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# TECHNOLOGY INNOVATION AND SOCIETY

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FOUNDATION FOR SCIENCE AND TECHNOLOGY

## FOUNDATION FOR SCIENCE AND TECHNOLOGY

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# FOUNDATION NEWS

## *Annual General Meeting*

The Annual General Meeting was held at the Royal Society on 17 May 1995 immediately following an Extraordinary General Meeting which gave provision for the Chairman of the Council for the Central Laboratory of the Research Council to be ex officio a member of the Foundation's Council.

Lord Butterworth, in the chair, gave his annual address as reported on page 22.

The annual accounts are shown in abbreviated form on page 23. Full copies are available from the Foundation's offices upon request.

## *Changes to Council*

The following have retired from Council at the recent Annual General Meeting:

**Mr David Andrews** as Hon Treasurer. Apart from increasing the associate membership, he was greatly involved in the Foundation's work with learned societies, especially in the preparations for the new accounting regime for charities: the Standard of Recommended Practice 2 and the parallel Home Office Regulations. He also initiated the Learned Societies' Computer Users Group. The Council intends co-opting David Andrews in order to retain his involvement in its affairs.

**Dr Ray Clark** is a member of the Foundation's Membership Committee, and represented Accredited Societies. His involvement in many societies of varying size brought valuable experience and knowledge to the Membership Committee.

**Mr John Pascoe.** He was greatly involved in developing the Foundation in its early days, introducing the idea of sponsorship of events through himself sponsoring the first evening lecture and supper. He chaired the Activities Committee for a number of years, bringing new people and contacts and also many fresh ideas to the Foundation, and he was for some years a member of the Finance and General Purposes Committee. The Foundation benefits from his continued individual membership.

The following join the Council for three years:

**Mr Roger G L Davidson** succeeds Mr Andrews as Hon Treasurer. His career was largely one of management in Shell.

**Sir Geoffrey Allen,** President, Institute of Materials.

**Sir Walter Bodmer,** Director General, Imperial Cancer Research Fund

**Mr Clive Foxell,** Member of Council, Institution of Electrical Engineers

**Mr D G Moorhouse.** Chief Executive of John Brown plc

*Further news on page 20*



*The Foundation's Chairman and the President of the Royal Society at the joint meeting reported on page 20 of this issue*

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## *New Individual Members*

The following have been offered and accept individual membership for a term of six years:

Lord Chorley  
Mr Leslie Jones  
Lord Gregson  
Dr Geoffrey Robinson

## *Retiring Individual Members*

The following retire on completion of six years as Individual Members:

Richard McLaughlin  
Sir John Egan  
Professor Colin Coulson-Thomas  
Sir John Knill

## *Modes of Appreciation – Foundation for Science and Technology*

At a recent Council meeting the following was agreed:

(a) Retiring honorary officers are automatically offered individual membership in accordance with the Bye-Laws for those retiring from Council

(b) A Foundation medal is to be struck and awarded by Council for those who have been deemed to have given outstanding service to the Foundation. Retiring honorary officers may well be considered for this award by Council.

(c) For those special cases outside the Foundation there may be rare instances where Council would wish to award honorary membership. Such membership will be for life, and no subscription is payable.

## *New Associate Members*

Aerial Group Ltd  
Contact: Mr Gerald H David OBE

Cranfield University of Technology

Contact: Professor F R Hartley

Hitachi Europe Ltd

Contact: Dr Y Kuwahara

Winsafe Ltd

Contact: Mr Philip Virgo

## *Foundation Event uses Information Highway*

The Foundation had satellite links from Sri Lanka and Washington via Post Office Tower to the Royal Society for its first event using information highways. British Telecommunications plc generously provided the links as well as part sponsoring the evening.

Dr Arthur C Clarke spoke from his sitting room in Sri Lanka, and David Barram, Deputy Secretary Commerce at the US Department of Commerce, spoke from the Conus studio in Washington, each for ten minutes on the subject of the information age from a global point of view. They then took questions from the audience. It was in many respects like a normal Foundation evening, but with the speakers appearing to be with us, yet in fact being thousands of miles away. Both speakers appeared on the screen for the discussion. Much was learnt about the limitations of technology, and also about the management of such an event. Some of those present have been providing interesting feedback through a questionnaire, and it remains to be seen what progress the Foundation will make in this area.

There was a second part to the event when European Commissioner Martin Bangemann spoke with Malcolm Laws, Technical Editor of the European Newspaper, both providing a highly stimulating basis for the remainder of the evening.

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# COMPETITIVENESS WHITE PAPER

The Foundation held a lecture and dinner discussion on the subject of “The Competitiveness White Paper” at the Royal Society on 28 June 1994. The Lord Butterworth CBE DL was in the chair and the evening was sponsored by the Department of Trade and Industry, Unilever plc, and contributors to the Foundation’s Shared Sponsorship Scheme: Biwater Limited, Cookson Group plc, Glaxo Holdings plc, UK Nirex Limited and Zeneca Limited. The speakers were: Mr Patrick McLoughlin MP, Parliamentary Under-Secretary of State for Trade and Industry, Professor Howard Newby, then Chief Executive, Economic and Social Research Council, and Mr Terry Rhodes, Director, Strategic Planning and Competition, Mercury Communications plc.

## Professor Howard Newby\*

### INTRODUCTION

This is the third occasion on which I have stood here in the last year to speak on issues related to economic competitiveness. I am concerned that we continue to be world leaders in discussing our problems, but behind the rest in doing something about them. The reasons why we, in Britain, do not do something about it compared with our international competitors, is a social science issue - that is, one which is amenable to investigation and analysis and one which, as the outgoing Chairman of the Economic and Social Research Council, I have made a priority in recent years. Of course, the experience of the past is not a reliable predictor of the future. Nevertheless, we can provide some hard information on which to base our choices for the future which is rather more robust than dogma, intuition and a selective quoting of anecdote. I believe we have made some progress in the last few years and that the White Paper on Competitiveness reflects this. This evening I want to highlight certain aspects of this, while looking forward to identifying those areas where we still know less than we should.

### SCOPE OF THE WHITE PAPERS

I cannot resist pointing out at the outset that this is, of course, the second White Paper in just over a year concerned with the problem of wealth creation. The earlier White Paper on Science, Engineering and Technology, ‘*Realising Our Potential*’, is the one which continues to consume our everyday lives in the Research Councils. Its central theme was to improve the links between our science and engineering base on the one hand and our economic competitiveness on the other. To achieve this the Government called for a closer partnership and better diffusion of ideas between the science and engineering communities, industry, the financial sector and government. In taking this theme forward the Government has diagnosed our national problem in science policy to be the widely perceived contrast between our excellent

#### Summary

*Professor Newby said that the main problem behind Britain’s relative lack of economic competitiveness was the country’s relative incapacity to innovate. This was, at heart, a people problem and one in which the social science base had already conducted useful research. Mr Rhodes argued the need to overhaul the UK’s competition law, improving the knowledge and skill base of the workforce, and by effective management, getting more out of existing resources.*

science and technology and our relative weakness in exploiting them to economic advantage.

The general prescription has been to promote arrangements for the transfer of knowledge between the different relevant sectors. There was a recognition that there was not a simple linear progression from invention to application, but a highly complex, interactive process. The simply linear model of technological change – invention leading to innovation, to be followed by diffusion - was recognised as not only inaccurate but as having had a harmful effect on previous policy initiatives designed to strengthen the links between science and industry. It had, for example, led to a disproportionate emphasis on ‘getting the science right’ and insufficient emphasis on the business processes required to bring technology to the marketplace.

The Competitiveness White Paper is, of course, painted on a much broader canvas. It is, in its own words, “an audit of the UK’s economic performance against our main competitors”. It brings together the Government’s policies which affect the competitiveness of UK industry and announces a number of new initiatives. The White Paper inevitably covers a great deal of ground, far more than I can possibly comment on in the time available to me this evening. For example, it points to the overarching importance of macro-economic management in influencing the competitiveness of the UK economy; but it also pays a great deal of attention to the micro-economic, organisational and institutional aspects of business activity which also have a determining influence. There is a very considerable emphasis on human resources – particularly education and training, and management – as well as innovation, infrastructure and legal and fiscal frameworks. It is also concerned with what

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\* Then Chief Executive, Economic & Social Research Council

government can *not* do. Government's role is seen as enabling, rather than managing, our international competitiveness. Nevertheless, we should note that this emphasis on human resources is a rather different, although not necessarily incompatible, approach to wealth creation from that taken in 'Realising Our Potential'. Personally, I find the division between the two White Papers not altogether – shall we say? – seamless.

