudes of the costs imposed on others. This will vary enormously, depending on the circumstances. A trip entirely in the country in a car powered by natural gas will impose very different external costs than a trip in a diesel-powered car in a congested city. One estimate puts these damage costs at 0.2 pence per vehicle km and 2.7 pence per km respectively[§].

Our ability to assess these costs has improved substantially in recent years. It will always be an imperfect science but it is possible to make estimates of orders of magnitude. It is apparent that none of the costs is infinitely high. It follows that it is not sensible to think in terms of eliminating congestion or pollution. Rather, we need to strive for a sensible balance of benefits against costs.

The second stage is to strive to make individuals "see" these costs so they cannot avoid taking account of them. Increasing fuel taxation is a direct approach to general traffic levels and emissions of the various gases produced by burning fuel. It has the advantage of being cheap to collect (since it is an add-on to an existing surcharge tax) and hard to evade.

The responsiveness of traffic to prices

The variation in fuel prices over time and across counties noted above allows statistical exploration of the extent to which people do respond to changes in the prices of fuel that they face, summarised in the Table**.

	<i>Immediate impact</i>	<i>Long run impact</i>
10% Fuel price rise on traffic	-1.5%	-3%
10% Fuel price on fuel consumption	-3%	-7%
Effect of 10% rise in incomes	12%	12%

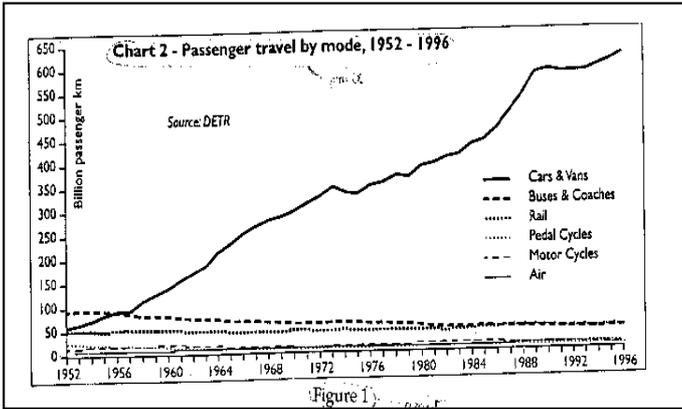
There is a distinction between the effect on traffic and the larger effect on fuel consumption. The difference comes about because people are able to adjust the way they drive and the fuel efficiency of the cars they use.

The role of fuel taxation

This is good evidence that people do, indeed, respond, especially over the kind of time horizon that transport policy should be con-

[§] N.J. Eyre et al. "Fuel and location effects on the damage costs of transport emissions", *Journal of Transport Economics and Policy*, January 1997.

** S. Glaister and D. Graham forthcoming.



▲ Fig.1. Passenger travel by mode, 1952 - 1996

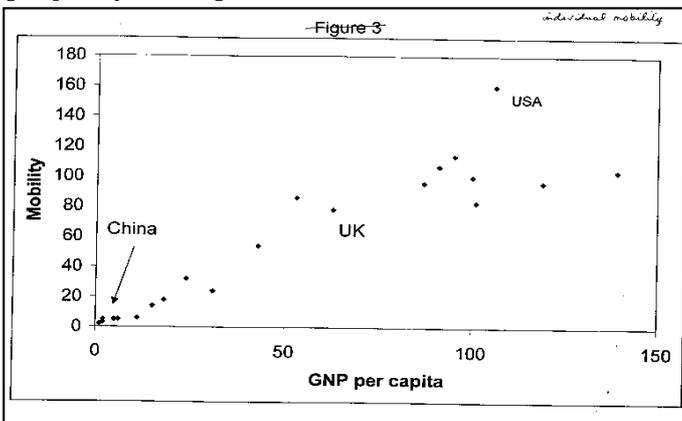
sidering. Raising taxation could, in principle, be used as a means to reduce both traffic and the quantity of fuel burned.

But the magnitudes also show the practical and political difficulties of achieving this. If real incomes grow at 2.5% per annum then this will lead to a growth in traffic and fuel consumption of $2.5 \times 1.2 = 3\%$. Merely to offset this and hold the level of fuel consumption constant would require fuel price to the consumers to rise by $3/0.7 = 4.3\%$ per annum and to hold the level of traffic, price to the consumer would have to rise by $3/0.3 = 10\%$ per annum. Current policy is to raise fuel tax (not the final price) by 6% per annum. The price of crude oil has been falling.

Current policies will not be enough to prevent the increase of traffic due to "routine" economic growth; and to this we must add growth due to improvements in car quality, reduction in manufacturing costs and demographic factors. Nor, on their own, will they be sufficient to make much of a contribution towards the Labour Government's Manifesto commitment to reduce carbon dioxide emissions to 20% below their 1990 levels by 2010. Even to move towards it will require the large-scale adoption of the fuel-efficiency benefits that available technology can already offer for conventional fuels.

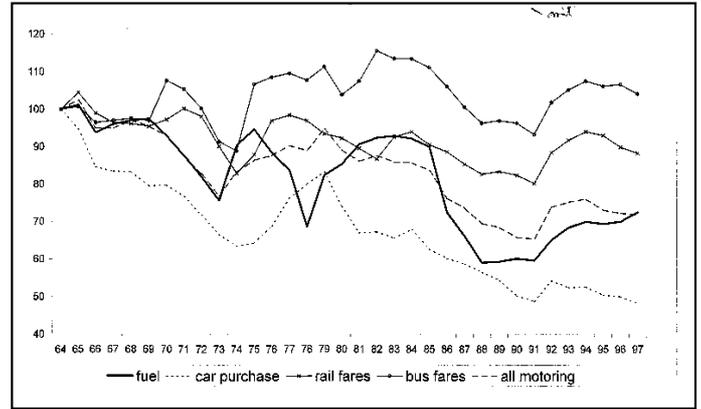
Some new fuels, such as natural gas, LPG and possibly hydrogen, offer the prospect of real advance in mitigating air pollution problems. But they will only be adopted on the required scale if motorists are given the financial incentive to do so. This implies its own set of reforms of relative tax rates.

Whilst rises in fuel taxation do have a part to play in facing motorists with the "correct" costs of their decisions, they are unlikely to achieve the Government's objectives on their own at politically acceptable levels. Nor should they, because they are blunt instruments. Set high enough to have a useful effect in congested cities they would cause unwarranted damage to the interests of those in less damaging circumstances such as the country areas. Further, the incidence of fuel tax increases on some poorer groups may be thought to be undesirable^{††}.



▲ Fig.3. World wide relationship between GNP and a measure of individual mobility

††S. Glaister and D. Graham forthcoming.



▲ Fig.2. Price indices relative to gross household income Congestion charging

Differential rates of tax on different fuels to reflect their propensities to cause damage can be effective. This is the fundamental logic that is now winning acceptance of the idea of congestion charging, the idea being a charge specifically for the use of congested road space, similar in magnitude to the external costs imposed. This will give the motorist the "right" signal as to the true cost of the journey.

Making these approaches work in practice is difficult – though an approximation is possible^{††} – and they will, inevitably, be rough and ready compared with the ideal. But they will give real and direct incentives to change behaviour in the right direction, something that mere exhortation is unlikely to achieve.

The prospect of congestion charging with revenues dedicated to investment in local transport systems is welcome. Now that the principle has been accepted the challenge is to develop the appropriate technology to implement it. Getting the technology right for successful implementation of congestion charging is a potentially lucrative opportunity – it will be adopted all over the world.

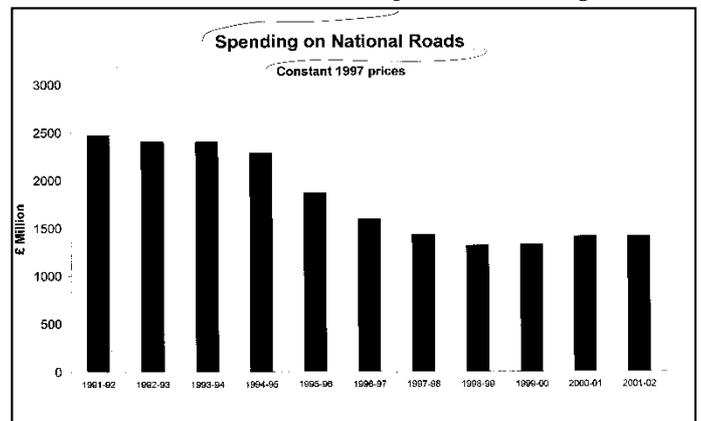
The need to provide for some traffic growth

The reality is that traffic will continue to grow under any likely set of policies. It is therefore inconsistent to have cut the scale of roads investment to the extent that successive governments have. Fig. 4 shows the extent of the previous, Conservative, Government's cut in expenditure on Trunk Roads and Motorways, and how this has been carried forward by the present, Labour, Government.

Appraisal of the benefits of roads

Over the decades the UK has been at the forefront of development and application of techniques for the assessment of the economic costs and benefits of road investments.

They are under continuous review and improvement and nobody would claim that they are perfect. However, they are some of the best established techniques for measuring value for



▲ Fig.4. Spending on National Roads, Constant 1997 prices

†† S. Glaister, Practical Pricing of Traffic in Towns, Social Market Foundation, March 1998 and DETR Breaking the Logjam, Consultation Document, December 1998.

money in use in the public sector and I believe that the results they produce do represent genuine effects. There are schemes recently removed from the Trunk roads programme in spite of having very high rates of return. It is hard to think of alternative ways of spending resources in the public sector that would show such high measured returns.

Shortage of capacity on the railways

Expansion of both freight and passengers is a central part of the Government's *Integrated Transport Policy*. Yet the railway is already congested, which is one of the reasons that the quality of service is not as good as it should be. Growth of railway traffic can only happen on a significant scale if more public money is made available.

Subsidy over the seven years of the Train Operating Companies' franchises falls from a total of £1,794m in 1997-98 to £656m in 2003-04. If the contracts are honoured and the saving is delivered, then this will be a major achievement. But the Comprehensive Spending Review shows that rather than ploughing the savings back into the railway the government will consider using them for other purposes. If the savings were to be ploughed back into railways as a part of the SRA's budget, then the Government's aspirations for the railways would look considerably more realistic

Conclusions

The prospect of growth in both road and rail traffic whilst failing to provide adequate infrastructure to cater for it is a major inconsistency in current policy. If it continues for long then congestion will worsen and quality of service on both road and rail will

decline. This will inconvenience a large number of people.

Further, as many Members of Parliament will attest, there is a large number of local communities that remain keen to secure "their" local bypass road. What was perceived to be a popular consensus concerning "the environment", "integration" and "sustainability" is likely to become an unpopular policy.

A major innovation in the Government's *Integrated Transport Policy* White Paper is the recognition that price incentives have a part to play in managing individuals' behaviour. As the policy is refined and made operational the Government should develop effective measures to offer motorists financial incentives to moderate their behaviour. They will also realise that future traffic growth is a fact of life and a good thing so long as it is sensibly managed. Adequate infrastructure will have to be provided to serve it to a greater degree than is currently planned.

The requirements are:

- a recognition of the benefits as well as the costs of increased mobility
- an acceptance that if it is undesirable or politically impossible to prevent further traffic growth then more infrastructure must be provided and better maintained to the extent that economic and other appraisals show this to be worthwhile
- further adjustments in the taxation and charging regimes to give incentives better aligned to transport policy
- wide-scale implementation of available technical improvements in vehicle efficiencies and emissions performance, encouraged by enforcement of existing regulations and an appropriate taxation regime.

QUALITY OF LIFE FOR THE MILLENNIUM CONSUMER

The Foundation, in association with DETR, DoH, ESRC, HSE, The Royal Academy of Engineering and the Royal Society, held a lecture and dinner discussion in the series, Quality of Life for the Millennium Generation, on the subject "Millennium Consumer" at the Royal Society on 9 June 1999. The event was sponsored by The Future Unit and Consumer Affairs Directorate, DTI, Unilever plc and the Foundation's Shared Sponsorship Scheme (ABPI, Comino Foundation, Esso Petroleum Co Ltd, Glaxo Wellcome plc, Premmit Associated Ltd and Science Systems (Resources) Ltd). The Rt Hon The Lord Jenkin of Roding was in the chair. The speakers were Mr David Hatch CBE JP, Chairman, The National Consumer Council, Mr Andrew Summers, Chief Executive, The Design Council, and Dr Nick Edwards, Business Technology Analysis Unit, BT plc

Mr David Hatch CBE JP*

Introduction

Auden said that whenever he found himself in the company of scientists he felt like a shabby curate who had strayed by mistake into a drawing room full of dukes. That is just about how I feel today.

You have asked me to talk on the theme of the "Millennium Consumer". By that I presume you don't just mean someone who is going to buy a model of the Dome. You wanted me to think rather more deeply about the role of the consumer as we start a new century and a new tomorrow. I am happy to do so. But "tomorrow" is not a greenfield site, so first we must glance back at the inheritance of yesterday and today. Every century has been a period of change but the twentieth century has been exceptional for the pace of change.

Summary: Mr Hatch discussed the position of the consumer as we entered a new millennium in relation to the impact of new technology, the need for better communication of science and what could be described as the creation of a culture of consumerism. He indicated the role of the NCC in guiding the consumer.

The past

Over the last one hundred years we have learnt what science can do for us. All around us are the benefits of a century of research and development – electric power, motor vehicles, plastics, aircraft, space travel, television and the computer. To stop and look back and see what has happened – as my Victorian parents did – is to gawp with awe at what the skills of man can achieve. But the twentieth century has also seen science harnessed for mass destruction and the unimaginable horrors of Hiroshima and Nagasaki. Similarly, advances in medical care have brought untold benefits to most, but the victims of Thalidomide remind us that sci-

* *Chairman, National Consumer Council*

ence is not invincible.

What science could do was not the preoccupation of ordinary citizens when the twentieth century began. Their concerns were more basic. Most were poorly educated. There was no welfare state, so unemployment meant losing your home, going into the workhouse as a pauper and subsequent loss of liberty. Hours of work were long, opportunities for leisure few.