Clearly, there needs to be a sensible division of labour between the two White Papers. There is no point in each repeating the material contained in the other. Nevertheless, the whole tenor of analysis is quite markedly different. One might have welcomed a White Paper on 'Realising Our Potential Competitiveness' which would have integrated the two rather more firmly together. For example, the White Paper on Science, Engineering and Technology, while abandoning the so-called linear model of innovation, makes only passing reference to the importance of the human factor in wealth creation; meanwhile the competitiveness White Paper places at the centre of its analysis markets, human capital and management. I remain suspicious that this is not a mere sensible division of labour, but a manifestation of something much deeper and more serious – namely, the two cultures problem, which allows the science and technology White Paper to be ignored by many industrial managers and executives, while the Competitiveness White Paper will be ignored by those involved in R&D whether in industry or academia. I say this because I wish to dispel the idea that the issue is simply a matter of better communication, of persuading business to adopt our excellent technologies and inventions in their processes. It is more than this: it is concerned with, above all, *attitudes*, as well as processes and practices.

## MAJOR CONCERNS

I was surprised that, one year after the S & T White Paper, it scarcely fell within the ambit of the audit contained in the Competitiveness White Paper. So, let me attempt to fill in the gap. I have three major concerns, each of which is relevant to the Competitiveness White Paper:

1. Over one year after the publication of the S & T White Paper, it is still difficult to discern any significant response from the industrial community. Large parts of it appear to have no knowledge of the Paper, nor to appreciate the significance of the changes proposed. Too many companies, and especially too many chief executives, are not aware of its potential significance. If the S & T White Paper is really to succeed, it will require thousands of individual relationships between industry and the academic community to be developed. For this to happen, much stronger systematic mechanisms will be required to motivate the two communities to become better acquainted.

2. Part of the reason for this is that there remains a 'two cultures' problem *within* industry. The gap between the R&D side of most major companies and what might be termed 'mainstream management' is as wide as that between the R&D side of industry and the academic scientific community. As I have pointed out before, too many senior managers remain technologically illiterate; and too many R&D specialists cannot produce a business plan. There are major issues here of business education which have scarcely been addressed – partly because it is difficult to identify where responsibility rests, and partly, I must say, of a misplaced application of the 'near market' principle to the quality control of management training.

3. Elements of linear thinking still abound. For example, those charged with implementing the S & T White Paper still seem most comfortable with the technology-push side of the

equation, rather than the market-led side. As *The Economist* recently pointed out, innovation requires the appraisal of changing *uses* and needs as much as new technologies. The strategic re-orientation of the UK science base therefore requires an analysis of social needs and potential markets which is as comprehensive and rigorous as an analysis of the opportunities being presented by basic science and technology.

To my mind these three issues take us into the heart of the Competitiveness White Paper. While no one doubts – certainly I do not – that the UK science base requires some strategic re-orientation towards areas which have potential for wealth creation, I have yet to see any evidence to suggest that the quality of the UK science base is the main problem, as opposed to the inability of UK industry to pick up and exploit the opportunities offered to it. After all, we are all by now familiar with the litany of examples of major exploitable technologies which have been invented in the UK but developed by our international competitors for their benefit. As a nation, we are remarkably inventive but not terribly innovative. British industry's relative incapacity to innovate lies at the heart of our relative lack of economic competitiveness. I do not for one moment wish to ignore the importance of macro-economic management in providing a good part of this capacity, but problems here usually signify a symptom rather than a cause. Nor is there a scarcity of exploitable technology. At heart, innovation is a people problem. That is, how to change motivation, to change the culture to make people more adaptable and flexible so that they are ready to accept change. I believe the Competitiveness White Paper shares this approach and, as such, I very much welcome it. I also believe, somewhat immodestly, that one part of our science base – the social science base – can claim some credit for having provided the kind of information on which this new approach has been based.

## ROLE OF SOCIAL SCIENCE

For example, we now know, thanks to the work of Professor Sig Prais at the National Institute of Economic and Social Research, that one of the major causes of productivity differences between the UK and our international competitors is the skills deficit at the intermediate and lower levels of ability amongst British workers. This has been based on very careful and detailed international comparisons amongst carefully selected occupational groups. It is now the kind of thing that 'everybody knows' – but the important point is that no one knew this until serious and systematic analysis was carried out. Similarly, we now know that, thanks to the work of Derek Bosworth and Richard Wilson, there is a clear link between the economic competitiveness of UK manufacturing companies and the skills and capacities of their senior management to understand and take advantage of new technologies. We know that 75% of UK manufacturing firms employ no graduates whatsoever in their R&D departments and that this, not surprisingly, constitutes a major blockage to innovative capacity. We also know, from the work of John Stopford at the LBS, that industrial regeneration is possible if companies are prepared to re-engineer their businesses and make a firm commitment to attitude change and the creation of what one might call 'intelligent business organisation'. Further work, by John Kay at London Economics, has shown that it is possible, on the basis of a systematic comparative analysis amongst companies, to tease out those factors which are responsible for successful innovation and improved market competitiveness. This work has recently been taken up by the DTI and is helping to pave the way towards the production of the supportive UK Innovation Index. I could go on, but the point

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I am trying to make here is, I hope, clear. This is research which is as crucial to improving the future performance of the UK economy as the very necessary and important research which is funded in the hard science and technology areas. It is, surely, no coincidence that the Japanese are increasingly focusing their attention on these 'softer' areas as a key to their future economic success. Japanese performance, after all, owes as much to Japanese management methods as it does to Japanese technology and, possibly, still less to Japanese basic science.

## MANAGEMENT OF INNOVATION

At this point I want to turn the tables. The Competitiveness White Paper not only takes up some of the themes of recent ESRC-funded research, but it also lays down a challenge to the ESRC and, indeed, to the entire social science community. If a good deal of economic competitiveness rests upon innovative capacity, and if innovation is primarily a people problem, then at the heart of this people problem is not only a set of management issues, but also a cultural problem. We must guard against a kind of simplistic historicism here. We live in a post-imperial nation and we may have a preference to a retreat into rustic pursuits rather than a continuance in the vulgar matter of trade, but we need to move away from these beguiling caricatures (some of which do not stand up to close analysis) and do our part in developing an internationally competitive research base on the management of change. Since last April the ESRC has assumed lead responsibility among the research councils for supporting work on the management of innovation. This is currently our corporate priority and we are busily developing a range of programmes and activities to fulfil this mission. The agenda is, inevitably, very wide ranging. For example, we can only systematically tackle the analysis of cultural issues by some kind of comparative, cross-cultural analysis. We have therefore launched a major programme on Pacific Asia which will tackle some of these issues. We also need to know much more about the perception and assessment of Risk. Are

British managers more risk-averse and, if so, why? But at the heart of our efforts will be a continuing emphasis on the innovative firm. This will involve collaboration with the other research councils through the Innovative Manufacturing Initiative and develop with industry an agenda which more closely matches its needs than perhaps has hitherto been the case. We still know remarkably little, in any systematic way, about how management structures promote or inhibit the culture of innovation, and has led, of course, to the flourishing of what one might call the 'airport book stall' school of management which swings violently from one fashion to another. We particularly need to know a great deal more in the area of technology management, of how marketing, development and production can be better integrated. I must confess that I am far less concerned about our supposed love of country life as a blockage on our enterprise culture than I am about the inhibitions placed on enterprise by the supreme metaphor of our age – an over-zealous adoption of the rules of accountancy.

But that is enough of my prejudice. I am, of course, aware that management is primarily a practical activity, where the relevance and utility of research is sometimes less apparent than in the more narrowly defined areas of science and technology. But management is not, and cannot be, a completely unreflective activity. High quality research on *relevant* management issues is as crucial to the fulfilment of both White Papers as the human genome project, materials science or information technology. This is the philosophy built into the programme on Innovative Manufacturing which my Council has recently launched with the EPSRC and the BBSRC. It is also the philosophy which underpins my own Council's response to both White Papers. But may I end with making a plea? We will not make serious progress unless we as a nation can seriously attack the two cultures problem which exists not only in academia but also in industry and, may I respectfully suggest, in Government. I am concerned that the two White Papers reflect two different cultures. If we are to realise our potential competitiveness, this is a luxury we can ill afford.

## Mr Terry Rhodes\*

### INTRODUCTION

Competitiveness is a slippery topic which can mean many different things to many different people. Let me start with a definition of what it is not:

Vaclav Havel described the Czech economic system under communism as "we pretended to pay people and they pretended to work". While there may still be some echoes of that sentiment, the opening up of new markets in the developing and former communist countries is changing the basis of competition for the OECD countries. No longer is it possible to rely on the traditional manufacturing excellence. Competitiveness in global terms means working towards higher value added – and in particular towards the products and services which are increasingly knowledge and information based.

I do not want to turn this into a debate about manufacturing versus services, because much of the value added content in manufacturing comes from the service elements. But I do believe that success at this skill-based work will define competitiveness in the information age.

Fortunately, the technology developments which are ushering in the information age also provide the UK with a

means to future success. You may have expected a presentation from an industrialist, particularly from the telecoms sector, to focus on the technology developments. I do not intend to do so, and will not try to convince you that all the hype surrounding information superhighways or, as they are now called in a multilingual description, "infobahns", is actually reality. It is not – yet.

But many of the products and services are not that far away – particularly for business users. The saga of the computer industry – the move away from centralised mainframes to decentralised PCs and their subsequent networking, will find parallels in the convergence of telecoms and computing and information and entertainment. You will have heard the first half of that equation before – the difference now is that the content half is digital.

Instead of technology, my focus will be on three areas – competition, education and people.

### COMPETITION

Can you have competitiveness without powerful competition law? The White Paper rightly points to the crucial future role to be played by Small and Medium Enterprises (SMEs). But to be successful those SMEs need to know that the balance of competitive advantage is not tipped in the favour of their larger opponents.

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\* Director of Strategic Planning and Competition Policy, Mercury Communications plc

The 1980s saw an increase in the concentration of power in British industry through both the merger boom and the policy of privatisation. Many of today's largest Stock Market companies did not exist - at least in their present form. Privatisation of monopolies and increased merger activity has provided more opportunity for the abuse of market power in the name of competitiveness.

This issue - the need for a major overhaul of the UK's competition law - is not addressed in the White Paper. Probably out of embarrassment. That there are defects in the present arrangement has been admitted. Quote: "In particular, there is a lack of deterrence against anti-competitive conduct. There are no penalties for past misconduct and no scope for interim relief for injured parties. Competitors can - and do - go out of business before action can be taken." Unquote. Not my words, but those of Michael Heseltine, introducing in Parliament the DTI's Green Paper on Abuse of Market Power in November 1992.

The response to the Green Paper saw the lobbyists of traditional big business close ranks. To Mercury - who has long been campaigning for better competition law, the Green Paper was an opportunity to address some of the powers of the individual sectoral regulators - such as Ofel and Ofwat and Ofgas.

These quangos now regulate major parts of the UK economy - in many cases addressing the same issues of anti-competitive activity - but in different sectors and with subtly different powers and responsibilities. Far better - in our view - to combine the general anti-competitive aspects in the Office of Fair Trading. Far better too to give small and medium enterprises some chance of redress. Virgin only succeeded in its campaign against the malpractices of British Airways by bringing a case of trade libel.

Instead of following the reformist path outlined as one option in the Green Paper, the DTI follow-up has been to publish a summary of the responses demonstrating that most respondents favoured the least radical option - and then plead lack of Parliamentary time for implementation.

In the meantime, the prospect for competition in many sectors - such as telecoms - declines rather than increases. Certainly, the DTI can now point to a long list of applicants - but how many new telecoms companies can you name? It is little use opening the floodgates to find that there is in fact no flood. For the economic reality is that telecoms is a managed utility rather than a competitive market; a managed utility where competitive success is penalised by increased payments to BT to compensate them for loss of market share. Mercury is currently in that position - already paying some £35m in compensation to BT - a figure that will double when we exceed 25% market share of international traffic. This in an industry where revenue has doubled in the past decade - and to compensate a BT whose profits have tripled - from £1bn to £3bn over the same period. In other words, a subsidy from a competitor, Mercury, which has 13% of the market overall and makes less than 1/10th of BT's profits.

By advocating more powerful competition law, I have no desire to shackle the international aspirations of the privatised utilities or any other major corporations. Far from it - both leading business school thinking and industrial experience suggests that protected home markets are detrimental rather than advantageous to competitiveness abroad. And protected home markets are certainly detrimental to consumers.

## COMPLACENCY vs. EUROPE

The DTI does have one safe refuge from my criticism as far as telecoms is concerned. The UK is ahead of Europe. But, although competition in the UK has delivered lower prices,

better quality and more innovation - there is not time to rest on our laurels. At the level of the economy as a whole, I believe there is a predictable pattern to the progression of economies towards the information age. But the timing is not determinate. This may well be a case of a multi-speed Europe, where the later entrants to the race not only run faster but have learned some of the short-cuts.

In the context of information infrastructure, the European Council in Corfu has just heard the report from Commissioner Bangemann on his study. Reading it there comes through a sense of urgency and excitement - unusual for a European Commission document. The recommendations - market-led funding and overwhelming support for competition - do not alone capture the flavour. It can be interpreted as Europe ready to catch up if not overtake the UK.

## EDUCATION

Why is this important? Am I not drifting into the hype about information superhighways which earlier I promised to avoid? Last month's CCTA report on the use of information superhighways outlines some of the potential uses of the role of information networks across the boundaries of the public and private sectors. The Labour Party's proposals for a University of Industry go further than this in putting information networks at the heart of the delivery mechanism for multimedia education and training techniques - in pursuit of the goal of continuous learning. The DTI Competitiveness White Paper lists many existing and some new education initiatives - all aimed at improving the knowledge and skill base of the workforce.

Overall, the White Paper contains little new thinking on education. "Modern apprenticeships" are welcome, as is the continued high profile for Investors in People. But too many of the training proposals are too generic, e.g. NVQs and GNVQs. Even reading the chapter on education and training is hard work for those not steeped in educational acronyms. By contrast, too little emphasis on supporting and recognising the best of private sector employer and industry based training. Flagship private educational establishments, such as the new £40m Cable & Wireless college at Coventry, are still limited in the qualifications they can offer. Extending the quality checks to the education which industry is undertaking for itself would be relatively easy and issuing qualifications would be self-reinforcing.

The skills necessary for success in the information age are the very skills of innovation, creativity and problem solving which the UK is rightly renowned for. But such skills cannot remain the privilege of an elite. According to the Labour Party document, in Britain only 28% of school leavers go to university - compared to 44% in the USA and 65-70% in Germany and Japan. Wider accessibility to knowledge and education in the UK is essential. I doubt whether the £20bn employers reportedly spend on education and training is delivering the value it could, nor the public sector spending of some £50bn.

At Mercury we have some ideas for improving the productivity of education, both private and public sector, using the power of networks. The information revolution has already swept through banking and retailing; now it offers the prospect of re-engineering education. Mercury already has a 27% market share of the university sector - with 82 sites already on our fibre optic network.

The opportunity now is to put the student at the centre of a source of access networks to the knowledge warehouses - libraries, museums, databases - and pull rather than push the learning. I am not advocating that form of software known as shovelware - where they shovel it out and you have to do all the hard work selecting what to use or not. Instead I am



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talking about live, controlled, interactive tutorials and seminars - not broadcasting free intellectual property. Nor am I advocating chaining students to their personal computers in isolated bedrooms. Far from resulting in an atomised society, it is more likely that e-mail will reinvent the art of letter writing and pen pals.

Much of this is already happening in an anarchic way on the Internet - our proposal is a professionally managed version. In many ways, this is about harnessing the creativity of the 1960s with the entrepreneurialism of the 1980s - blending both into a superior version for the 1990s.

## PEOPLE AND MANAGEMENT

Education cannot stop at the university - increasingly, the requirement for competitive success is that all organisations implement "continuous learning". The Competitiveness White Paper is not harsh enough on British management here.

There is little recognition that the traditional hierarchical organisational structures do not promote continuous learning. The survey of the top 100 companies may demonstrate this - but I doubt it. Rather, everyone will claim that people are their most valuable asset. Well - here's a little test: look at the glossy Annual Reports of those companies and see how many pictures are of the Chairman, the Chief Executive, the directors, and how many are of the people who really do the work. Mercury's 1993 Annual Report contained no pictures of Lord Young, the Chairman, nor of the directors - only of our people, the facts and figures and stylised representatives of growth.

For Mercury is, in many ways, a microcosm of these wider social and economic trends. Invented to sharpen up a sleepy monopoly, that job is largely done. Mercury's competition was largely in the traditional mode - build a network and offer similar services a bit cheaper and a bit better. That was the appropriate model for success in our industry in the 1980s - but it is not in the mid 1990s. The basis of competition is changing from networks to services - and after all

you can export services but you cannot export fibre in the ground.