Death before the age of 60 the norm; the concepts of retirement and youth had yet to emerge. Youth incidentally is the last stage in your life when you will be happy that the phone is for you. For the Victorian worker, the elegant phrase "life's a bitch, and then you die", must have seemed an apt motto.

Nowhere more did the Victorian citizen feel his vulnerability than at work. No protection from dismissal, no holiday entitlements apart from bank holidays, no ability to sue a company after injury, no sickness benefits – it's startling when we look back.

So, one hundred years ago there was little science and there were no consumers except amongst the very wealthy. Since the Second World War all that has changed. The creation of the welfare state and the growth in real incomes have transformed the lives and prospects for most of us. By the 60s and 70s, we had reached a stage in our economic and social development when people began to see themselves as not merely existing but having choices about their lives, and it was in that period, 1975, when my organisation, the NCC, was created.

Role of the NCC

The NCC is not just about the products in the high street. It's about access to justice, the CAP, BSE, utility regulation, public service broadcasting, data protection, the health service, the environment, information technology, transport, and much, much more. We examine all these things through the prism of seven principles: access, choice, safety, information, fairness, redress, representation. And what do we see!

The relative power of the consumer today is weak. There is more choice than in the past, but those choices are often constrained. Lack of information, restricted access to technology, worries about safety and financial problems all contribute to the consumer being forced effectively to make decisions they do not want to make.

The power of the individual computer user compared to that of Microsoft is a vivid example of power in the modern marketplace. It is an extreme example but it is a crucial one because the consumer of the future will need "the gateway" to the market of information and communications that technology provides. It is not just about the Internet, although that will grow in importance for all of us, it is access to services such as banking and opportunities for learning that matter just as much.

Choice

However significant the changes in Britain (as the consumers

exercise their buying power differently), there are strong pressures to constrain choice. Free trade is more of a reality today than it was in the time of Gladstone, but barriers to trade are still there but today are almost hidden from view behind the boardroom doors of the multinationals. We at the NCC welcome freer markets, where they enhance consumer choice and advance progress. But we are also mindful, as we must be, of those many consumers who do not have freedom of choice. Globalisation can be a serious restriction on choice. Global companies can be a force for good if they are well run and are socially and environmentally responsible businesses. But if they seek to exercise monopoly power, to restrict choice and drive up the prices, then they are a serious threat to us all.

Having the reins of economic power in the hands of a few is as bad if the economy is capitalist, as if it were communist. Markets are not enough, they must be free.

Science in context

How will science fare in this global marketplace of goods and information? Well, I suppose if you work in GM food at the moment you will probably think: not that well. In March 1996 here at the Royal Society I said to those present, on this very subject "tell the public as much as you can about what you're doing and why, not ducking the questions and consequences that could flow from that, because if you don't the public will become distrustful and suspicious". I went on to say that the "customer isn't always right, but he isn't always wrong either".

Three years later my "Thought for Today" would be the same. Fear of crime can be just as paralysing as crime itself, remove the fear and people venture out into the streets and into the 'novel' and GM food shelves.

Huxley once said that the great tragedy of science was that it involved "the slaying of a beautiful hypothesis by an ugly fact". Eloquent, but wrong. As this century has progressed, we have learnt the hard way that science is not about facts, it is not about absolutes.

Yes scientists are the experts, but experts are no more right than other people, they are just wrong for more sophisticated reasons.

Bertrand Russell was once asked whether he would be prepared to die for his beliefs. "Of course not", he replied, "after all, I might be wrong".

The tragedy of Thalidomide was a watershed for science and medicine in Britain. In considerable measure the distrust of scientists and doctors as well as the public desire for more open government and transparency stems from the fiasco of Thalidomide. Since then, we have seen so many health scares that new ones may be having less impact. But the scale of the public's reaction to the 1988 salmonella-in-eggs alert, the world-wide response to BSE, the contraception-pill-panic and the recent prosecution of former Ministers in France over blood products contaminated with HIV, shows that science and medicine are a long way from winning the



▲ Dr Nick Edwards (right) from BT Laboratories, Martlesham, with Professor David Cope, Director of the Parliamentary Office of Science and Technology. Nick Edwards had just presented the view of a Foundation workshop for younger scientists and engineers to guests attending the evening event.



▲ Roger McDermott (left), Project Manager at the Future Unit, having attended the workshop for younger engineers and scientists on "The Millennium Consumer", meets John Reynolds, Director the Future Unit, at the evening lecture and dinner discussion.

unquestioning trust from the public they enjoyed in earlier days.

Risk

The current debate about GM food crystallises many of the issues involving science and the consumer. Science cannot tell us whether GM-altered foodstuffs are safe in the common meaning of that word. So, for the new millennium give the public a handrail, explain simply and clearly what "risk analysis" is all about. It ought not to be impossible. Was it Rutherford who said "a scientific theory worth its salt should be explainable to a barmaid"?

Harold MacMillan said "to be alive involves some risk". At the NCC we fully recognise that and we argue for a "precautionary" approach to be taken to the whole question of risk – and food safety in particular. Napoleon had it right: "rashness succeeds often but still more often fails". And we know what happened to him!

Consumers cannot find out whether what they are eating contains genetically modified ingredients because the labelling laws do not require producers to display this information. Product labelling is turning into the new technologies' Achilles heel – if a label can have a heel without turning into a corn plaster. Politicians try to reassure but fail because they do not have the answers either. Consumers are suspicious and confused. And who can blame them? At the National Consumer Council we do not seek bans on GM food, but we do demand that all food is properly labelled – because it's the customers who must decide what risks they're prepared to run.

Communication

Choice does not exist without information. You cannot choose if you do not know what the options are.

What should scientists do about this situation? Well, above all, you must learn the art of communication.

The best communication is honest communication. As I've said, you must tell people what you know – and what you do not know. What you do not know is often as crucial as what you do, so spell it out. Scientists have to learn, as doctors have had to over the last twenty years, that the public are not idiots who cannot understand the issues. The British people have never been better educated. They can make judgements for themselves and they have to be allowed to do so.

Sometimes I think that scientists are afraid to let the public know what is happening because they are frightened people will make what they see are the "wrong" choices. This was the argument deployed for centuries as to why democracy could not provide decent government. Of course, the reverse has proved true. Under despotic government, rumour becomes more important than fact. A frustrated consumer is harder to reason with than an informed one. People make wiser choices when they have all the information before them.

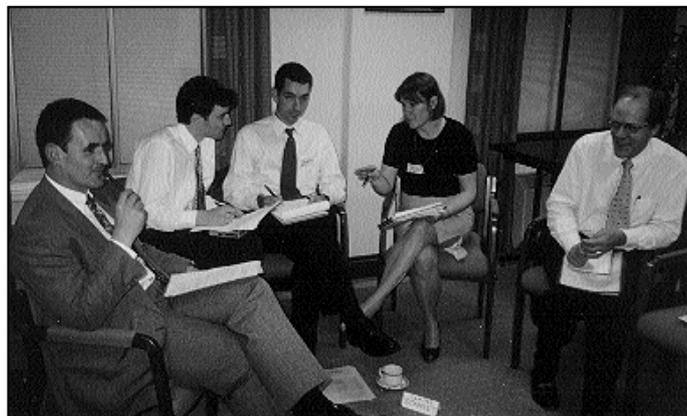
In the past, people were starved of food; in the future they could be starved of information. Poverty will take on a new meaning in the information society of tomorrow.

More power to the consumer

Advances in technology and the desire for social change have given most of us more leisure time as well as greater wealth. We have the money to buy and the time to go shopping. Yet, as I said, we consumers are relatively powerless players in the marketplace. How can we change that?

The first change is one of culture. For all those in positions of power, and that includes scientists as much as politicians, it means recognising the legitimacy of the rights of the consumer. It means giving access to information and protective rights, not begrudgingly but in a positive spirit. Business leaders need to recognise that ultimately we all gain from more powerful consumers.

The next change is in the relative power of consumer affairs in academia and the public services. We are going to have a University for Industry; what about a University for Consumers? There are dozens, maybe hundreds, of Professors of Business Studies at British universities but not a single one in consumer studies. We have business schools, medical schools, even veteri-



▲ Carol Samms, a facilitator at the Foundation's workshop for younger engineers and scientists, with one of the groups discussing "The Millennium Consumer". This was the fourth workshop in the series.

nary schools, but none for consumers. To paraphrase the Prime Minister, the emphasis of government policy should be "Consumer Education, consumer education, consumer education".

We welcome David Blunkett's moves to include citizen/consumer issues as part of the national curriculum. It still amazes me that up till now we have not been taught about how to pay bills, what direct debit actually is and how it works, how the different kinds of mortgages work, the basics of nutrition and which are the consumer symbols and logos that represent quality. Must we only pick these things up by making mistakes ourselves?

And yet we are all consumers. Consumption affects all of us, every day. The present administration has realised that the time has come to separate the producer interest from the consumer one in food. Why not apply that same philosophy across all government departments? Why not insist that every government policy is subject to a consumer impact assessment?

Is not devolution and the modernising government agenda all about putting the citizen centre-stage and the bureaucrat in the wings? If it is not, it will surely fail.

The creation of a culture of consumerism requires a change in media attitudes as well. For too long in Britain, consumer affairs has been seen as being about complaints. Programmes like *Watchdog* and magazines like *Which?* perform a very useful function, but they are only a small part of consumerism. We need newspaper pages devoted to consumer affairs. Already, the television networks (quick to identify a trend) have responded to the new consumer age by appointing specialist correspondents; others will follow soon.

Looking ahead

The Millennium Consumer will want the information to make choices and they will have, in many cases, the financial resources to choose quality. Consumerism is not just about price, safety and quality count just as much. They will expect government and public services to see them not as a damn nuisance but as citizens entitled to expect the best from the state-funded services just as they do from the private sector.

Government will intervene to protect the consumer because the consumer is the voter. Ministers will have to balance more carefully and evenly the interests of producers with those of users. International bodies will play a growing part in regulation and in being the consumer's friend. We will all shop not just in the next town or the nearest city but across the world through e-commerce. Trade barriers will have to be abolished or consumers will simply bulldoze through them.

Markets will create unparalleled choice but will have to be regulated to ensure that more choice for some does not become less or no choice for others.

The challenges of the 21st century for consumers embrace and are integral to the three big issues that intermingle with each other and that face the world and its governments.

First, globalisation and a whole range of civil society issues,

including for the consumer the difficulty for the individual of getting any leverage and input to crucial decision making as it becomes ever more remote.

Second, the challenge of sustainable development and balancing the three Es – Economic growth, the Environment and Equity.

In Economic Growth, how to ensure and reconcile the needs and ambitions of the haves and the have nots, both within countries and between countries.

In the Environment, how to reconcile Environmental Protection whilst sustaining Economic Growth. This is where innovation bumps into precaution.

It's a matter of balancing those two things so progress isn't halted. But nor should we rush ahead and become rash and forget safety. Only this week, we've seen that under-regulation of animal feed in Belgium causes us here in Britain a problem. Pollution affecting the food chain can no longer be confined within national boundaries. Incidentally, that Belgian problem was known about for a month before the public were told: we seem to have learned nothing from the BSE affair.

Then there's equity, and the north-south divide, and the need in a fair society, and in a fair world, to have continually in mind the poor and under-privileged both here and abroad.

Here, and elsewhere, the growth of urbanisation is causing huge problems for consumers in rural areas. Post Offices are closing down and the government wants to pay people's benefits into

banks. Banks themselves are withdrawing from rural areas, so how does the rural consumer get access to actual cash?

In the same box there is a whole raft of problems caused by an ageing population worldwide and how the poor and the weak are to be paid for and protected.

Thirdly, and lastly, the speed and growth of technology. It has made possible new cross-border shopping markets and that raises all the issues of redress, privacy and fraud. How do you know that the companies on the Internet from which you are buying actually exist? Will the technology only benefit the rich and how can we avoid that?

Consumer issues are not peripheral to state policy, they are root and branch matters. This government recognises the importance of the consumer's voice, and not just cynically as voters but because a strong consumer movement is a driver for improving business, improving standards of the public services, and can act as the conscience of the state in voicing the concerns and difficulties of those less fortunate than most.

Everyone should be a consumer activist. At the NCC we don't just want joined-up government, we want a joined-up consumer movement, and with those two acting in harness, we'll have a joined-up society and a joined-up world.

Hopefully, the "shabby curate" hasn't crashed the pips with his Thought for Today, and hopefully too he has made some pips squeak a little.

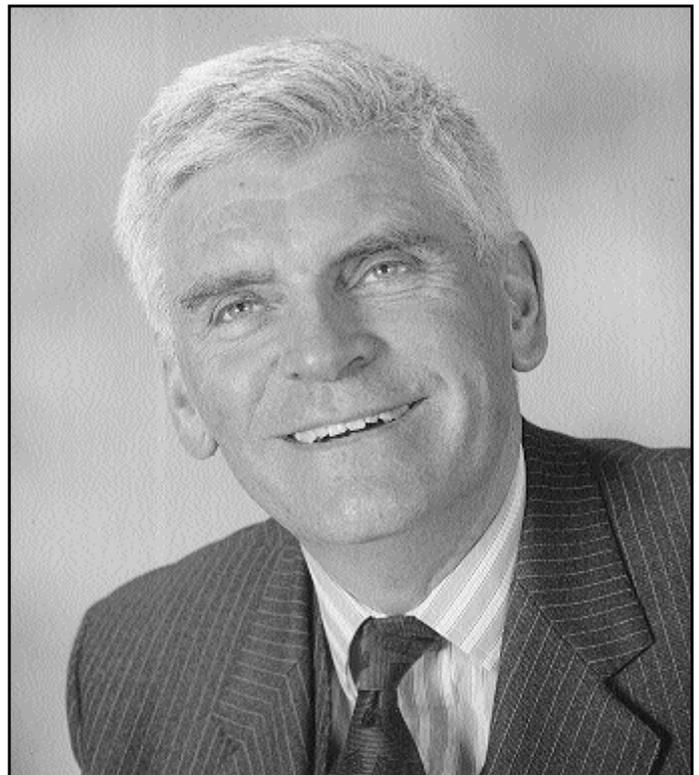
PROFILES OF COUNCIL MEMBERS

Dr Bruce Gordon Smith CBE FREng

Dr Smith enjoyed a stable and encouraging early life. His parents rather hoped that he might become a medical practitioner as he was both able and interested in science: scholarships to Dulwich College and Christ Church, Oxford, indicated that their ambitions might be fulfilled. He himself loved Oxford and, for a period, he envisaged an academic career – perhaps in physics where, he recalls, the order and rationality (compared with the looseness of biology) had a decided attraction. However, there was also an attraction from the worldly interests of business which led him, following a First and a DPhil in elementary particle physics and marriage to an Oxford contemporary, to follow the conventional 'brain drain' to the United States of America.

He applied for a number of American academic appointments, accepting one with the University of Chicago in the area of solid state physics. His attraction to the University was that it wanted his discipline in a particular research team and he was happy to join that team in 1964 as a research fellow. However, business was still calling and, in 1965, he joined Bellcom Inc. which was then preparing for the manned-flight space programme. Dr Smith recalls the excitement of the American 'can do' culture, the ability of Americans to harness high level academic ability and direct it to practical goals, and the intellectual ferment that he found both in academe and in industry at that time. At Bellcom, he was a junior member of the space team, concerned particularly with selecting landing sites on the moon, but he remembers the time as wonderfully character-forming.

He did, however, want to start his own business, having imbibed the entrepreneurial culture of the USA, and so he returned to the United Kingdom to practise system engineering. He needed, firstly, to understand the British business culture and so he joined Decca Radar Ltd in 1968 where, he judged, the atmosphere was as similar as possible to that of his experience in America. The time was a happy one and Decca remained a good customer for years after he left – as leave he did, in 1971, to satisfy that inner insistence that he set up his own business.



▲ Dr. Bruce Gordon Smith. Courtesy of Dawson Strange Photography Limited.

Thus was created Smith System Engineering Ltd, in one room with his wife as part-time secretary, and so it remained for three years as the business took root and grew. Some, in those circumstances, might have felt at least concern at the loss of guaranteed income and institutional support at a time when his young family was at its most vulnerable, but Dr Smith felt confident – indeed he

recalls that it did not cross his mind that he might fail. The company grew at the uniform rate of fifteen percent each year, employing eventually one hundred and forty staff (of which the Foundation's Honorary Secretary, Professor Elliott, was the fourth to be appointed!). It was, he says, a most fulfilling and totally absorbing occupation, although, notwithstanding his claims not to have suffered any sleepless nights, he does admit to a constant alertness – even on holidays – for possible troubles. It is told of him, as an example of his approach to management, that, when he had responsibility for organising the races at his sailing club and so had to deal with the problem of duty officers failing to attend, he increased their responsibility, devolving to them more authority than had been usual so that they rose to the challenge and thus their attendance rose also.

Generally, he looks back over a remarkably stress-free life, although he gives the impression of one not much given to self-analysis and doubt. His secure early years, his intellectual ability, his robust good health, his happy family life (with four children, all of whom are engaged in fulfilling lives and who are happy to maintain close links with their parents) provide the context for his business success. Life, he thinks, is arbitrary: some have so much good luck and some have so little yet he wondered whether his good health had allowed him to devote himself to the exciting growth of his company or whether his excitement and happiness at what he was doing resulted in natural good health. He has no religious belief but lack of expectation of anything beyond this life does not seem to worry him: he lives for this life but not for the moment as was shown by, for example, the ten year planning for his retirement.

He learned the lesson early that business growth may be limited by its owner not wishing to let go of the reins. So he decided, ten years before he was to retire, that he would develop a programme of outside activities – particularly in trade association matters where, in addition to leaving his staff free to manage, he received the strategic benefit of walking and talking with politicians and

civil servants. His company culture was to promote from within so all managers were home-grown and, therefore, recognisably company-trained so he worried less when he was away than he had done at an earlier stage. The management was comfortably in place by 1997 to effect a management buyout: it was a smooth transition and Dr Smith was able to realise his dream of creating his own successful company and ultimately capitalising on his investment.

He walked away without emotion. Already he was involved in a number of organisations as an officer or board member or a director (currently of Industrial Technology Securities Ltd, Esys Ltd and Southampton Innovations Ltd) and, in particular, he had created the Smith Institute for Industrial Mathematics and System Engineering in 1993 as a private Faraday Centre (ie an institution directed to bridging the divide between academe and industry by orienting research in university departments towards industrial needs and reporting the results to industry). This project had started as a division of his company but was now a separate entity: he is Chairman of its Council which is responsible for strategy. The Institute had co-operated considerably with St Catherine's College, Oxford, which had made him a Domus Fellow in recognition, so he returns to Oxford with some regularity. He has also become a governor of Imperial College of Science, Technology and Medicine, and he is Vice Chairman of the Surrey Branch of the Prince's Youth Business Trust, Chairman of Industrial Technology Securities, Chairman of the Economic and Social Research Council, Chairman of the National Space Science Centre and Chairman of the BNSC Earth Observation Programme Board.

He recognises his good fortune in the upward track of his life. He is still busy working a full week, enjoying dinghy sailing, cycling and walking both alone and with his family. In one sense, he is a self-contained personality yet enjoys the corporate, collegiate and family life: he is certainly a high achiever and, with energy and enthusiasm still to offer, this Profile is a long way from completion.

FOUNDATION NEWS

Lord Lloyd of Kilgerran Prize

The 1999 award was presented by the Lord Butterworth, the Foundation's President, to Professor Jane Plant CBE, the Assistant Director of the British Geological Survey, before the lecture and dinner discussion on 19 October 1999. The award was in recognition of her contribution to the application of fundamental geochemical modelling and sound observation in the development of simple, cost-effective methods of minimising the impact of contamination on the environment, and particularly human health. The application has already reaped benefits both in the UK and in the developing world.

The prize was established to mark the many rich aspects of the life of the late Lord Lloyd of Kilgerran, second Chairman and first President of the Foundation for Science and Technology. Members will have been asked for nominations for the Lord Lloyd of Kilgerran Prize for 2000.



▲ Lord Butterworth, President of the Foundation, presents Professor Jane Plant with the Lord Lloyd of Kilgerran Prize for 1999.

Foundation's Annual Event with the Royal Society of Edinburgh

The topic for the Foundation's annual event with the Royal Society of Edinburgh, in their rooms in George Street, Edinburgh, on 7 October 1999, was "Public and Parliament – Managing a Knowledge Economy". Dr John Taylor OBE FEng FRS, Director General Research Councils, joined Henry McLeish MP MSP, Minister for Enterprise and Lifelong Learning, and Dr David Milne, OBE FRSE, Managing Director, Wolfson Microelectronics Ltd as the three speakers for the evening. Professor Malcolm Jeeves was present for the last time with the Foundation as President of the Royal Society of Edinburgh before handing over to Sir William Stewart at the end of October. Among some of the questions asked were: What would be considered a good university in 2005? Are there too many HEs in Scotland? Do we focus enough on indigenous growth for research?



▲ Dr David Falvey, Director of the British Geological Survey, with Professor Jane Plant on his right, with her son, daughter and husband on the evening that she received the award from the Lord Butterworth.

Appointment of Next Director of the Foundation



▲ *Dr Dougal Goodman*

Dr Dougal Goodman, Deputy Director of the British Antarctic Survey has been selected to succeed David Hall as Director of the Foundation from 3 April 2000. David Hall retires after 18 years from the Foundation at the Annual General Meeting on 1 May 2000. He was the first full-time Director of the Foundation.

The Foundation's Council appointed a selection committee chaired by the Rt Hon the Lord Jenkin of Roding who spent over ten months over the process of searching for the new Director.

Dougal Goodman started his career as a research fellow at the Cavendish Laboratory, the Physics Department at the University of Cambridge and at the University of Hokkaido in Japan where he studied the creep and fracture properties of ice. In 1980 he joined British Petroleum (now BP Amoco) to lead a research effort to estimate the design load for oil production structures to be built in the icy waters off the coast of Alaska and Canada. He then worked offshore as a production manager on an oil platform in the Forties Field in the North Sea, was operations manager for the Magnus Oil Field and developed the statement of requirements for the Miller Oil Field. He was called back in 1987 to the corporate centre to run a world-wide campaign to reform safety management in the company during the period when the oil industry faced major changes resulting from the Piper Alpha disaster and the Exxon Valdez incident.

From 1989 to 1990 he was sent by BP to attend the Sloan Programme at the Graduate School of Business at Stanford University in California. The Sloan Programme is a broad based business degree programme focused on strategy, finance, organisational structure and marketing. On his return he joined the Chairman's strategy team to develop the new focus strategy for BP and to undertake a review of the changing structure of the global oil industry. He also led a strategic review of the European refining network while working in Brussels. Finally, for the Company Secretary he reviewed BP's risk exposures from environmental extreme events and operational failures. The latter study included the development of a new risk instrument working with the financial and insurance services sectors.

In 1995 he left BP to return to research as Deputy Director of the British Antarctic Survey, a component institute of the Natural Environment Research Council (NERC), which is responsible for leading the UK's Antarctic science programme. At BAS he led a major change to the way science is organised within the Survey and for NERC a Sector Challenge initiative – the TSUNAMI initiative – to help the UK insurance industry be more competitive through closer links to the UK science base.

On accepting his appointment at the Council meeting he said "I am honoured to be appointed the new Director and hope I can

build on the successful formula so well developed by the previous Director. I will use my broad experience in both industry and science to serve the Foundation".

Dougal has also been on fifteen expeditions to the Arctic and the Antarctic, many of which he has led. In 1998 he was awarded a Polar Medal by Her Majesty the Queen for services to science in the Arctic and the Antarctic.

New Member of Council

Professor Peter Lachmann FRS, President of the Medical Sciences Academy, has been co-opted to the Foundation's Council.

Shared Sponsorship Scheme

The Foundation is extremely fortunate in having the support of those who contribute to the Shared Sponsorship Scheme, this being an important aspect in the preparation of the Foundation's programme. Those contributing for 1999 are:

ABPI
Comino Foundation
Esso Petroleum Company Limited
Glaxo Wellcome plc
Premmit Associates Limited
Science Systems (Resources) Limited

New Associate Members

The following have become Associate Members of the Foundation for Science and Technology:

Habilis Ltd

Contact: Mrs EM Bennett, Managing Director

NIMTECH

Contact: The Lord Wade of Chorlton, Chairman

Thames Valley Nuffield Hospital

Contact: Mr Ken K Nischal, Consultant Ophthalmic Surgeon

Learned Society News

The October seminar was a very well attended occasion with 90 participants. This was a joint seminar with the Association of Learned and Professional Society Publishers (ALPSP) under the title of 'The Future of Learned and Professional Societies: Threats and Opportunities in the Twenty First Century', which reviewed the growth of such societies over the last decade and a half and looked ahead to the changes taking place as a result of the electronic revolution in communications, changes in the regulatory environment and in the availability and interest of volunteers, and the continuing need to find alternative sources of income. The Chairman of the Foundation took the Chair. The first of the new Learned Societies' Annual Luncheons took place on 12 October, again under the Chairmanship of Lord Jenkin of Roding and there was almost a full house. Lord Neill, Chairman of the Committee on Standards in Public Life, spoke on the subject of Standards in Public and Professional Life with particular reference to Professional Ethics. It is hoped to be able to include his address or a summary thereof in the Journal.

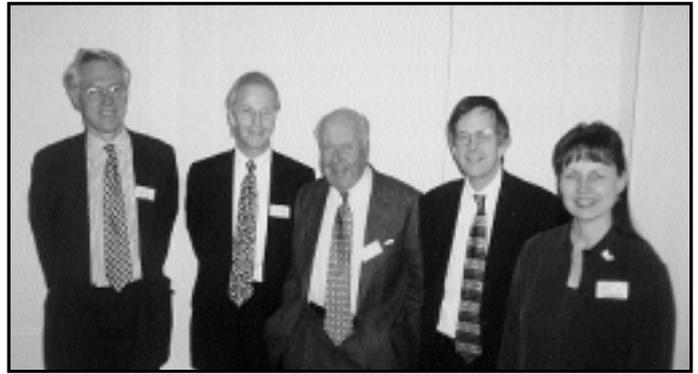
The October Newsletter contained a copy of the Foundation's response to HMG paper on the Review of Charity Taxation as an occasional paper and an article on The Woolf Report, Expert Evidence and Professional Societies, which summarised a Foundation working party discussion on this subject: the working party comprised Professor C Elliott (Honorary Secretary), Mr R Freeman (Academy of Experts), Mr C Leach and Mr C Price (Institute of Road Transport Engineers), and Mr K Lawrey.

There continue to be requests for advice and guidance about various charity constitutional issues which the Learned Societies' Liaison Officer is always happy to give. He has held useful discussions recently with the Academy of Experts, the Charity Directors Finance Group and the UK Inter Professional Group.

K Lawrey
Learned Societies' Liaison Officer



▲ An evening on "IT and the Health Service". In the front row of the lecture theatre for the evening devoted to "IT and the Health Service" from the left are Sir Eric Ash, Treasurer of the Royal Society, talking to the Lady Lloyd of Kilgerran, on whose left was Phil Chubb, Director, Health Care, EDS (the sponsors) talking to Professor Jane Plant, British Geological Survey, winner of the 1999 Lord Lloyd of Kilgerran Prize.



▲ On Lord Butterworth's right is Phil Chubb who represented the sponsors, EDS. The three speakers are: on the left, Dr Jeremy Wyatt, School of Public Policy; on the right, Mrs Jackie Axelby, Chief Executive, Northumberland Health Authority; and Alasdair Liddell, Director of Planning, Department of Health.



▲ Phil Chubb, representing EDS, makes a point to Alasdair Liddell.



▲ The Director saying farewell to Professor Henri Gibert, the outgoing French Science Counsellor, and welcoming Professor Michel Bernier who arrived in the late summer to take up the post.

SEEKING CONSENSUS ON CONTENTIOUS SCIENTIFIC ISSUES

The Foundation held a lecture and dinner discussion at the Royal Society on 12 July 1999 on the subject "Seeking Consensus on Contentious Scientific Issues". The event was sponsored by The Wellcome Trust and The Lord Butterworth CBE DL, President of the Foundation, was in the chair. The speakers were Mr Gunnar Bengtsson, Director General, National Chemicals Inspectorate, Sweden, Sir Robert May AC FRS, Chief Scientific Adviser to the UK Government and Head of OST, and Professor Robert Worcester, Chairman, MORI Ltd.