So Mercury is reinventing a new future - adopting the Merlin approach of standing in the future and working backwards rather than being obsessed with today's firefighting. To do so means unblocking the potential of all 11,000 people - so we've implemented a major cultural change programme.

Like many organisations, we found a great deal of creativity and energy - but much of it pulling in different directions or dissipated in turf battles. So we have moved towards virtual teams as the major way of working - teams which come together across the company, are focused on achievement and then disbanded. We're about to set up one team comprised entirely of women because we want to unlock their potential away from the often unwitting domineering influence of their male colleagues. We will extend this approach beyond the traditional organisational boundaries to try to reach the entrepreneurs of the future, who today are probably playing video games.

I recognise that when presented briefly like this, such culture change can come across like a ratatouille of management gurus - mix some Handy, some Peters and add a dash of Toffler. So I will leave you with a very practical example to bring it right down to earth. 200 people in Mercury, together away from the office for two days, diagnosed many of the blockages to releasing our potential. One was "too many meetings" - which may well strike a chord! Then we looked again - the idea of the meetings was right - to involve people - but the output was unproductive. So we found the top causes of ineffective meetings - what we've called the "meetings wreckers". These have been pasted up on walls to remind us how not to do it - they include agree/disagree, jump in, dominate/hide, giving answers not remotely related to the question.

You can probably compile your own list. We have already found that we can take a lot of the noise out of the system this way. Getting more out of the resources you already have - that way true competitiveness lies.

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# Obituaries

## *Sir Alastair Pilkington*

On 5 May 1995 news was received that Sir Alastair Pilkington had died after a relatively short illness.

Sir Alastair had been a Vice-President of the Foundation since the late 1980s, and had been a member of the Finance and General Purposes Committee as well as of Council. He was therefore deeply involved in the Foundation's major areas of policy and of its development. Indeed, in the early lecture and dinner discussions on education, starting with that on the subject of "The image of Industry in Schools today", he played a leading and crucial role, pointing out that nearly all appeared to agree on an urgent need for change in certain areas. He pointed out that the British are good at discussing and analysing their problems, but less good at doing something constructive. Within a week of saying that, he had been invited to chair a working party for the Foundation. He accepted, and within twelve months had produced the report "The Path to Higher Education", published in 1987.

We learnt during his work on that report that he felt passionately about certain things, giving him great determination and huge energy. Those controlling the glass company bearing the same name must have felt those qualities when he pushed through his invention and development of float glass.

He and his wife regularly brought their intellect and wisdom to the Foundation's events, and it is a partnership that will be hugely missed.

## *Dr Helen Wallis*

Helen Wallis, the great map historian of her time, had joined the Foundation's Council first in 1986 representing Accredited Societies, and then later representing members. Hence she had a rather longer spell on Council than most, and was, too, a valuable member of the Foundation's Membership Committee. She was also involved in a huge span of other organisations, bringing to them her intense interest and infectious enthusiasm. It was a measure of her popularity and the respect held for her, that at a meeting of commemoration after her death some five hundred gathered from many different walks of life: the Hakluyt Society, the British Library, the Frederick Soddy Trust, the Royal Geographical Society, and many other diverse institutions.

Helen had an enormous capacity for work. There was a story of her waiting with colleagues to board an aircraft, and stealing the last few minutes to scribble an obituary on some rough paper and ask the airport officials to 'pop it in the post' for her. During her illness before her death she bought a special chair and organised her work around it so that she could continue to the end, never losing her cheerful approach to life, and her warm welcome to many friends. The Foundation was one of many organisations to lose something special when she died.

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# WOMEN IN SCIENCE, ENGINEERING AND TECHNOLOGY

On 14 February 1995, the Foundation held a lecture and dinner discussion at the Royal Society on the subject "Women in Science, Engineering and Technology - the Opportunities". The evening was sponsored by The Engineering Council, Glaxo plc, and The Office of Science and Technology. The Lord Butterworth CBE DL was in the Chair and the evening was introduced by the Rt Hon David Hunt MBE MP, Chancellor of the Duchy of Lancaster. The evening began with the presentation of the 1964 Lloyd of Kilgerran Prize to Dr Bridget Ogilvie, Director of the Wellcome Trust, who was also a speaker at the event. The other speakers were Mrs Lynda Sharp, Head of Development, Office of Science and Technology, Mrs Marie-Noëlle Barton, Manager, WISE, and Mrs Betty Barratt, OFSTED Inspector.

## The Rt Hon David Hunt MBE MP\*

### INTRODUCTION

Let me start by adding my congratulations to Bridget Ogilvie for her richly-deserved success in receiving the Lloyd of Kilgerran prize. Bridget has made an outstanding contribution to science for the benefit of society. I personally also greatly value her input as a member of the over-arching Council for Science and Technology, which I chair on behalf of the Prime Minister, and which provides advice on the Government's broad strategy for science, engineering and technology.

### OVERALL POLICY ON SCIENCE

Before moving on to Women in Science, let me just put this important topic in the context of overall Government policy.

The Government decided in 1992 to set up the Office of Science and Technology. The OST serves as an influential focal point for science, engineering and technology policy across Government. It works directly to me, but the Chief Scientific Adviser also has direct access to the Prime Minister.

The OST, in a short time, has proved to be a huge success. It has provided the catalyst for the White Paper "Realising our Potential", the re-organisation of the Research Councils; the increased partnership between the public and private sectors and the building up of a new infrastructure for the future.

And the achievements don't end there! We have attracted the European Bioinformatics Institute to the UK. We have taken the decision to develop the new Edward Jenner Vaccines Institute. There has been a report by Professor Kay Davies on Human Genome Research; and the review of UK Microbial Culture Collections by Professor Roger Whittenbury.

#### Summary

*The initiatives introduced by the Government aimed at enhancing the role of women were outlined by David Hunt. The Development Unit on Women in Science, Engineering and Technology were discussed in detail by Mrs Sharp. The role of the Engineering Council was described by Mrs Barton who concluded that considerable progress had been made after a decade; it was necessary, however, to consolidate and increase the WISE initiative. Mrs Barratt said that although more girls now studied science related subjects, there was need to encourage them to become more interested in that area post-16. Greater co-ordination of the effort of the very many agencies currently involved was called for. Dr Ogilvie regretted the fact that so many women fell out of the scientific workforce so soon after training. The Wellcome Trust offered encouragement in a number of practical ways. She concluded with some case studies of women who had reached high positions within science even after career breaks.*

That there was so much work of importance and quality going on was vital to my success in sustaining the Science Budget in real terms next year, in a very difficult PES round.

### ENHANCING THE ROLE OF WOMEN

Let me end my selective list of recent achievements with one of the most important - the decision by the Chief Scientific Adviser, Sir William Stewart, to set up a Committee to consider the issue of Women in Science. We must do everything possible to remove the obstacles which prevent women from realising their potential. Throughout my career, I have taken a close interest in these matters.

As Secretary of State for Employment, I chaired a Cabinet committee responsible for coordinating women's policies across Government. I also launched the "Fair Play for Women" initiative, which involves local groups in developing strategies to enhance the role of women in the local economy and public life.

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\* Chancellor of the Duchy of Lancaster

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Now, as Cabinet Minister for Science, I am taking action to ensure that the best people are encouraged to pursue careers in science.

## THE DEVELOPMENT UNIT

“The Rising Tide” report emphasised that too few women were being attracted into science, engineering and technology. And too few were making it to the top.

The Government has therefore set up a Development Unit in the Office of Science and Technology, to promote the role of women in science, engineering and technology, for national advantage and for the benefit of science.

The Unit’s Head, Lynda Sharp, is working on a range of ideas, which she will shortly be telling us about in more detail.

I am delighted at the positive welcome - and the many offers of support, assistance and partnership - the Unit has received.

## INITIATIVES TO DATE

We have already made significant progress, and I have been able to announce two new initiatives. First, the Development Unit will produce a joint brochure with Opportunity 2000. It will contain a number of case studies highlighting the benefits of family-friendly working practices. The brochure will be targeted at employers of scientists and engineers in universities, government and industry.

Secondly, I have written to all the organisers of this year’s National Week of Science, Engineering and Technology, encouraging them to consider the impact of their events on girls and women.

This year’s Science Week - which will take place between 17 and 26 March - is set to be an even bigger success than last year’s, with over 3000 events. I intend to get to as many events as I can. And I hope that all of you will also lend your support.