Dr Gunnar Bengtsson*

Introduction

I would like to deal with life in poorer conditions for a little while. The mean life expectancy in years depends on the available resources. Historical development has been towards more resources and higher life expectancy. Venus of Willendorf people with scarce resources may have lived around 25-35 years, Swedes 200 years ago about 40 years, and this still holds for people in the poorest countries on earth today. Under harder conditions, securing more resources and distributing these in a reasonable way is

Summary: Mr Bengtsson discussed the complex nature of decision making in the control of risks to health and the environment. Professor Worcester put forward five theses based on empirical evidence of the behaviour, knowledge and views of the British public of science, government and business in relation to new advances. The results emphasised, he believed, the importance of the social sciences in guiding the public's decisions.

very high on the political agenda, as witnessed by the large number of such bills submitted to the Swedish parliament by its members in 1965 (Sjöberg *et al.* 1998). Today, the fraction of such bills

* Director General, National Chemicals Inspectorate, Sweden

has dropped, and bills dealing with more long-term risks to health and the environment have become equally frequent. This increased concern thus does not have any counterpart in a corresponding direct threat to health, as measured in terms of survival.

Framework for decisions involving risks

While recognising that the immediate threats from hunger and poverty are more important in many countries of the world, I will now address modern concerns, using a guiding framework where analyses of potential decisions start from the generation of alternatives. These are assessed as to their consequences in terms of benefits, costs and risks, where special input from science on hazards to health and the environment is required. The analyses are examined in the light of the values adhered to by the decision makers, a decision is taken and its outcome monitored with subsequent corrections when more experience has been gained.

Choice of decision options

The first step is to consider what alternative decisions may be taken. I will use the example of combating pests in agriculture. No change is always an option. Reducing the need for pest abatement through precautionary action should be a first alternative. In agriculture, this is called Integrated Pest Management (IPM). Chemical pesticides are often thoughtlessly used today. My belief is that we can replace most of these by biological controls in less than a generation from now. There are already options available to control fungi using antagonistic bacteria, to control weeds using competing fungi, and to control insects using their built-in signal substances, pheromones. Designing plants or animals to make best use of these controls is already a fact using genetic engineering.

The selection of options is a very important stage and clearly those concerned should be involved to promote the possibility of finding later consensus.

Defining costs, risks and benefits

There are possibilities for miscommunication in the definition of costs and risks. The scientist may speak at length about the risk of lung cancer from radon without meeting the concern of the home owner who is mainly afraid of declining property value. I have seen the equivalent also in the case of low frequency power lines in Sweden. Costs, risks and benefits have many different dimensions which should be discussed with those concerned, not the least since they may be very unevenly distributed among them.

Scientific analysis of hazards

Hazard analysis is a mainly scientific undertaking which applies to exposure in general, for instance from radiation or hazardous chemicals. If, in going from higher to lower exposure, there is an exposure level below which there is no risk of injury (threshold limit), the obvious option for risk management is to keep 'exposure' below this threshold. This fits well with our strong desire not to be at any risk at all. Unfortunately, there are many situations where scientific data indicate a remaining risk, however low the exposure, for instance when the dose-response curve is linear. This may apply to risks for cancer, hereditary disease or foetal injury from radiation or chemicals. In the case of small exposures, the correct message may well be: "You should have avoided eating your parsley and salmon, but if you did eat them, there is little reason for concern".

Such double talk, however scientifically correct, was ridiculed in Sweden after the Chernobyl accident. People who had a strong interest in optimising their food intake, such as local hunters or fishermen, were however able to learn to establish radioactive intake budgets. In this case, hunting and fishing associations were very important in assisting the learning process. If there is no such incentive for learning, I think it will be a matter of generations before this double talk can be appreciated rather than ridiculed.

Information on the consequences of the options is never exact and comprehensive. The quantities involved are always *variable*. For instance, fish come in a variety of weights and such variations should be understood. Often uncertainty is harder to estimate than

variability (Risk Analysis 1999).

Evaluation of options: uncertainties and the role of experts

The next step means examining the consequences of the options. There is always a variability in the degree of political consensus that can be achieved on an issue, and there is always uncertainty in the available scientific knowledge.

- With a high degree of consensus and sufficient knowledge, decisions would mainly be a matter of calculating the technically optimal solution. Constructing a new highway is an example.

- Having consensus but lacking knowledge, the reasonable way ahead is to increase knowledge through research, and deciding on small increments in the desired direction until further knowledge is available. One example concerns the application of biological pesticides.

- When knowledge exists but there is disagreement on the way ahead, dialogue to find compromises may facilitate finding an agreed solution. Action against smoking may fall in this category.

- The most difficult situation is when there is neither knowledge nor consensus. Most of the controversial modern issues involving risks fall here: Radon in homes, genetically modified organisms, energy supply through nuclear power are some examples. There is no easy way out here but for all those involved to engage in a dialogue with an open mind, and promoting fora for discussions is an important task for the decision maker. Science is naturally of little importance if there is little scientific certainty.

In these processes, which involve a lot of judgement, scientists often have difficulty finding an adequate role. A scientist has special knowledge in a given domain. A decision maker weighs knowledge from several domains and judges uncertainties in reaching a decision. Scientists assisting in decision-making outside their domain of expertise take on the role of analysts and are no longer referring to their deep special knowledge. Often their values enter in a way which is not transparent. Scientists acting as analysts should state that they do so, should declare what their domain of expertise is, and should declare what interests and values may bias their opinions.

Evaluation of options: the significance of risk perception

The variation of perception of risk can be explained by many factors (Sjöberg 1999). Reactions to particular aspects of the risky agent, e.g. radiation, are important. Life style or nature-related hazards tend to be tolerated more easily than those which for instance are new, involuntary, have catastrophic potential, or have been heavily covered in news media.

Government agencies have different roles in relation to individuals who are risk prone and risk averse, respectively. Individuals who were at risk during the Chernobyl accident could, for instance, change to less healthy food, move to a place with inherently higher cancer risk or even make abortions for fear of health effects to the foetus. In such cases, agencies could try to provide perspective, help solving problems such as certain types of food shortage, and look for the protection of third parties, such as children deprived of mothers' milk through stringent counter-measures.

Individuals who are prone to take high risks, e.g. with respect to radon, could trigger a different pattern of action from government authorities. Awareness-raising activities might be justified and extensive advice on the need for mitigating action required. Third parties such as children might require particular protective action.

Conclusion

I have used a framework to illustrate where, in the decision-making process, different aspects might come in. In reality, more complex decisions tend to be very iterative and a tangle might be a better description of the process. There is even some empirical support for the "garbage-can hypothesis" on decision-making. According to this, problems, solutions, participants and suitable opportunities for decisions are mixed in a rather random fashion

and occur simultaneously by chance or by the intervention of entrepreneurs. Decision-making does not follow simple routes!

As the fight against hunger and poverty is no longer overshadowing political life, attention in decision making has increasingly turned towards managing less direct risks to health and the environment. Increasingly, this management will require global action, and the employment of governance methods other than those based on command-control (OECD 1997). In recent years, explicit discussions on ethics have surfaced as a tool for facilitating reaching consensus.

I have tried to illustrate some potential rules of thumb to facilitate the dialogue and make positions more reconcilable:

- A particular dimension entering a decision may carry different weight for different sections of the population
- There may not be any safe exposure (no threshold)
- Variability and uncertainty must be accounted for
- Science should be separated from policy, and scientists should be aware if they enter the role as analysts
- Different decisions may be taken by risk averse persons, risk prone persons and society
- Clarifying ethical values often helps reconcile different views.

I would like to conclude by quoting a definition of risk communication which tells me a lot about a good management of decisions involving risks: "Risk communication is the mutual control of change" (Earle 1998). I repeat: "Risk communication is the mutual control of change".

Keeping to that definition, we might find a good balance between solving the pressing needs for the global population and anticipating the solutions to the problems of tomorrow.

Professor Robert M Worcester*

Preface

I am pleased to be invited to discuss this subject with such distinguished scientists, and especially to follow on from Sir Robert May, who recently expressed his personal conviction of the need for the public understanding of science, and that he considered the passing on of scientific knowledge to society as one of the duties and responsibilities of the scientist today. I am also pleased to be here to represent the social sciences. In *naturenews+*, the daily report of the ICSU/Unesco World Conference on Science on 28th June, the publication's leader made a number of points which this audience might consider: that 'the relationship between the natural and the so-called 'social' sciences has never ... been a particularly comfortable one' and that 'some physical scientists ... often find it difficult to accept that another, but equally valid, form of reality can be revealed by what are often disparagingly called the 'soft sciences' ... and that 'they have provided a deep understanding of the dynamics of human society that, in its own way, has made an equally fundamental contribution to our social well-being'.

There are five theses which I propose to put forward in this paper, based on empirical evidence of the behaviour, knowledge and views of the British public:

1. **The British public tend to judge the value of scientific advances by their end purpose.** If no end purpose is made clear to them, many tend to implicitly assume that it has no useful purpose or even that its purpose will be detrimental rather than beneficial. The intensity of ethical objections to particular work, for example the use of animals in experimentation, is similarly significantly affected by understanding of what it is hoped will be achieved.
2. **Scientific developments aimed directly at achieving improvements in human health care are the most valued by the public.** However, the public is often ill-informed about the

*Chairman, MORI¹/Visiting Professor of Government, London School of Economics and Political Science

¹Sir Robert May, speech to the launch of the UNESCO World Conference on Science, Science Museum, London, April 1999.

References

Earle, Timothy C: Social trust: Outline of a new understanding. Psychology Department, Western Washington University, Bellingham, Washington 1998.

OECD: The OECD report on regulatory reform. Synthesis. OECD Paris 1997, reprinted 1998. Risk analysis: Special collection: Workshop proceedings for "When and how can you specify a probability distribution when you don't know much?" Part II, in particular the paper Foundations. Risk Analysis 19, 43-152, 1999.

Sjöberg, L: Policy implications of risk perception research: A case of the emperor's new clothes? In Risk Analysis: Opening the Process. Proceedings of the 8th Conference of the Society for Risk Analysis Europe, Paris, Oct 10-14 1998. Editors: Philippe Hubert and Claire Mays. Fontenay aux Roses: IPSN, 1999.

Sjöberg, Lennart, af Wahlberg A and Kvist, P: The rise of risk: Risk related bills submitted to the Swedish Parliament in 194/5 and 1993/95. Journal of Risk Research Vol 1, 1991-1995, 1998.

In addition, useful recent references include:

Health and Safety Executive: Reducing Risks, Protecting People. Discussion Document, Health and Safety Executive, HSE Books, Sudbury 1999.

Lofstedt, Ragnar and Frewers, Lynn: Introduction to the Earthscan Reader in Risk and Modern Society, sid. 3-27. Earthscan, London 1998.

McQuaid, Jim: Policy issues arising from the judgmental nature of risk-based decision making. In Risk Analysis: Opening the Process. Proceedings of the 8th Conference of the Society for Risk Analysis Europe, Paris Oct 10-14 1998. Editors: Philippe Hubert and Claire Mays. Fontenay aux Roses: IPSN, 1999.

purpose of scientific experimentation, and public opinion is less supportive than it otherwise might be because not enough people instinctively make the connection between means and ends. Research for its own sake, and particularly research seen primarily as having a commercial motive, is unpopular.

3. **Ignorance about the way in which science is regulated and restricted leads many of the public to assume that the regulation is insufficient, and this in turn make them more likely to be hostile to science.** Yet they are eager to receive such information and show intelligent interest when they do so. Regulatory bodies whose work was well publicised and which were seen to be free of control by government or other vested interests might significantly improve the climate of public opinion.

4. **There is scepticism and mistrust in government and business alike, and although a majority of the public say they trust "scientists" but whenever a scientist's employer or sponsor is mentioned, the veracity of the source becomes highly relevant: the scientists trusted by the highest proportion of people are those working for environmental NGOs.** It is clear that many of the public assume (perhaps not consciously) that scientists cannot maintain their independence, integrity or objectivity when working for an interested party. Furthermore, in most fields of public controversy, the government is regarded as an interested party, and neither it nor scientists seen to be working for it are trusted by a majority of the public.

5. **Significant numbers of the public are prepared to use their power as consumers to put pressure on those involved when they object to a scientific procedure or principle.** Science is important to people, and they understand that it is. We are all affected by science, from today's weather to global warming, from developing world famine to GMOs, from new developments in medical research to space exploration, but we know what we don't know, and suspect those that do. That is human nature, and scientists must understand that in the world of the 21st century, it is no longer acceptable to have the good of mankind at heart, but to be seen to have the good of mankind at heart. If scientists do not do so, they run the risk of public scepticism at best, cyni-

cism somewhere in the middle, and distrust, suspicion and negative reaction at worst.

Public Opinion

When speaking of “public opinion”, it is most often meant to describe the adult population in a one-person-one-vote model, which would have been unheard of a century ago. Yet Abraham Lincoln not only used the concepts of extended franchise and democratic involvement, “... of the people, by the people, and for the people” in the Gettysburg Address, he is also quoted as saying “Public opinion is everything”.

I am convinced that as a tree falling in the forest makes a noise whether anybody is there to hear it or not, so public opinion exists, perhaps unheard until someone listens. It seems to me that a simple definition will do: ‘Public opinion is the view of a [representative sample of a] defined population’ Worcester (1997). The words in brackets delimit the difference between ‘public opinion’ and a ‘public opinion poll’.

I define ‘views’ at three levels, rather too poetically I fear for scholarly adoption, as “*opinions: the ripples on the surface of the public’s consciousness, shallow, and easily changed; attitudes: the currents below the surface, deeper and stronger; and values: the deep tides of public mood, slow to change, but powerful*”.

Opinions are those low salience, little thought about reactions to pollsters’ questions about issues of the day, easily manipulated by question wording or the news of the day, not very important to the respondent, not vital to their well being or that of their family, unlikely to have been the topic of discussion or debate between them and their relations, friends and work mates, easily blown

about by the winds of the media.