## A NEW INITIATIVE

Many of the events will be aimed at children. It is crucial to capture the imagination of boys *and* girls, and help them realise the excitement and value of science.

There is encouraging news at GCSE level, following the introduction of the National Curriculum. The proportion of girls taking GCSE science and maths, and gaining good grades, is now slightly higher than that of boys.

That is promising, for the future. But at the moment the talent in evidence at 16 is all too often lost to science later on. Statistics show, for example, that women represent only

12% of computer science undergraduates, and only 14% of those studying engineering.

We need to make sure that girls are fully aware of the exciting challenges and opportunities which exist in these professions - opportunities which we must ensure are as open to women as they are to men.

For this reason, I am delighted to announce a new initiative between the Science Museum and the Development Unit. The Museum runs a series of exhibitions on contemporary issues in science, technology and medicine. These are known as “Science Boxes”, and are sponsored by Nuclear Electric.

I am pleased to announce that the OST will sponsor a special launch event on the relationship of women to the information superhighway. It will be linked to a forthcoming Science Box on the Information Superhighway beginning in April. Science Boxes begin in London and then tour the country. The tour of the Information Superhighway Science Box is also being sponsored by the Office of Science and Technology.

The Development Unit will be working with the Science Museum to try and provide similar events for future Science Box exhibitions.

## RETAINING WOMEN IN SCIENCE

But just as we need to encourage our best women to *enter science*, so we must invest to *keep* our best brains in science.

Earlier this month, I announced the Science Budget allocations for the coming Financial Year. These contain a number of new initiatives which will keep us at the forefront of world science -including the introduction by the Royal Society of the Dorothy Hodgkin fellowships.

These will be targeted at top-class scientists who have just completed their PhD - a time when, as “The Rising Tide” showed, many women are lost to science.

## CONCLUDING REMARKS

But, if women are to have the chance to realise their full potential, they should not be dependent just on initiatives from Government and the Royal Society. Parents, teachers and employers must all play their part.

The role of the Development Unit is to stimulate new contacts. To bring people and organisations together to generate new approaches and ideas. I believe the Unit will have an important impact in encouraging girls and women to pursue careers in science, to the benefit of us all. I’m sure I can count on everyone here tonight to work with us towards these important ends.

**Mrs Lynda Sharp\***

## INTRODUCTION

I am particularly pleased to be making my first public speech on the activities of the Development Unit in such auspicious surroundings as these. It is just over two months since I took up post as Head of the new Development Unit on Women in Science, Engineering and Technology.

I am fortunate indeed to have been given such a stimulating and challenging job. But the last two months have also

been highly enjoyable due to the positive support received from many of the people I have met.

## ROLE OF THE UNIT

As you have heard, the Development Unit is facilitative in role and operates by stimulating and co-ordinating the actions of existing expert bodies and individuals.

A significant proportion of my first few weeks in office have involved meeting or contacting many of these experts. These have included Marie-Noelle Barton and representatives of Dr Ogilvie’s Wellcome Trust. As well as a

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\* Head of Development Unit, Office of Science and Technology

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number of distinguished members of this evening's audience.

To meet its objective of promoting the role of women, the Unit will *actively* pursue six functions, which are based on the recommendations from the Rising Tide. I have listed them here in an order of progression up the career ladder. They are:

- to raise public awareness of the contribution women can make to science, engineering and technology;
- to ensure access to adequate careers advice ;
- to promote good employment practices;
- to create a catalogue of databases of women in SET;
- and to monitor progress and the impact of initiatives.

## RAISING PUBLIC AWARENESS

The Unit will seek opportunities and ways of increasing public awareness. The Chancellor advised you of two actions taken so far; a letter which was issued to all organisers of this year's National Science and Engineering Week, and the new initiative with the Science Museum.

## CAREERS ADVICE

But if we stimulate enthusiasm then we have to make sure it can be channelled into taking forward a career. The Rising Tide report identified a possible weakness in careers advice. The Unit will therefore work with the Departments of Employment and Education to help ensure that girls and women have access to adequate careers advice.

## GOOD EMPLOYMENT PRACTICES

It is also important that equality of opportunity exists for women who then progress through to employment.

Women represent some 59% of university undergraduates in the biological sciences. The topic is therefore of appeal to many women. But when we look at the statistics for people employed in universities in full-time posts and fully funded by the universities then we find that women represent only 15% of these. This pattern is found in many other employment areas in science, engineering and technology, and is due in part to the problems women face in combining a career with a family.

The Unit will therefore encourage the widespread adoption of positive equal opportunities policies and practices which allow women to combine these two responsibilities. This effort will be targeted at all types of employers. In

## INTRODUCTION

The Engineering Council launched the Women Into Science and Engineering (WISE) campaign in 1984 jointly with the Equal Opportunities Commission to attract more girls and women into science and engineering.

The Engineering Council targets several groups: Girls and women; Parents; Teachers and lecturers; Employers; the Media

## GIRLS AND WOMEN

The Council produces booklets ("Awards, Courses, Visits", GET WISE), posters and videos.

Four buses and one trailer (sponsored by Government departments, industry, universities and other organisations) visit secondary schools to offer hands-on experience of

order to help persuade them, particular emphasis will be given to the economic advantages which may be gained. As the Chancellor has mentioned our first step towards this will be the production of a brochure with Opportunity 2000.

An important aspect of the Unit will be its role in monitoring progress by employers. It will monitor developments by the Research Councils, other funding bodies and universities to remove the obstacles to women in research. It will monitor developments across Government departments and agencies, and within private industry. Where further improvements seem necessary and feasible, the Unit will assist organisations in developing best practice.

## WOMEN AT THE TOP

The Rising Tide highlighted the fact that women are under-represented in senior positions. In 1992 women represented only some 13% of those sitting on SET-related public bodies. It was recognised that something had to be done to rectify this.

The Unit will shortly begin gathering information on the databases of women specialists which exist already. The aim is to hold a catalogue of such databases in order that suitable candidates for Public appointments can be easily identified.

## MEASURING SUCCESS

And finally, how do we know whether we are being successful? Some progress will be readily apparent through the creation of items like a catalogue of databases and future publications. Measuring the impact of implementing these recommendations is more difficult and is still under review, but may include, if feasible, the use of statistics and surveys to measure changes in career flows and perceptions.

## CONCLUSION

Overall, the numbers of women studying science, engineering and technology at university continues to grow slowly. Some momentum is already being generated by forward-looking employers who realise that their future competitiveness depends on having the best people working for them.

But there is still some way to go. The Unit has a full action agenda for the next two years. Through its unique position at the heart of Whitehall it will help remove the barriers to the progress of women, and help to ensure equality of opportunity at every level. I hope that I can count on your support in this important endeavour.

**Mrs Marie-Noëlle Barton\***

technology to girls in Year 9 (aged 13-14). On the WISE vehicles girls are able to sample technology such as CAD, electronic and pneumatics away from the boys. The evaluation of the programme shows that it is a very effective initiative.

Role models of women engineers are invited into schools to discuss their work.

The Engineering Council ensures that awards for girls or groups of girls entering engineering competitions are available.

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\* *Manager, WISE Campaign, The Engineering Council*

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## PARENTS, TEACHERS AND LECTURERS

The Council produces guides of good practice for parents, teachers and lecturers. These are entitled "Engineering Equals".

Teachers receiving a WISE vehicle will be helped by the WISE vehicle's video and information sheets.

The Council holds conferences and seminars to discuss the issue of women into science and engineering with teachers, lecturers and careers officers.

Through its "Opening Windows on Engineering" and "Neighbourhood Engineers" schemes, The Engineering Council ensures that men and women engineers visit secondary schools and promote engineering among young people and teachers.

Finally, The Council gives support to a network for further education lecturers involved in promoting science and engineering for women.

## EMPLOYERS

Following a survey of women engineers and of employers, it was perceived that the most important issue to resolve was that of career breaks. For this reason The Engineering Council published a career break video and booklet.

## INTRODUCTION

I was very pleased to receive the invitation to contribute to this evening's lecture and dinner discussion as I have spent much of my career in education promoting equality of opportunity which has included, of course, promoting the participation and achievement of girls in education and in the advancement of their careers.

My present work in schools includes OFSTED inspection, consultancy and advisory work and draws significantly on my teaching and headship experience in both girls' schools and in large co-educational comprehensive schools, and also on my experience across all phases of education as the Chief Local Education Authority Inspector in the very large county of Essex.