Attitudes, the currents below the surface, derive in my view from a deeper level of consciousness, are held with some conviction, and are likely to have been held for some time and after thought, discussion, harder to confront or confound.

Values are the deepest of all, the powerful tides of individual and group beliefs, learned parentally in many cases, and formed early in life and not likely to change, which only harden as we grow older. These include belief in God, views about abortion or the death penalty, family values, and the like. It is almost impossible for these to be changed by persuasion, by media discussion or propaganda, or by the positions and arguments of political debate, except over long periods, concerted thought and discussions, a feeling that one is out of step with others they know and respect, new evidence, changing circumstances or behavioural experiences.

Thesis 1: The British public tend to judge the value of scientific advances by their end purpose

What do the public think of as “science”? The first factor to be considered in understanding the public’s attitudes to any subject is how they instinctively interpret references to the subject itself. In the case of science, what are the aspects which most spring to mind when scientific developments or discoveries are mentioned? MORI’s 1999 survey on attitudes to bioscience for the British Government’s Office of Science and Technology (using the ‘People’s Panel’) began with a more general, unprompted, question to gauge precisely this.

<i>Q. Thinking about major scientific discoveries or developments, do any spring to mind?</i>	<i>First Mention %</i>	<i>Any Mention %</i>
Treatments/Cures for/Eradication of illnesses/ diseases/Medicines/New drugs/Penicillin/Antibiotics/Vaccines etc./Operations/Surgery	11	32
Computers/The Internet/E-mail/Millennium bug/Compliance	8	21
Space/Sending people to the moon/Life on Mars	8	21
Genetically modified, genetically altered/genetically engineered food	9	18
Medical Research	6	15
Cloning/Dolly the sheep	5	12
TV/New TV sets/Cable TV/Satellite TV/Digital TVs	4	12
New telecommunications (fax machine/mobile phone)	2	10
(Others below 10% omitted)		
No, none spring to mind	23	
Don’t know	4	
Any mention	74	

Source: MORI/OST 13 March-14 April 1999, Base: 1109 British adults

It is therefore predictable that it is scientific developments related to advances in human health which spring most immediately to mind. At this unprompted question, as many as 41% of the public named at least one bioscience (increasing to 57% when treatments/cures for diseases was added in). Sixty-three% mentioned one or more non-bioscience.

The main issues which the public would take into account in

determining whether a biological development is right or wrong are whether people would benefit from it and whether it would be safe to use. Other significant considerations would be whether the benefits outweighed the risks, whether or not it interfered with nature, whether animals would be harmed and – something the question was in fact testing – whether it was considered to be right or wrong.

<i>Q Now thinking about biological developments again, what things, if any, do you think you would personally take into account if you were deciding whether a particular development was right or wrong?</i>	<i>First Mention %</i>	<i>Any Mention %</i>
Whether it would help people/be beneficial	15	33
Whether it banned people	10	29
Ethics/Morals/Whether it was right or wrong/whether it was for the general good	12	22
Whether it had been tested properly/was safe	5	20
Whether the benefits outweighed the risks	8	19
Whether it had side effects	3	17
Whether animals would be harmed	6	16
Whether it interfered with nature	5	16
Consideration for future generations	3	11
Whether it was controllable/well regulated	2	9
Whether it was useful to me/people	2	9
(Others 5% and below omitted)		
Don’t know	1	
Any mention	82	

Source: MORI/OST, 13 March-14 April 1999 Base: 1,109 British adults

Thesis 2: Scientific developments aimed directly at achieving improvements in human health care are the most valued by the public.

The public have clear opinions that some scientific developments are beneficial and that others are not, as the OST survey shows. Again, advances in human health score highest, clearly representing in the public's mind the biggest benefit to arise from scientific

developments. Specifically, the development of new medicines (antibiotics and vaccines) was most commonly mentioned by 57% in the quantitative stage, followed by transplants of various organs (51%), cures for or eradication of diseases (43%) and new operations/surgery (31%). These medical benefits are clearly widely felt to be beneficial to society, and we found almost no advocates of a contrary view.

Q On this card is a list of various scientific developments. Which two or three would you say have been beneficial for society as far as you are aware?	Not Beneficial		
	Beneficial %	Beneficial %	NET %
Q And which two or three would you say have not been beneficial for society, as far as you are aware?			
Medicines/New drugs/Penicillin/Antibiotics/Vaccines etc	57	1	+56
Transplants e.g. of heart, liver, kidneys etc	51	1	+50
Cures for or eradication of illnesses/diseases	43	1	+42
New operations/Surgery	31	*	+31
Computers/The Internet/E-mail	28	4	+24
Genetic testing or screening for particular things, e.g. diseases	24	2	+22
Discovering global warming/Climate Change/Disruption to weather patterns/Greenhouse Effect	19	6	+13
New and alternative sources of energy	17	4	+13
New telecommunications (fax machine/mobile phone/TV)	14	5	+9
Test-tube babies/In-vitro fertilisation	11	9	+2
Faster/cheaper travel	6	16	-10
Robots in industry and medicine	3	18	-15
Splitting the atom	4	20	-16
Space Research/Sending people to the moon	2	25	-23
Genetic modification/engineering of animals and plants	1	28	-27
Genetically modified food	1	45	-44
Cloning/Dolly the sheep	2	57	-55
Other	*	*	
No. none spring to mind	*	5	
Don't know	*	1	

Source: MORI/OST 13 March-14 April 1999 Base: 1,109 British adults

Looking at 'net beneficial' scores, (i.e. the proportion saying something is beneficial to society, minus the proportion saying it is not), we can see that development of new medicines receives a net score of +56 and transplants +50, cures for/eradication of illnesses +42, yet cloning gets a -55. Genetically modified food is also not regarded overall to be beneficial to society; it receives a net score of -44. Genetic modification of animals and plants also gets a negative score (of -27). In the qualitative phase of the research, group members made very little connection between animal cloning (viewed with suspicion) and advances in human health (the latter being of prime importance to the public).

One conclusion that seems clear from the OST survey is that scientific developments can gain quick acceptance if the public has wide experience of them and finds them useful. One area where public acceptance of scientific advances seems to be growing significantly is in information technology and telecommunications, especially the Internet, which scored a net +24 as beneficial in the survey for the OST.

A particularly clear instance of an ethical issue to be resolved in judging science is the question of experimentation on animals. This was considered in considerably more detail in a survey for *New Scientist*.² Though this was an exploration of a specific scientific issue, it may be considered to have much wider implications as an exemplification of the way in which and extent to which the British public is prepared to trade-off its ethical objections to scientific processes or developments in the light of the concrete benefit to which they are intended to lead.

Public attitudes towards animal experimentation are far from clear-cut. While, the initial "knee jerk" reaction may be one of opposition, the public is receptive to messages explaining (justifying)

what benefits such experiments may bring. Two-thirds of the British public disagree that scientists should be allowed to conduct experiments on live animals; around a quarter agree, when asked in a "cold-start" question, without any preface or prompting as to the purpose behind it or for the need to conduct such experimentation.

The purpose of an animal experiment has a significant effect on the public's likelihood, or not, to approve of it. The public differentiates substantially between curing leukaemia in children on the one hand and testing cosmetics on the other. Where no pain for the animal is involved, the balance of opinion is in favour of eight out of the nine experiments for mice, and seven out of the nine for monkeys.

As with the more general questions asked in the OST survey, the *New Scientist* research confirms that the public finds medically-motivated research more acceptable than any other. The experiments that the public feels are most justified are those with a specific medical aim – for example, relating to curing leukaemia or AIDS. Experiments with less specific medical aims are not felt to be as justified, but are nevertheless felt to be more warranted than experiments to test garden insecticides and cosmetics. This "ranking" remains identical regardless of the species to be experimented upon.

The public's perception of the purpose of scientific development also seems to affect their acceptance of procedures where their objection is probably principally a perceived health risk rather than ethical objections. This is illustrated by the case of genetic engineering. Questions about the acceptability of using biotechnology for various purposes were put to respondents as part of the 1999 International Environment Monitor.

²'Let the People Speak', *New Scientist*, 22 May 1999, pp. 26-31, 60-61.

Q Biotechnology, including genetic engineering, can be applied in a number of ways. Please tell me if you strongly favour, somewhat favour, somewhat oppose or strongly oppose each of the following uses.

	<i>Applying biotechnology to enable farm animals to grow faster or produce more meat or milk, %</i>	<i>Applying biotechnology to grow pest-resistance crops that require less farm chemicals, %</i>	<i>Applying biotechnology to grow food crops that contain more nutrients, lower fat or no cholesterol, %</i>	<i>Applying biotechnology to develop new medicines and treatments for human diseases, %</i>
Strongly favour	1	7	7	27
Somewhat favour	5	29	28	42
Somewhat oppose	18	16	20	9
Strongly oppose	67	39	34	12
Neutral/neither favour nor oppose	3	3	4	3
Have never heard of biotechnology	1	1	1	1
Don't know/no answer	4	4	5	4
Favour	6	36	35	69
Oppose	85	55	54	21

Source: 1999 International Environment Monitor

Base: 975 British adults aged 15+ interviewed by MORI

7-10 May 1999

Here, even more so than in the animal experimentation survey, the basic cast of the public mind towards a development that they are inclined to distrust is clear. For a purpose expressed as having a purely economic benefit, public opinion is overwhelmingly against use of biotechnology. For intermediate benefits, producing foods that would improve public diet or offering a reduction in chemical use in farming, there is considerably greater acceptance though a majority is still opposed. For the directly stated purpose of improving medical treatment, however, most misgivings melt away, with only one in five of the public maintaining their opposition.

The case of using biotechnology to reduce the need for pesticides in particular illustrates how the public weighs up perceived alternative risks. The survey found that 61% disagreed that "The benefits of using chemical pesticides and herbicides on food crops are greater than the risks", which all things being equal should incline them to support an alternative to pesticide use. However, 57% also disagreed that "The benefits of using biotechnology to create genetically modified crops, that do not require chemical pesticides and herbicides, are greater than the risks", and thus would not support biotechnology as an alternative.

The survey also reveals that the public's misgivings are not simply based on a knee-jerk reaction of opposition to anything scientifically-based or 'natural'. Almost three-quarters, 72%, agreed that "Chemicals are safe when properly used and controlled".

Since it seems clear that public attitudes to science are very largely determined by perceptions of what it is intended to achieve, public knowledge about and understanding of science is clearly important. Unfortunately, such knowledge and understanding seems limited, but the public themselves are eager to rectify this if information can only be made available to them.

The vast majority of the public are at least aware of major scientific developments that have been reported (whether or not they

Q As you may know, there have been a number of developments in biology in recent years. Which, if any, of the following have you heard of?

	%
Transplants of human organs (e.g. heart, liver, kidneys) to another human	93
Test tube babies (also known as in-vitro fertilisation)	90
Genetically modified food	89
Cloning/Dolly the sheep	87
Development of new medicines	77
Transplants of animal tissues (e.g. pig tissues) to a human/Xenotransplantation	72
Genetic modification/engineering of animals and plants	69
Genetic testing or screening for particular things, e.g. diseases	67
Tissue cultures/artificial tissue e.g. skin	62
Gene therapy	42
None	1
Don't know	*

Source: MORI/OST 13 March-14 April 1999 Base: 1,109 British adults

have yet been put to any practical use which is directly benefiting the public). In the OST survey, respondents were shown a list of ten biological developments and asked which, if any, they had heard of that they may not have mentioned earlier. Almost everyone (93%) had heard of the transplantation of human organs. Almost as many had heard of 'test tube babies'/in-vitro fertilisation (90%) and, topical at the time of the survey, GM Food (89%). Combining genetic modification and GM food and excluding the overlap increases the figure to 91%, placing it second highest after transplantation of organs. Cloning came just behind GM food with 87% – narrowing the 14% gap seen at the earlier spontaneous question.

Though kept abreast of the existence of scientific developments by media reporting however, the public may be ignorant of the background information which is necessary to put scientific developments in context. For example, the research for the OST revealed that many people didn't realise that genes are naturally present in non-GM products. Such misconceptions that must put in question the public's ability to make sense of scientific news stories unless accompanied by copious explanatory material.

Thesis 3: Ignorance about the way in which science is regulated and restricted leads many of the public to assume that the regulation is insufficient, and this in turn makes them more likely to be hostile to science.

Many of the public are unclear what scientists are trying to achieve in their work, which naturally reduces their understanding of the potential benefits and hence acceptance of the value of the research. This is especially true in the case of cloning which, as we have seen, is held by almost three in five of the public not to be beneficial to society.

In the OST survey, three people in four, 77%, offered a reason why genetic modification takes place, or why there is GM food; 68% for why animal cloning takes place and 66% for why 'transplants of animal tissues to humans' (xenotransplantation) takes place. However, some of the reasons perceived to be behind the research are unlikely to make it more publicly acceptable.

The public are aware that they do not know enough about scientific developments, and are keen to be better informed. In the workshops in the OST qualitative research, most expressed a desire for more information, many saying they had heard of Dolly 'after the event'. Discussions in the workshops about genetic modification often produced comment about the need for clear labelling of food.

A survey on Public Understanding of Risk for the Better Regulation Office of the Cabinet Office explored in greater depth the relationship between perceived risk of scientific developments and self-assessed level of knowledge. MORI listed six possible health risks, and asked the public how well informed they felt about each, which they thought posed a serious threat to them or their family, and on which the government should legislate or provide advice and information about.

Q On this card are a number of issues that have been described as health risks. Which, if any, do you feel well informed about?

Q Still thinking about the same issues, which, if any, do you think pose a serious risk to you and your family?

Q For which of these, if any, do you think there should be more Government legislation?

Q Alternatively, for which of these, if any, do you think the Government should restrict itself to providing advice and information?

	Informed %	Risk %	Legislate %	Advice %
Smoking	90	43	26	35
Unhealthy diet	61	32	15	38
Genetically modified food	16	31	53	24
Too much alcohol consumption	66	22	39	31
Measles, Mumps and Rubella (MMR) vaccines	36	14	20	27
Raw (unpasteurised) milk	15	10	12	20
Other	1	1	1	1
None of these	1	15	11	18
Don't know	1	2	3	7

Source: MORI/Better Regulation Unit (Cabinet Office) 9-19 January 1999
Base: 1,015 British adults aged 16+

Only 16% of the British public said they feel well informed about genetically modified food, but 31% said they felt threatened by it and more than half, 53%, thought there should be more government legislation about it. By contrast, with the other 'scientific' threat on the list, MMR vaccines, more than twice as many, 36%, felt informed and there was correspondingly a much lower feeling of threat (even among those with children under 5 years, those most likely to be affected, only a quarter of whom said they were worried) and less support for the government legislating about it.

This might seem to imply that ignorance about scientific developments encourages the public to fear them, which would be a plausible enough conclusion. However, examination of the data in detail reveals a more complex relationship. For five of the six listed 'risks', there was no statistically significant difference between those who said they felt well-informed and those who did not in their assessment of whether there was a serious risk to them or their families. The exception was GM food: those who felt well informed about GM food were significantly *more* likely to feel at risk (43% said they thought there was a serious risk, compared to 31% in the population as a whole).

However, this result seems closely tied up with distrust of official sources of information. Of those who felt well informed about GM food and also said that they trusted government ministers to tell the truth, only 26% thought GM food posed a risk, but of those who felt informed but did not trust ministers to tell the truth, almost twice as many, 47%, believed that there was risk. Plainly, while the government is identified with denying any risk to health in GM food, many of those who feel informed are receiving their information from sources of an opposite view.

This suggests that the general principle still stands: the better informed the public is by official and reliable sources, all other things being equal the more acceptable they are likely to find scientific development. However, where these sources have been less effective, it merely magnifies the effect of the smaller group whose sources of information may be inherently hostile – whether for ethical, religious or political reasons. This vacuum can develop in the absence of sufficient official information is of course also an opportunity for more cynically-motivated disinformation.

There is strong support for the Government to be more open in its decision making process. Over nine in ten think it should be more open (and 61% *strongly* agree), and eight in ten think that the Government should release what information it does have even when it is unsure of the full facts (43% *strongly* agree). This reflects one of the most powerful findings from our qualitative study.

It is also clear that the public is keen to be given the facts to make up its own mind, even if the facts are not conclusive. An

overwhelming 80% think that the government should publish what information it has available, even if it is unsure of the facts. This follows naturally from the public's distrust of the government, and to a lesser extent of government scientists, explored below.

Thesis 4: The majority of the public say they trust "scientists", but whenever a scientist's employer or sponsor is mentioned, the veracity of the source becomes highly relevant: the scientists trusted by the highest proportion of people are those working for environmental NGOs.

Overall attitudes to Government

Q I am now going to read out a list of statements, and I would like you to tell me how strongly you agree or disagree with each.

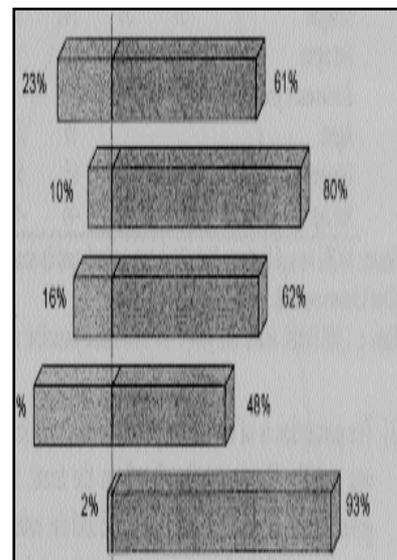
The Govt should do more to protect people by passing more laws that ban dangerous activities

When the Govt is unsure of the facts, it should nonetheless publish what info it does have available

The Govt does not trust ordinary people to make their own decisions about dangerous activities

I am confident the Govt will act generally in the public interest

The Govt should be more open about how it makes its decisions



SOURCE: MORI/Better Regulation Unit 9-19 January 1999 Base: 1,015 British adults aged 16+

If the public distrusts what scientists say, it is a barrier both to their willingness to listen to scientific arguments for the need for experimentation (or to the case for considering alternatives) and to arguments that humankind will suffer and/or die for the lack of it. Such considerations are particularly pertinent in cases such as the question of animal experimentation, where there is widespread and highly emotionally charged instinctive opposition to the idea, and a reasoned case needs not only to be made out but to be put across to the public if the work involved is to find any degree of general acceptance. In such cases it is not realistic to assume that the public will hold an open mind.

There is considerable scepticism among the public about scientists' competence as experts. In the field of the environment, this perception has been fairly steady for a number of years, with the public generally fairly evenly divided on the proposition that "even the scientists don't really know what they're talking about when it comes to the environment". This perception, of course, is fostered by the way in which the media, especially the broadcasting media, cover scientific news stories. Conflicting scientific reports abound, and public understanding is not helped by the media's habit of 'even-handedness', pitting the spokesperson for say 'global warming', who represents the vast majority of scientific opinion, against the scientific sceptic, who speaks for a few dissidents.

On the whole, this does not give an accurate picture of what the environmental journalists themselves think – when asked the same question about scientists' knowledge, the majority usually disagree. Nevertheless, in MORI's 1996 Environment Journalists survey, the number agreeing the scientists didn't know what they were talking about was as high as three in ten.

Q Do you agree or disagree? "Even the scientists don't really know what they're talking about when it comes to the environment"

	1989	1992	1993	1995	1996	1997	1998
	%	%	%	%	%	%	%
General Public							
Agree	36	37	41	36		49	41
Disagree	37	38	34	35		33	37
Net agree	-1	-1	+7	+1		+16	+4
Environment's journalists							
Agree			19	21	31	16	
Disagree			65	63	62	60	
Net agree			-46	-42	-31	-44	

Source: MORI Annual Business & the Environment study and Environment Journalists survey (Don't know omitted)
Base: c. 1,000 British adults each year, c. 25 environment journalists each year

The perception is of course swayed by events, and in 1997 the margin in favour was considerably greater than has been the trend. Such public failures as the government's scientists' u-turn over BSE and the embarrassment of Greenpeace's scientists over Brent Spar presumably contributed. In the circumstances, it would not be surprising if the public were wary of taking any single scientific pronouncement as representing authoritative truth.

Nevertheless, the majority of the public generally trust scientists to tell the truth. In general, scientists perform reasonably well (but not outstandingly) when compared with other groups on how far the public trusts them to tell the truth. This can be tested in two ways. MORI's standard 'veracity' test (last conducted for the British Medical Association in January 1999) asks respondents to judge for each group whether they are generally trusted or not; in both 1997 and 1999, 63% of the public said they trusted scientists, putting them ahead of the benchmark figure (56% in 1997 and 60% in 1990) of "the ordinary man/woman in the street", but well behind the most trusted groups, doctors and teachers, and indeed behind professors. (By way of contrast, when the Louis Harris polling organisation asked an identical question in the USA in 1998, scientists came near the top of the list, trusted to tell the truth by 79% of the American public.)

Q Now I will read out a list of different types of people. For each, would you tell me whether you generally trust them to tell the truth or not?

	April 1997			January 1999		
	Trust %	Not %	Net %	Trust %	Not %	Net %
Doctors	86	10	+76	91	7	+84
Teachers	83	11	+72	89	7	+82
Clergymen/priests	71	20	+51	80	14	+66
Professors	70	12	+58	79	10	+69
Judges	72	19	+53	77	16	+61
Television newsreaders	74	14	+60	74	17	+57
Scientists	63	22	+41	63	27	+36
The Police	61	30	+31	61	31	+30
The ordinary man/ woman in the street	56	28	+28	60	28	+32
Pollsters	55	28	+27	49	35	+14
Civil servants	36	50	-14	47	41	+6
Trade Union officials	27	56	-29	39	47	-8
Business leaders	29	60	-31	28	60	-32
Government Ministers	12	80	-68	23	70	-47
Politicians generally	15	78	-63	23	72	-49
Journalists	15	76	-61	15	79	-64

Source: MORI/British Medical Association (1999); Times (1997) Base: c. 1,000 (1997)/c. 2000 (1999) British adults

Just as the public trusts some groups in society more than others to "tell the truth" in general, so also there is a hierarchy of trust in providing "honest and balanced information" about specifically scientific matters, which combines requirements of having the accurate knowledge and integrity in reporting it.

Again, doctors top the list, but on this question there is a much clearer division into several categories – what might be described

as the professional experts, including "scientists", are trusted by more than distrust them. "The general public" and "patients" both score close to zero, though with marginally negative net scores. Other groups, however, ranging from farmers to animal welfare groups to industry to religious groups are greatly more distrusted than trusted. But both consumer groups and environmental groups score well.

Q Which, if any, of the following types of people or institutions would you trust to provide you with honest and balanced information about biological developments and their regulation?

Q And which, if any, would you not trust to provide you with honest and balanced information about biological developments and their regulation?

	Trust %	Not Trust %	Net Trust %
GPs/Family Doctors	60	6	+54
An Advisory Body to Government, composed of people representing different viewpoints	48	9	+39
Hospital Doctors	44	6	+38
An Advisory Body to Government, composed of experts	47	15	+32
Pharmacists/Chemists	32	10	+22
Consumer Groups	33	15	+18
Nurses	23	6	+17
Scientists	34	20	+14
Vets	20	8	+12
Environmental Groups	31	20	+11
The General Public	14	17	-3
Patients	6	11	-5
Sociologists	9	16	-7
Animal Welfare Groups	16	35	-19
Governments	19	39	-20
Religious organisations	9	32	-23
Farmers	8	34	-26
The Media	14	47	-33
Retailers	4	46	-42
Industry/manufacturers	3	53	-50
None of these	2	1	
Don't know	1	2	

Source: MORI/OST 13 March – 14 April 1999 Base: 1,109 British adults

The media is greatly distrusted, with more than three times as many respondents saying they would not trust the media to provide them with honest and balanced information as say they would trust them. The media – especially television – is the public's main source of information. Inevitably, this must mean that the public is inclined to treat much that it hears about science with suspicion.

These perceptions have changed little over the years. A 1985 MORI survey for the Technical Change Centre asking which groups from a list of sixteen respondents would, and which they would not, "trust to tell the truth about the effect scientific and technological developments will have on our lives", found very similar results. Doctors topped the poll while Members of Parliament and newspaper journalists were most distrusted (by 63% and 66% respectively), and consumer groups scored better than environmental groups. Interestingly, "presenters of scientific programmes on television", while trusted by 37% were also distrusted by a substantial 23%. Perhaps more significantly, however, twice as many distrusted "scientists working for major companies" as trusted them.

Some scientists are trusted more than others. MORI surveys have persistently found that trust in scientists' pronouncements are affected by knowledge of who is sponsoring the scientists' research. A 1997 survey for the Cancer Research Campaign asked the public how much confidence they would have in what each of ten groups had to say about their research projects and findings. The ten groups listed were four categories of charity and scientists working for six different types of sponsor. All four charitable categories scored higher trust ratings than any of the scientists.

Q How much confidence would you have in what each of the following have to say about their research projects and findings?

	A great deal %	A fair amount %	Not very much %	None at all %	Don't know %	A great deal/fair amount %
Cancer research charities	39	49	6	1	4	88
Medical research charities	37	50	6	2	5	87
Mental health charities	31	53	8	2	6	84
Animal welfare charities	20	53	18	5	5	73
Scientists working for the IT (Computer) industry	15	53	16	4	12	68
Scientists working for industry	6	53	30	5	6	59
Scientists working for the Government	5	45	38	6	5	50
Scientists working for the Chemical industry	7	35	41	10	7	42
Scientists working for the Nuclear industry	6	26	41	20	7	32
Scientists working for the Tobacco industry	3	15	42	34	6	18

Source: MORI/Cancer Research Campaign 9-12 May 1997 Base: 1933 British adults

But, more significantly, there were very substantial differences in reactions to the scientists. At one end of the scale, two-thirds of the public (68%) had at least a "fair amount" of confidence in what "Scientists working for the IT (Computer) industry" said; at the other, barely one in six (18%) trusted scientists working for the tobacco industry to the same degree.

The CRC research is not an isolated finding. MORI's Business and the Environment studies regularly test trust in different groups

of scientists on the more specific question of what they have to say about environmental issues. The surveys invariably find that the public have considerably more confidence in what "scientists working for environmental groups" have to say about environmental issues than "scientists working in industry", who in turn have tended to be slightly more trusted than "scientists working for the Government", although the latter marginally had the edge in the last (1998) survey.

Q How much confidence would you have in what each of the following have to say about environmental issues?

	great deal/a fair amount				Not very much/none at all			
	1995, %	1996, %	1997, %	1998, %	1995, %	1996, %	1997, %	1998, %
Scientists working for environmental groups	82	75	83	75	12	20	13	19
Scientists working in industry	48	45	47	43	45	49	48	50
Scientists working for the Government	38	32	44	46	55	63	50	47
Net lead (environmental groups overgovernment)	-42	-43	-39	-39				

Source: MORI Annual Business & the Environment studies Base: c. 2,000 British adults each year

MORI's surveys of environment journalists, asking the same question, have also found a clear hierarchy of trust, but in their case, scientists working in industry are very much less trusted than those working for the government. In 1998, 83% of the EJs said they had a great deal or a fair amount of trust in scientists working for environmental groups, 67% in those working for the Government, and just 29% in those working in industry.

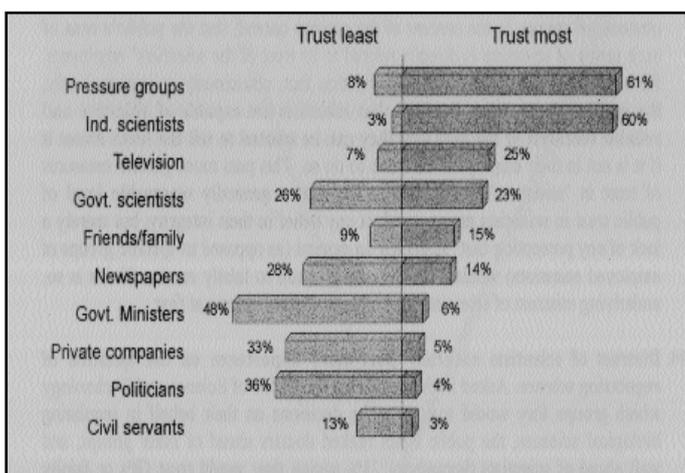
A separate study, the survey for the Cabinet Office's Better Regulation Unit, finds a similar differentiation of trust. The survey went on to examine two specific environmental issues, pollution

and BSE (see graphs below): while "independent scientists" scored a high degree of trust, "government scientists" are very much more distrusted.