In these capacities, as might be expected, I have always wanted the very best in terms of achievement and career prospects for all pupils and have been involved in a very wide range of local and national curriculum projects and activities to this end, and in close liaison with higher education and employers.

This evening's theme has been central to much of this activity and to much of my work as a whole over many years, and it is one where I feel both a sense of achievement and a sense of frustration. Achievement in that in the fields of both education and employment the participation of women has come a long way, and frustration that in some respects there remains, after so much activity and hard work by so many people, much more to be done.

## ACHIEVEMENTS

I would like to begin by focusing on the achievements:-

The National Curriculum now ensures that all pupils are required to study mathematics, science and technology from the age of 5 to 16.

The inspection of Equality of Opportunity in schools is a statutory requirement of OFSTED Inspection

The Engineering Council is an Opportunity 2000 employer and therefore gives the lead to engineering companies to join the scheme and to make sure that their women employees progress in their career.

Finally, through its newsletter, The Engineering Council informs employers of WISE initiatives and explains how employers can be involved.

## MEDIA

The media is the most powerful and effective mechanism to promote the WISE campaign. The Council issues press releases and articles and holds press conferences for major projects. Staff at The Engineering Council are regularly interviewed on radio and TV on the issue of WISE.

Finally, increasingly, producers invite staff at The Engineering Council to sit on working parties at the early stage of an appropriate programme production.

## CONCLUSION

In conclusion, after a decade, The Engineering Council can see considerable progress with the number of women studying engineering at higher education level having risen from 7% to just over 14% now. However, The Council is not complacent and will therefore expect to consolidate and increase the WISE initiatives.

## Mrs Betty Barratt\*

Girls now do better overall at GCSE than boys: in 1994 nearly 46% of girls gained 5 or more passes at grades A to C, compared with under 37% of boys.

More 16 year old girls than boys (82% compared with some 78%) continue in full- or part-time education.

At GCE Advanced level, girl entrants now score higher success rates not only in English but also in mathematics, physics and technology.

The breadth of opportunity post-16 for both boys and girls is being significantly increased by the introduction of a range of vocational courses within the General National Vocational Qualification, which include manufacturing. All courses focus on the core skills of communication, numeracy and Information Technology.

The proportion of girls in the intake to higher education has steadily increased: over the past decade alone, it has risen from 42% to 47% - therefore parity has nearly been reached.

A recent survey has shown a dramatic expansion in the employment of women graduates. Three out of the ten leading companies studied now take in more women graduates than men. ICL heads the field with as much as 65% of their 1994 graduate intake being women.

If we turn specifically to the hiring of women graduates as engineers, a significant example of change comes from the Ford Motor Company which has increased the percentage of women in its engineering department from 3% in 1986 to about 16% currently. In part, this has been as a result of the changed nature of technology and engineering - it is for example much cleaner, but it has also resulted from a very strong thrust by the company to employ women and also to encourage them to remain at work. In common with many other major industrialists, Ford has developed a whole range of very practical strategies to make careers in

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\* OFSTED Inspector

engineering more accessible and attractive to women. The figure of 16% incidentally is higher than the percentage of women undergraduates currently studying engineering which is about 13%.

## MORE REMAINS TO BE DONE

These achievements represent a very encouraging picture in many ways. But more remains to be done if we are to make the maximum use of the talents of women - described in the *Rising Tide* report as representing nearly half of the civilian labour force.

By the way - the Secretary of State for Education recently challenged the view that girls represented only half our future. Her view is that as while statistically that is the case the sphere of women's influence goes much wider.

So what remains to be done? I would like to conclude my comments by focusing on what I perceive to be some of the key issues which require attention in order to promote the greater participation of women in science, engineering and technology.

Firstly back to school, the recent report of Her Majesty's Chief Inspector of Schools showed that whilst standards in mathematics, science and technology were in many ways satisfactory there were some important areas of concern and these in my view are of direct relevance to the topic being discussed this evening.

For example: *In mathematics* the Report states that pupils are not good at applying their knowledge in new situations and in about half the schools, pupils' competence in numeracy is insufficient - both matters of crucial importance to the creative and practical processes inherent in science, engineering and technology.

*In science* poor standards in primary schools often occur where teachers have insufficient understanding of the physical sciences, in particular, and do not link investigative work to appropriate scientific knowledge. In secondary schools also pupils make less satisfactory progress in investigative work than in other aspects of science, and work in GCSE courses is criticised because of its narrow focus and the insufficiently systematic teaching of the skills of investigative science.

*In design and technology* standards are judged to be lower than in other subjects. The Report acknowledges the difficulties and uncertainty experienced by teachers in relation to the now replaced National Curriculum Order for the teaching of Technology. The same report shows that whereas girls achieve broadly similar standards to boys in mathematics and science, and slightly more girls choose to study technology in the Sixth Form than hitherto, the proportion of girls continuing with mathematics and science beyond GCSE is still comparatively small.

At GCE Advanced level boys account for four-fifths of candidates in physics, and for two-thirds of candidates in mathematics. Moreover, in relation to the quality of teacher training, the report states that in science and technology, students' subject knowledge is insufficiently developed across the content range required within the National Curriculum.

These findings are, in my view, of crucial importance to the question posed in *Rising Tide* on how can we ensure that more girls become sufficiently interested in science, engineering and technology to choose to study the subjects post-16 and to embark upon careers in science, engineering and technology. The quality of their learning and of their experience during the time when the study of the subjects is compulsory is a powerful determinant in relation to whether they will wish to pursue them when they have the freedom to choose; and whilst much progress has been made, much



*The Rt Hon David Hunt MBE MP, Chancellor of the Duchy of Lancaster, introducing the subject "Women in Science, Engineering and Technology - the Opportunities" at the Foundation's meeting.*

remains to be done to ensure that the quality experienced by pupils prior to the age of 16 is of the highest standard.

In choosing to study subjects at an advanced level and to pursue careers in the areas concerned, pupils need to enjoy and be confident about their ability to do well. One of the issues to be addressed therefore is that of confidence and there are two other issues I want to mention which also begin with the letter C.

These are communication and culture. Both in many ways are interrelated and very difficult to address.

To begin with communication. It is important that the changed nature of jobs and careers in science, engineering and technology is made explicit along with the opportunities available for women in these areas.

Recruitment strategies need to be aware of the need to communicate these changes and of the fact that they have to counter what may be the most powerful influence of all - the influence of culture.

## CULTURE

The strength of the peer group culture in particular is a factor we overlook at our peril! Young people have to make important decisions about their future at a time of their lives when they are very vulnerable - when, for example, they are seeking the approval of their peer group, not wanting to be perceived as different. Girls wanting to be liked by the boys and not wanting to be seen as a challenge. Not all girls but the problem is still there for some!

In addition, there is, despite the many changes which have occurred in our society, the on-going expectation in many cases, that women take the main responsibility for child rearing; and of course there are the very strong cultural influences of the religions and traditions of the different ethnic groups within our society.

In our work with schools we have, for example, come across instances where careers teachers have told us of Asian girls especially whose traditions and culture make it

difficult for them to enter careers which are not seen to be compatible with those traditions. The evidence at the Ford Motor Company bears out this view - despite carefully targeted graduate recruitment drives - there is a lack of Asian women among the engineers employed by the company.

Some of these issues are more tangible and easier to address than others and certainly although some of the problems in education seem to have been with us for a long time, gradually many of them are being addressed - and there are structures in place to help this to happen.

## Dr Bridget M Ogilvie ScD FIBiol, FRCPATH\*

### INTRODUCTION

I am greatly honoured to receive this prize and I am particularly happy to do so in the presence of Lady Lloyd and Mrs Edwards, Lord Lloyd's widow and daughter. Thank you very much indeed for conferring such a distinction on me. It is a great encouragement, and I am happy to accept it not only on my own behalf but also on behalf of all my colleagues at the Wellcome Trust with whom I am glad to share this honour.

The theme of this meeting is the opportunities for women in science, engineering and technology. In my talk I will describe how women are getting on in the world of biomedical science by reference to the support of women scientists by the Wellcome Trust. I will give a few statistics, report some of the results of an opinion study we commissioned, and then describe some case studies of the ways in which the Trust is helping women to stay in or return to work.