On the subject of pollution, the public has most confidence in pressure groups and "independent scientists"; each trusted to give advice by three-fifths. Both are especially likely to be picked out by those with professional jobs, and less likely by those aged 65+. Interestingly, television is trusted much more than newspapers – reflecting one of the findings of our qualitative work.

Trust on Pollution

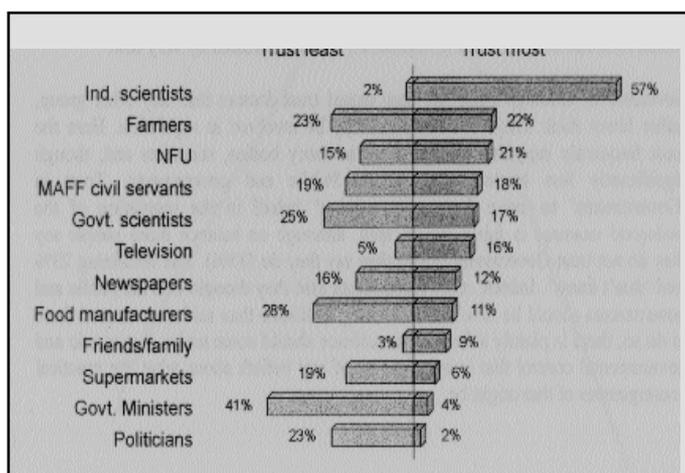
Q Thinking now about pollution, which two or three, if any, of these sources would you trust most/least to advise you on the risks posed by pollution?



Source: MORI/Better Regulation Unit Base: 1,015 British adults aged 16+ 9-19 January 1999

Trust on BSE

Q Now thinking about BSE, which two or three, if any, of these sources would you trust most/least to advise you on the risks posed by BSE?



Source: MORI/Better Regulation Unit Base: 1,015 British adults aged 16+ 9-19 January 1999

Although this differentiation of trust levels depending on who employs a scientist may be felt to be fairly case-specific, its implications are much wider. It is fairly obvious, of course, in the context of the surveys quoted, that the public's trust of each group of scientists is directly related to its trust of the scientists' employers. However, this clearly carries the implication that, consciously or unconsciously, the public rejects either the idea that scientists are capable of objective and reliable research or the idea that they can be trusted to tell the truth about it if it is not in their employers' interests to do so. This puts more general measures of trust in 'scientists' into disturbing context: a generally reasonable level of public trust in scientists may not reflect any belief in their integrity, but merely a lack of any perception that 'scientists' in general (as opposed to specific groups of employed scientists) would be under any pressure to falsify results. If this is so, underlying mistrust of scientists may be higher than it seems at first.

Distrust of scientists naturally puts more importance on the question of regulating science. Asked in the survey for the Office of Science and Technology which groups they would trust to make decisions on their behalf in regulating biological sciences, the public again ranked doctors ahead of other groups, and well ahead of scientists themselves, 71% saying they would trust GPs or family doctors and 69% hospital doctors, while only 55% would trust scientists. It is also worthy of note that there would be slightly greater trust for an Advisory Body to the government if it was composed of "people representing different viewpoints" than if it was composed of "experts". Also, although environmental groups are trusted as much as scientists, animal welfare groups (35%) would be trusted by very many fewer people. Industry and retailers, presumably assumed to have vested interests in manipulating regulation, would be trusted by very few.

Nevertheless, although more say they would trust doctors than any other group, rather fewer think that they should actually be involved in regulation. Here the most frequently supported groups

Q Which, if any, of the following types of people should be involved in making decisions on your behalf in the regulation of the biological sciences?

Q And for each of these types of people or institutions, would you tell me whether you trust them or not, to make decisions on your behalf in the regulation of the biological sciences?

	<i>Should be involved</i>	<i>Trust</i>	<i>Not trust</i>	<i>Don't know</i>	<i>Net Trust</i>
	%	%	%	%	±%
GPs/Family Doctors	37	71	13	16	+58
Hospital Doctors	36	69	13	18	+56
An Advisory Body to Government, composed of people representing differ- ent viewpoints	48	66	13	21	+53
An Advisory Body to Government, composed of experts	45	62	19	19	+43
Pharmacists/Chemists	22	56	20	24	+36
Environmental Groups	40	56	21	23	+35
Nurses	10	54	20	26	+34
Vets	17	54	22	24	+32
Scientists	47	55	26	19	+29
Consumer Groups	31	48	26	27	+22
The General Public	46	43	30	27	+13
Patients	19	35	32	33	+3
Animal Welfare Groups	26	35	38	27	-3
Governments	41	35	43	23	-8
Sociologists	12	27	36	37	-9
Farmers	17	26	50	24	-24
Religious organisations	12	22	51	27	-29
The Media	11	12	69	20	-57
Industry/manufacturers	16	11	70	19	-59
Retailers	7	9	70	21	-61
Other	2				
No-one/None of these	*				
Don't know	1				

Source: MORI/OST 13 March-14 April 1999 Base: 1,109 British adults
Source: MORI/OST 13 March-14 April 1999 Base: 1,109 British adults

were advisory bodies, scientists and, though significantly less trusted, the General Public and governments. Trust in 'Governments' to make decisions on 'your' behalf in the regulation of the biological sciences is fairly evenly split, although on balance more people say they do not trust Government (43%) than say they do (35%). The remaining 23% said 'don't know'. Indeed, more respondents said they thought that the public and governments should be involved in making decisions than said they trusted them to do so; there is plainly a feeling that science should come under democratic and governmental control that is independent of any beliefs about what the practical consequences of that might be.

The vast majority of the public (97%) believes that it is important that there are rules and regulations in place to control biological developments and scientific research, and as many as 88% believe this is very important. In MORI's experience, to have over 30% saying something is "very important" does indeed represent a high figure. These findings very much reflect people's views in the qualitative phase. The main reasons given (spontaneously) for having rules and regulations is because of the possibility that 'Things could go too far/get out of hand' (21%), followed by 10% saying 'We do not know the long-term effects' and 'Because it is potentially dangerous' (10%).

On balance, more people feel there is too *little* regulation to control biological developments and scientific research, but this view is by no means expressed by a large majority of the public. Approaching four in ten (38%) say there is too *little* regulation, but 28% say there is the right amount and just 3% that there is too much. Reflecting feelings in the workshops, as many as three in ten said they really didn't know – quite a high proportion for a 'don't know' category. (n.b. In this survey MORI interviewers were instructed to read out the 'don't know' category – not usual practice – because many participants in the qualitative phase said they did not know much about regulation.)

Despite the fact that, on balance, most people feel there is too little control over the regulation of biological developments and scientific research, most (71%) have at least a little confidence that regulation is keeping pace with developments.

However, the public are not well informed about regulation – and they wish to be. The thing which the public says it most wants in relation to the biosciences is more information on the rules and regulations. Seventy-two per cent said they have received too little information, 20% said about the right amount and just 2% said too much. The remaining 6% said they had no opinion or did not know.

Despite their limited knowledge, workshop participants were in the main well able to discuss their ideal mechanism for regulating the biosciences. Indeed, they did so with energy and interest, working in mini-groups and then presenting back their ideas to the full number of participants. Their key considerations are largely consistent with the points mentioned above which emerged from the quantitative phase, though perhaps cost and cost/benefits came up a little more often in the qualitative phase, compared to the 5% who mentioned it in the quantitative survey. We feel that this is because, in qualitative research, people are able to return to issues and exchange ideas with one another. In quantitative research, respondents are interviewed in a one-to-one situation, are moving from one aspect of a topic to another and are not therefore entering into a dialogue with other people. Equally, they are not being influenced by other people (which some people may be, in qualitative research). Both techniques are therefore valuable, and are complementary.

Having information and perceiving honesty and openness are the two key considerations for the public in order for them to have trust in a system of controls and regulations about biological developments. (27% and 23% respectively mentioned these factors spontaneously – see table overleaf). No other factor was mentioned by more than 11% (having people making decisions who are either independent, or declare their interests). However, the relatively low figures are unsurprising given that this was an unprompted question and that the public knew little about regulation of the biosciences.

After being shown a list of factors that might contribute to a regulatory process, far higher proportions selected many of the items on it. Indeed, the difference between the spontaneous and prompted figures is greater than MORI often finds. This suggests that many things matter to the public to enable them to have trust in a regulatory system but they tend to express this 'top-of-mind', in terms of having information and honesty/openness.

The 'honesty/openness' category increased to 71% and 'having information' to 61%. However, three further categories were mentioned by almost as many. These were: 'having a system which is open for anyone to have access to information, including the results of decisions and reasons behind decisions' (69%); 'having a system that monitors developments after they have become available to the public and is prepared to withdraw them if there are concerns' (62%); and 'having random spot checks of all regulated activities' (61%).

There was not an overwhelming feeling in the workshops that there is a lack of honesty about developments in the biological sciences. Rather, there is a feeling that the public receives little infor-

mation about this complex area of science that matters to them. This was coupled with the feeling that things are conducted without the opportunity for the public and other key groups to express their opinion. The fact that this series of workshops was being undertaken received a very warm response from participants – albeit with a few comments such as “Is this a public relations exercise?” and “But will they listen?” Many participants felt proud of the opportunity to have been given their say and welcomed receiving information about the sciences during the course of the workshops.

Although the subject matter of this survey was confined to biological sciences, there seems little reason to doubt that its lessons can be applied more widely. The public is not well informed about the regulatory regimes that govern science in this country. This causes them to lack confidence in the regulations, and they equate the failure of government and the scientific establishment to ensure that they are informed with a lack of openness and honesty. In particular, they want to be assured that decisions are taken by

Q. *What things, if any, do you personally feel would give you trust in a system of controls and regulations about biological developments?*

Q. *Which, if any, of the things on this card do you personally feel would give you trust in a system of controls and regulations about biological developments?*

	<i>Spontaneous</i> %	<i>Prompted</i> %
Honesty/openness	23	71
Having a system which is open for anyone to have access to information, including the results of decisions and the reasons behind the decisions	11	69
A system that monitors developments after they have become available to the public and is prepared to withdraw them if there are concerns	6	62
Having information about it	27	61
Having random spot checks of all regulated activities	3	61
Better labelling/Labelling of foods/of medicines	4	57
Publishing research	10	57
Ensuring safety of developments	5	56
Set rules/Written code of practice	4	55
Having a wide range of people with different expertise and interests involved	9	54
Having people making decision who are either independent or declare their interests	11	46
Asking the public for their views	6	42
Having more than one political group, that is Labour, Conservative, Liberal Democrats and Nationalist parties involved in making the rules	2	34
If pace was to slow down	1	15
Having experts/people with expert knowledge	3	3
Proof of what they are doing	2	2
Information that is easy to understand/in layman's terms	2	2
Proper testing	2	2
Government input	2	2
Accountability	1	1
GPs/Doctors	1	1
If can show benefits/that it is done for the good of the people	1	1
An advisory body	1	1
Qualifications of the people involved	1	1
Trust in the people involved	1	1
Funding/the cost	1	1
Strong regulatory body that will do its job/powerful body/the right people on the body	1	1
Open debate/discussion between all groups	*	*
Information on television/radio	*	*
Scientists	*	*
Have people with opposing viewpoints	*	*
Public having their way	*	*
Good results/good track record	*	*
People using moral/Christian guidelines	*	*
Other	3	4
Don't know	28	1

Source: MORI/OST 13 March-14 April 1999 Base: 1,109 British Adults

independent experts and not by governments or interested parties. **Thesis 5: Significant numbers of the public are prepared to use their power as consumers to put pressure on those involved when they object to a scientific procedure or principle.**

Public opposition to scientific developments has the potential to be converted into considerable consumer power. In the case of environmental objections, this is already a well-established phenomenon. During the period 1988-1991, the proportion of

Environmental Activists measured in MORI's Business and the Environment surveys (defined as those who have done five or more from a list of 'green' activities) increased from 14% to 31% of adults, before falling back to 23% by 1992 as the state of the economy, or rather the state of economic optimism, declined. Since then, Environmental Activism and other green activities have levelled off in Britain, but Green Consumerism has also stabilised, at a high level: in September 1998, 27% of adult Britons were classified as Environmental Activists (EAs), and a third, 33%, as Green

Consumers (GCs) – those who specifically stated that in the previous year or so they had selected one product over another because of its environmentally friendly packaging, advertising or formulation.

The survey for *New Scientist* in March 1999³ found proportions claiming to have shopped selectively for other reasons. One in three (32%) said that over the past two years or so they had “bought ‘cruelty-free’ cosmetics, not tested on animals”, and one in five (20%) that they had “avoided genetically modified foods”. Similarly, in the Better Regulation Unit survey, 11% said they had bought organic food over the past two or three years “because of any risks involved”.

MORI’s 1998 Corporate Social Responsibility survey found consumers willing to widen the scope of their selective consumerism from the product to the company. One in six (17%) said that in the past year or so they had boycotted a company’s product on ethical grounds, and 19% that they had chosen a product or service because of a company’s ethical reputation; 28% had done one or the other. While a company’s ethical reputation is, of course, by no means confined to science-related factors, this is certainly one of the factors such consumers take into account.

Retailers appear to be well aware of the potential of consumer power, and would be foolish were they not to track public attitudes to their products, and to the scientific principles behind them, through their own market research. The recent actions of the main supermarket chains to remove GM foods from their shelves can be seen as a pre-emptive strike against the commercial dangers of being identified with the sale of products which a considerable proportion of the general public currently view as a health risk.

Conclusions

Science is under attack, and probably feels hard done by, but is not alone. Business, government, the universities, charities and other NGOs all feel under attack today.