### ANALYSIS OF TRUST AWARDS

When we analyse the numbers of men and women holding our various awards, we find that slightly more women than men hold our Prize Studentships which are won by graduates wishing to obtain a PhD degree. Immediately after this, however, the ratio of women to men changes to the progressive disadvantage of women and, at the most senior level, there are at least 8 men to every woman. This is not because women compete less successfully than men: when we analyse our results according to their relative success in winning awards in competition, women do as well as men. Why then do women fall out of the scientific workforce so quickly after completing their postgraduate training? It is important to address this situation for economic reasons as well as on the basis of equity. We calculate it costs about £200K to train a graduate in research (5-8 years post BSc).

### OPINION SURVEY

We commissioned an opinion survey by our Policy Research in Science & Medicine Unit (Women in Science: attitudes of university students towards a career in research: a pilot study. M O'Driscoll & J Anderson. *PRISM report No 4*). Undergraduates and postgraduate women and men in the departments of physics and biochemistry at Leeds and Cambridge universities were asked to comment by questionnaire and interview on a variety of propositions. Today I will give just two examples of the results. The first shows that women even more than men agreed that they do not need role models to stay in science. I was not surprised by this result

The important matter I believe is that sight is not lost of any of the issues which influence, in one way or another, the advancement of women's careers in general, and in science, engineering and technology in particular; and that there is a far greater co-ordination of the effort which is being made to this end by the very many agencies currently involved. A well co-ordinated effort by all those who share a common goal is far more likely to succeed than one which is fragmented.

as my personal prejudice is that the concern with "role models" is an American preoccupation which does not fit the UK scene especially well. The second indicates that women and men too feel that scientists work too hard. In general, this study suggested that women felt that more effort is needed to make both undergraduate courses and laboratory life more "woman friendly".

### CASE STUDIES

To turn to practical matters, all Wellcome Trust awards can be held on a part-time or shared basis and when considering eligibility for awards, years of post doctoral experience rather than chronological age is the determining factor. I am glad to say too that all posts at our office can be held on a part-time basis. At present we have 34 (out of 290) staff working part-time, and this includes 1 man who has elected to go part-time for a period after the birth of a child.

To encourage people - mainly but not only women - who have trained as scientists at the postdoctoral level to return to work after they have taken a career break, we set up a scheme of re-entry fellowships. These allow returnees to spend about a year retraining, and then have 3 years to undertake a research project. Two awards have been made. After 8 years out, Dr Alison Howorth can now return to the School of Biological Sciences, University of Manchester, to work with Professor Maynard Case on "Characterisation and expression of a pancreatic NaHCO<sub>3</sub> co-transporter", where she will work 60% time for the first 2 years. The second is to Dr Angela Coutts who wants to return to the Department of Biomedical Sciences, University of Aberdeen, after a 12-year break. She will work with Dr Roger Pertwee on "Mechanisms underlying the smooth muscle relaxant effects of cannabinoids".

Apart from these special fellowships, the Trust supports women in many different ways. Professor Jenefer Blackwell, a sadly rare example of a female biology professor, is now Glaxo Professor of Molecular Parasitology in the Departments of Medicine and Pathology at the University of Cambridge. She was supported previously by the Wellcome Trust for 15 years in various ways at the London School of Hygiene and Tropical Medicine to undertake her research on the genetics of the host response to infection by the protozoan parasite *Leishmania*. Like me, she has survived very well in the UK without having to endure the "gold standard of the A-levels system", because we were both educated to graduate level in Australia. Although she has two children, Jenny has always worked full time and she is known to be an excellent mentor for both men and women. For example, currently she has Dr Nancy Miller working with her as a part-time technician, after taking a 10-year break from a successful research career to raise a family.

\* Director, Wellcome Foundation



*The Lord Butterworth CBE DL (third from left), with the speakers.*

*From left, Mrs Lynda Sharp, Dr Bridget Ogilvie, Lord Butterworth, Mrs Betty Barratt, the Rt Hon David Hunt MBE MP, and Mrs Marie-Noëlle Barton.*

Whilst analysing another group which receives considerable support from the Wellcome Trust, I came across two more women scientists who have returned to scientific work after a career break. Dr Cay Kielty is a molecular biologist working at the School of Biological Sciences, University of Manchester, who took 4 years off, then won a Wellcome Trust post doctoral research fellowship before being awarded a 5-year MRC Fellowship. Sue Craig is a technician who has returned to work part-time, encouraged both by the Trust and by her colleagues at the University of Manchester. Both these women work in a research unit headed by Professor Mike Grant. This illustrates a key, to me probably **the** key factor in ensuring better career opportunities for women scientists - which is that because leadership positions are mostly filled by men, opportunities for women are largely in their hands. Thus, the attitudes of men are vital for the careers of the majority of women.

I am delighted that the Foundation of Science and Technology, overwhelmingly run by men (there are 32 men in the 34 names listed on your writing paper), is taking such an interest in opportunities for women. I appreciate too the high profile that this important topic has in the activities of the Government's Office of Science and Technology. As I have earlier indicated, there can be no more cost effective way to increase the numbers of people in science, engineer-

ing and technology than by improving the retention in work of trained women.

To end on a personal note. Throughout my professional life, I have worked in male dominated worlds. To illustrate, I was the only woman in my graduating class and all my university teachers were men. Fortunately, at all stages my male mentors have been wonderfully supportive and encouraging. The Dean of my undergraduate faculty was delighted when I asked if I could join the first group of students in his new course at the beginning of their second year. I was amused at his comment "That will make those fellows work!" And it did - following my arrival, the average mark jumped 15 points. I am aware that not all women are fortunate enough to have supportive, encouraging male mentors. The fact that I did a new undergraduate course and became a research scientist in fields that were quite new and growing rapidly, immunology and experimental parasitology, was probably greatly to my advantage.

I have only once before won a prize that had money attached and that was awarded me by the Dean of my undergraduate faculty on the basis of our final year examination results. I confess that I spent it all on a beautiful evening dress and a black wool stole - and I regret to say that although I am no longer the hard up new graduate that I was then, I will almost certainly spend at least some of your Prize on something equally frivolous!



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# ZUCKERMAN LECTURE

The annual Zuckerman Lecture was given by Monsieur François Fillon, French Minister of Higher Education and Research, on 19 January 1995. It was a joint meeting with The Office of Science and Technology on behalf of the Duchy of Lancaster, held at the One Great George Street Conference Centre. The Rt Hon David Hunt MBE, MP and the Lord Butterworth CBE DL were in the Chair. The sponsors were Amer-sham International plc, AEA Technology, Generale des Eaux UK and Rhône-Poulenc Ltd.

## STRATEGIC DIRECTIONS OF FRENCH RESEARCH POLICY

### Monsieur François Fillon\*

#### INTRODUCTION

I would first of all like to say what an honour and pleasure it is for me to be here in London to give the internationally renowned Zuckerman lecture. I wish to extend my heartfelt thanks to the Chancellor of the Duchy of Lancaster, Mr David Hunt, and to William Waldegrave for having asked me to perform this important task. In particular, I would like to pay tribute to you, Mr Waldegrave, for the role which you played in bringing our two countries closer together in the fields of science and technology when you were Minister of Science.

I noted with interest the recent co-operation agreement between "Le Monde" and your excellent scientific magazine "Nature". I wish today to discuss the research policy pursued by France and to share with you my belief that in our complex world, governments and public policies must continue to play a fundamental role in the organisation and promotion of science.

When we question the role which research must play in our society, we are inevitably struck by the changes which have taken place in recent years. What first occurs to us as citizens or policy makers is that something has changed in our perception of progress. And this initial observation is far from being rhetorical, so profoundly affected have we been by the change.

Over the last twenty years, the domain of scientific activity has indeed undergone a profound cultural, economic and social transformation. From the beginning of the eighties through to the nineties, doubt has taken hold of our minds.

Of course, this can be explained by economic crisis, alienation, inequalities, the loss of traditions and memory, the dangers inherent in international turmoil. However, perhaps there is an even deeper cause: man is now confronted by the exponential complexity of problems in all areas of his working life.

We are becoming increasingly aware of our growing lack of control over phenomena, of the diversity of the challenges facing us, and of the numerous connections linking our planet. Given the increase in international exchanges on the one hand and the search for individual identity on the other, our social and political institutions appear ill-equipped to deal with the change. Doubt is rooted in this confused understanding of the world, in this difficulty in perceiving reality.

#### Summary

*As his contemporaries in Great Britain have stated on many occasions, Monsieur Fillon referred to the increasing complexity of science and the need for science to encourage public debate and to adapt itself to the needs of society. He described the way in which French research is organised, the need to cater for national priorities and the co-ordination of national research policies with the internationalisation of science, notably within the European Union.*

As a result we are tempted to seek some form of distraction which increases our fear of the future. This fear is not peculiar to France or Europe, but is felt by the whole of the Western World. And science is clearly not immune to this phenomenon.