The speed of communications today means that more information, in both width and depth, is available to more people, faster, than ever before. People’s faith in their governments has declined precipitously over the past fifty years, as it has in nearly all institutions. Even in Great Britain, mother of parliaments, confidence in British institutions has generally declined over the past three decades, and is now extremely low. Fewer than half the British public say they can trust their civil servants to tell the truth (47%), only a quarter of the public feel they can trust business leaders to tell the truth (38%), and fewer than a quarter say they have faith in the veracity of their government’s ministers (23%). Fewer than half even say they trust what scientists working for either government (46%) or the British industry (43%) have to say about the environment. Over the period there has also been a decline in confidence in industry, although the trade unions are no longer the bogeymen they were in their period of ‘beer and sandwiches at No. 10’, when two trade union leaders were thought to be among the most powerful half-dozen people in the country. Now they hardly rate among the so called ‘Power 300’; Bill Gates is number three.

There has also been a precipitous decline in the confidence people have in the system of governance of the country, and there is a huge majority for such constitutional reforms as a Bill of Rights, a Freedom of Information Act and even a written constitution. At the same time, there has been a loss of confidence in Prince Charles’s future kingship, although no correlative rise in support for the abolition of the Monarchy. The shock to the system of first the Labour landslide on May 1, 1997, at the British General Election and then of the public reaction to the death of Diana, Princess of Wales, in September sent a message to the British establishment that should assist the radical reform of British governance intended by the new Labour Government.

There is a four-stage process of effective communication, starting with awareness, the provision of knowledge, a feeling of openness, and the belief that the information is provided without any ‘hidden agenda’, and from a source of trust; the second stage is involvement, where the individual can see some clear link between themselves and/or their family, and in some way can

benefit, be made healthier, or richer, or better feeling in some way; the third stage is persuasion, in that the individual feels informed and aware, and alert and involved, and is in a receptive mood to listen to the argument, and the fourth stage then is action, to do what the giver of the information wishes to be done, whether to quit smoking, or diet, or exercise, or cut energy use, or use the car less, or whatever action that the communicator wishes the recipient of that information to do.

If that is kept in mind, and scientists accept that people have the right to know for whom they are acting, the right to know what their scientific studies have concluded, and a feeling that they are being treated as responsible citizens, then bridges can be rebuilt. It is unlikely that the blind faith in the men in white coats will return, so expect that in the future scientists will have to take the time and trouble to explain what it is that they are trying to do, how they are going about it, and who will benefit therefrom.

Appendix

General Public surveys

The details of the surveys of the general public cited in this submission are as follows. In each case, the survey data were weighted to match the known profile of the national population.

Multi-client co-operative survey on Corporate Social Responsibility: MORI interviewed a representative quota sample of 1,935 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in home, on 18 July-2 August 1998, on successive waves of MORI’s regular Omnibus survey using CAPI (Computer Assisted Personal Interviewing) technology.

Multi-client co-operative survey on Business and the Environment: MORI interviewed a representative quota sample of 1,823 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in-home, on 4-11 September 1998, as part of MORI’s regular Omnibus survey using CAPI (Computer Assisted Personal Interviewing) technology. Clients included BP, Shell and WWF UK).

In the British fieldwork for the 1999 **International Environment Monitor**, MORI interviewed a representative quota sample of 975 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in home, on 7-10 May 1999, as part of MORI’s regular Omnibus survey using CAPI (Computer Assisted Personal Interviewing) technology. Clients included Greenpeace International.

For the **Better Regulation Unit of the Cabinet Office**, MORI interviewed 1,015 members of the People’s Panel aged 16+ across Great Britain, face-to-face in home on 9-19 January 1999.

For the **Office of Science and Technology of the Department of Trade and Industry**, a representative sample of 2,200 members of the People’s Panel was selected, of which MORI interviewed 1,109 adults aged 16+ face-to-face, in home, across Great Britain and Northern Ireland on 13 March-14 April 1999. The quantitative survey was accompanied by qualitative research, for which MORI conducted six two-day workshops around the United Kingdom between 5 December 1998 and 6 February 1999. In total 123 respondents attended the workshops. Three workshops were held in England, one in Scotland, one in Northern Ireland and one in Wales.

For Motorola Ltd, MORI interviewed a representative quota sample of 1,000 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in home, on 21-24 August 1998, as part of MORI’s regular CAPI Omnibus survey. The data was published in *The British and Technology 1998* Motorola Report.

For the *British Medical Association*, MORI interviewed a representative quota sample of 2,051 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in home, on 8-12 January 1999, as part of MORI’s regular CAPI Omnibus survey.

For the **Cancer Research Campaign**, MORI interviewed a representative quota sample of 1,933 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in home, on 9-12 May 1997, as part of MORI’s regular CAPI Omnibus survey.

For the **Technical Change Centre**, MORI interviewed a representative quota sample of 1,824 adults aged 15+ across Great

Britain. Interviews were conducted face-to-face, in home, on 4-9 June 1985 as part of MORI's regular Omnibus survey.

For *New Scientist*, MORI interviewed a representative quota sample of 2,009 adults aged 15+ across Great Britain. Interviews were conducted face-to-face, in home, on 5-8 March 1999, as part of MORI's regular CAPI Omnibus survey. The survey was published in the edition of 22 May 1999.

Survey of Environmental Journalists

In MORI's 1998 survey of Environment Journalists, 30 journalists from the national and regional press, specialist press and broadcasting organisations were approached, of whom 24 were inter-

viewed (a response rate of 80%). Interviews were conducted face-to-face on 16 September-20 October 1998.

Further details of these and other relevant surveys are to be found on the MORI Web Site, www.mor.com.

Reference

Worcester, R. 'Why do we do what we do? A review of what it is we think we do, reflections on why we do it, and whether or not it does any good', *International Journal of Public Opinion Research*, Volume 9 Number 1. Spring 1997, pp 2-16.

SPONSORED LECTURES, LEARNED SOCIETY SEMINARS AND FOUNDATION VISITS 1 JANUARY 1999 – 31 OCTOBER 1999

LECTURE TITLES

"Distance Learning – Can it Effectively Deliver to Industry and Business?"

"Mobility in the Future"

"Northern Ireland's Science Base For Future Economic Regeneration"

"Postgraduate Education for UK plc"

"How Interdisciplinary is the Science Base"

"Linking Science and Industry – improving the dialogue on risk assessment between the insurance sector and the UK science base"

"Nuclear Waste – Past or Future?"

"Science and Food in the 21st Century"

"The Impact of Science and Technology on Medicine"

"Millennium Consumer"

"Railways in the Next Decade – S&T and the Strategic Railway Authority"

The Sixth Zuckerman Lecture

"Seeking Consensus on Contentious Scientific Issues"

"Public and Parliament – managing a knowledge economy"

"It & the Health Service"

SPEAKERS

Dr Geraldine Kenney-Wallace FRSC
Mr Simon Howison
Professor Brian Fender CMG
Mr John Gray
Dr Anne Wright CBE

Dr David Fisk CB FENG
Professor Stephen Glaister CBE
M. Jean-Francois Abramatic
Mr Edward Gillespie

Mr William J Todd
Sir Roy McNulty CBE
Sir Kenneth Bloomfield KCB

Professor Robert Burgess
Dr David Clark
Professor A Ledwith CBE FRS Dsc

The Earl of Selborne KBE FRS
Professor Burton Richter
Professor Julia M Goodfellow

Mr Steve Robson CB
Mr Nick Golden
Professor Julian Hunt CB FRS

The Lord Tombs FENG
Mr Peter Beck
Professor John R Durant

Professor Christopher Leaver FRS FRSE
Professor Alan Gray
Professor Derek Burke CBE DL

Professor John Bell
Professor Richard Kitney
Professor Ara Darzi

Mr David Hatch CBE JP
Mr Andrew Summers
Dr Nick Edwards

Sir Alastair Morton
Dr Peter Watson OBE FREng
Professor Tony Ridley CBE FREng

Dr Neal Lane

Mr Gunnar Bengtsson
Sir Robert May AC FRS
Professor Robert Worcester

Mr Henry McLeish MP MSP
Dr David Milne OBE FRSE
Dr John Taylor OBE FREng FRS

Mr Alasdair Liddell CBE
Mrs Jackie L M Axelby
Dr Jeremy Wyatt

SPONSORED BY

Engineering and Marine Training Authority

Department of the Environment, Transport and the Regions
Engineering and Physical Sciences Research Council
Railtrack plc
Foundation's Shared Sponsorship Scheme

Industrial Research and Technology Unit
Perfeceal Inc

ESRC
NERC
UK Council for Graduate Education
The Wellcome Trust

Zeneca Group plc

The Tsunami Consortium

BNFL
SYNROC INTERNATIONAL LTD

Smith & Nephew plc

The Future Unit and Consumer Affairs Directorate, DTI
Unilever
Foundation's Shared Sponsorship Scheme

Lloyd's Register of Shipping
Railtrack plc

British Aerospace plc
Pfizer Ltd

The Wellcome Trust

Engineering and Marine Training Authority (Scotland)
BIOSIS UK
Foundation's Shared Sponsorship Scheme

EDS

LEARNED SOCIETIES' ACTIVITIES

Seminar – Employed by Trustees

Trustees Briefing Workshop

Seminar – The Future of Learned and Professional Societies: Threats and Opportunities in the 21st Century

The Learned Societies' Luncheon – The Lord Neill of Bladen QC spoke

ASSOCIATE MEMBERS & MAJOR DONORS

Whose support of, and involvement in, the affairs
of the Foundation is gratefully acknowledged
1 OCTOBER 1999

3i plc	Authority	Oxford Innovation Ltd
Aberdeen University	Esso UK plc	Oxford Natural Products plc
AEA Technology plc	Ford Motor Company Ltd	Oxford University
Aerial Group Limited	Fraser Russell	Parliamentary Office of Science & Technology
AgeNet	General Utilities plc	Perrotts Group plc
AIRTO	Glaxo Wellcome plc	Pfizer Central Research
Arab-British Chamber of Commerce	Glasgow University	PowerGen plc
Association of the British Pharmaceutical Industry (ABPI)	Greenwich University	Premmit Associates Ltd
Aston University	Habilis Ltd	Public Record Office
AstraZeneca plc	Harley Street Holdings Ltd	Queen Mary and Westfield College
A.T. Kearney Ltd	Heads of University Biological Sciences	Railtrack plc
Bank of England	Health & Safety Executive	R&D Efficiency
Barr Holdings Ltd	H J Heinz Company Limited	Reading University
BioIndustry Association	Heriot-Watt University	Research into Ageing
BIOSIS UK	Hertfordshire University	RHM Technology Ltd
Birmingham University	Higher Education Funding Council for England	RINGI Ltd
Blake Resource Development	Higher Education Funding Council for Wales	Roche Products Ltd
Bristol University	House of Commons Library	Royal Botanic Gardens, Kew
British Aerospace plc	House of Lords Committee Office	Royal Commission for the Exhibition of 1851
British Antarctic Survey	Hull University	Royal Commission on Environmental Pollution
British Council	IBM United Kingdom Limited	Royal Holloway & Bedford New College
BG plc	Imperial Chemical Industries plc	Science Policy Research Unit
British Geological Survey	Imperial College	Science Policy Support Group
British Library	Institute of Food Research	Science Systems
British Maritime Technology	Intellectual Property Institute	Scottish Higher Education Funding Council
British Nuclear Fuels plc	Japan Society for the Promotion of Science	Severn Trent plc
British Safety Council	Johnson Matthey plc	Sharp Laboratories of Europe Ltd
British Standards Institution	Keele University	Sheffield University
British Technology Group plc	Kessler International Ltd	Shell UK Limited
British Telecommunications plc	Kings College London	SmithKline Beecham Pharmaceuticals
Brown & Root (UK) Limited	Knoll Pharmaceuticals	Software Production Enterprises
Brownell Limited	Kobe Steel Ltd/Kobe Steel Europe Ltd	Southampton University
Brunel University	KPMG	South Bank University
Buckingham University	Laing Technology Group	Sunderland University
CAMPUS	Leeds University	Surrey University
CBI	Leicester University	Sussex University
CIRIA	Liverpool University	Technology Colleges Trust
CSE International Ltd	Lloyd's Register of Shipping	Teesside University
Calderwood Han Ltd	London Guildhall University	Thames Valley Nuffield Hospital
Cambridge Consultants Limited	Loughborough University	Thames Water Utilities Ltd
Cambridge University	LSI Logic Europe Ltd	The British Academy
Campden & Chorleywood Food Research Association	Lucas Varity plc	The D Group
Cancer Research Campaign	Luton University	The Engineering Council
Technology Ltd	Mainprice Napier & Co.	The Open University
Chantrey Vellacott	Management Technology Associates	The Royal Academy of Engineering
City University	Manchester Metropolitan University	The Royal Society
Comino Foundation	Manchester University	The Smallpeice Trust
Conoco (UK) Limited	Merck Sharp & Dohme	Thorn EMI/CRL
Contendere SA	Meteorological Office	Trade Association Management Ltd
Cookson Group plc	Metropolitan Police Service	UK Council for Graduate Education
Council for Industry & Higher Education	Microsoft Research Ltd	Ulster University
Coutts & Co	Middlesex University	UKERNA
Cranfield University	Ministry of Agriculture, Fisheries & Food	UK Nirex Limited
David Leon Partnership	Ministry of Defence	UMIST
De Montfort University	Napier University	Unilever plc
Department for Education & Employment	National Grid Company plc	Union Railways (North) Ltd
Department of Health	Natural History Museum	University College London
Department of the Environment, Transport and the Regions	New Property Cases Ltd	University of Kent at Canterbury
Department of Trade & Industry	New Product Research & Development	University of the Highlands & Islands
Director General Research Councils	Newcastle University	Warwick University
Dundee University	NIMTECH	Wates Technology
Durham University	Nortel Ltd	Westminster University
East Anglia University	Nottingham Trent University	Westport Energy Corporation
EDS	Novartis UK Ltd	Winsafe Ltd
European Public Policy Advisers	Nuclear Electric plc	WIRE Ltd
Edinburgh University	Office of Science & Technology	Wolverhampton University
Elsevier Science Ltd	ORBIC (International) Ltd	WRC plc
Engineering and Marine Training	Ordnance Survey	WS Atkins Consultants Ltd
	Ove Arup Partnership	



FOUNDATION
for SCIENCE and
TECHNOLOGY