Having been called upon to carry out increasingly diverse tasks, the sphere of scientific activity has expanded appreciably. Through the increase in the number of players and their relations, both on a national and an international scale, research has become an extremely complex system. The increase in knowledge has now reached the stage where science compels man to ask fundamental questions as to the ethical limits of his interventions in life sciences. Finally, the equation research-technology-employment is no longer as linear as the over-simplified slogans of not so long ago had us believe.

Although the public continues to be fascinated by the sciences, there is however some doubt as to the true capacity of research to maintain itself as the rational discipline within our societies. The belief in progress brought about by the advances in knowledge is paradoxically undermined by the very same scientific and technical power which threatens our values, our way of life, our natural environment.

Without becoming overly alarmist, we must not underestimate this possible negation of the foundations of our modern culture, which the French have perhaps too hastily likened to the legacy of the Age of Enlightenment or the 1798 revolution, whenever we think of the importance of European philosophy of the Classical Age.

Faced with this threat to our values, the most dangerous reaction would be to yield to fatalism. More so than others, the scientific community has the responsibility of not being influenced by prevailing attitudes and not giving in to disenchantment while, in my opinion, politicians have an obligation to be vigilant and clear thinking, but, in particular, imaginative and audacious.

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\* French Minister of Higher Education and Research

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In view of the increase in the irrational, the para-scientific, and indeed the anti-scientific, we must now, more so than ever before, give problems a vision which contributes to their understanding. We all recall the Heidelberg appeal in 1992 denouncing "the irrational ideology" which occasionally surrounded the beginning of the ecological movement. Beyond the issues at stake, the signatories had sought to emphasise the need to apply a truly scientific approach to ecology.

The only way to respond to complexity is by constantly increasing our search for knowledge and our research capacities.

In order not to yield to fatalism, we must also view science as a remedy to the problems of society, although it must never claim to hold all the solutions. Scientific research and technological development represent a huge asset in overcoming this crisis, an asset whose importance increases year after year.

We must intensify our efforts to understand the scientific mind, to popularise science and to encourage the participation of the public in scientific debates. The world of research must therefore enter into a dialogue and explain, explain tirelessly. The world of politics must draw up clear objectives to show that the present difficulties, however serious they may be, have a solution, that the crisis is a transitional phase and that a better world awaits.

## NEED FOR SCIENCE TO ADAPT TO NEEDS OF SOCIETY

However, in order not to yield to fatalism, science must adapt itself thoroughly to the needs of society through the bringing together of scientists and non-scientists and through the marriage of knowledge and cultures.

This means that each individual researcher must endeavour to take into account the demands of society. It also means that their voices must be heard more and more in public debates, not only on scientific matters, but with regard to our collective concerns as a whole.

In order to achieve this, we must, particularly in France, overcome two traditional divisions which could hinder this relaying of social needs.

The first concerns the relationship between research and higher education. You are aware that in France high-level research is organised in a particular way, comprising, on the one hand, the university system and, on the other, large public research bodies controlled by the State. Training in and through research must be developed in the universities, while the public research bodies must participate more fully in higher education. This is all the more important now that the number of students enrolled in higher education in France is at an all-time high. It was precisely to encourage this coming together that the Government decided to combine universities and research within one ministerial department for which I am responsible.

A second division used to separate research and industry, and still occasionally does in France. This division is destined to become less marked as their mutual needs become more and more evident. Indeed, businesses have recourse to the know-how of public research, particularly for all matters relating to basic research, while the public research bodies must work at incorporating their links with the business world into their activities.

In order to re-invest science with all its power to enable society to thrive, and in order to prevent institutional divisions from hindering the role which research must play within our economies, we must come up with a policy response to scientific challenges.

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## ROLE OF THE STATE IN FRANCE

Both the historical and the current circumstances surrounding French research, and in particular the importance of public bodies such as the CNRS (The French National Centre for Scientific Research), explain why in France the Government must play a major role in the conception and implementation of the research policy. We live in a world in which the organisation of scientific activities is becoming increasingly difficult. A research policy is built on a medium- and long-term basis and entails an overall vision, a future vision of the country's higher concerns and of international co-operation.

As you listen to a French minister talking about the role of the State, do not be tempted to believe that nothing has in fact changed on the Continent. I shall try to convince you by showing, by means of a quick look back through history, how this role has changed in the post-war years, how it has alternated the good with the not so good, and why we now feel that it is important to reinvent it.

With regard to the dynamic role played by the State in the field of science and technology in France, we need only think of the numerous achievements which have enabled us to consolidate our industrial potential. It is clear that the leading positions occupied by France in nuclear technology, transport or aeronautics are the result of the political willingness, shown since the 1960s, to undertake major projects. It was precisely during this period that science and research became - to borrow a famous expression - "l'enfant chéri" (or favourite child) of the 5th Republic, through the impetus given it by its founder. General de Gaulle had indeed forecast the crucial role which research and technology would play in the modern era in the economic and social development of France, contributing to its international influence and its sovereignty.

It became a priority in the activities carried out by the Government and has remained so over the last thirty years, with the result that France today occupies fourth place worldwide with regard to the amount it spends internally on research and development and first place in many disciplines and achievements. The High-Speed Train, our nuclear potential, our space industry and our achievements in biology and genetics are the fruit of the efforts rooted in the past and constantly encouraged by the Government right through to the present day.

However, the State has not always played such an eminently positive role in encouraging research and technology. The last decade proved in particular that too interventionist an approach coupled with the temptation to implement technological "colbertism" (patronage) tended to impose on French research too rigid a framework, which impeded mobility, innovation, efficiency - in short dynamism. Although a certain programming of public resources allocated to large installations, applied research and the transfer of technologies can be justified, on the other hand it appeared illusory to seek to lead discoveries in basic research.

At the same time, it had to be acknowledged that it was inevitable that a situation more in keeping with the resources actually available had to be returned to. Sooner or later choices had to be made, whereas for too long we had believed that we were capable of anything. These choices are all the more difficult given that a research policy is based on continuity and stability. Although our research budget continues to represent one of the most sustained rates of growth among the countries belonging to the OECD (3.8% annual growth in 1994 and 1995), choices have to be made and will continue to have to be made with regard to the growing cost of large-scale scientific and technological programmes.

These choices involve the planning of the financial effort required and, in particular, a continually revised strategic vision, to guide scientific and technological policy.

If I began my talk by referring to the new needs of society, it was to emphasise the fact that the role of the government must be adapted to the new scientific and social circumstances. In this respect, the State must take more account of the aspirations of the majority and reinvest in research, but reinvest itself differently.

Without intervening too directly or imposing restraints on research, the government must nevertheless draw up a policy capable of instilling dynamism and direction into the field of science. Such a policy involves the co-ordination of various activities. I have chosen to consider three principal areas which serve to illustrate the policy which I have been implementing for the past two years. These three areas correspond to three different but complementary levels of activity. In the development of research and technology, the Government in France must intervene at three levels simultaneously: the research community, the major national priorities and, finally, European and international co-operation.

## THE RESEARCH COMMUNITY

At the level of the researchers themselves, the challenge lies in taking into account both the public dimension of the scientific work and the indispensable autonomy of the researchers. The Government's main task in this respect is to listen closely to the scientific community on a regular basis.

This is what I did during a Consultation which commenced in June 1993. This was in fact when I launched the national Consultation on the major objectives of scientific and technological research, which mobilised thousands of people in an extensive and particularly intense debate lasting almost a year. This in-depth dialogue made it possible to intensify talks between government, researchers and industrialists, and allowed different priorities to emerge.

The first priority to emerge was to take account of the fact that research is managed on a long-term basis and that it is particularly important to provide it with the means required by a stable and continuous activity. This means the maintenance and increase of the monies granted by the State for the financing of public research so as to guarantee the acquisition of, and access to, knowledge. Each individual, in whichever discipline or scientific field, must be assured of the opportunity to achieve excellence, provided there are rigorous evaluation procedures.

Whereas other major research countries tend to have a sizeable private patronage system, in France it is the Government which is responsible for guaranteeing a fundamental research programme offering a real possibility of long-term excellence. Our public research system can become a strategic asset to the country, provided that it can be targeted at real priorities and is truly competitive in the field of science as a whole. During periods when risks or difficulties accumulate, we must make sure that the granting of public funds is not based on criteria which establish too clear-cut a distinction between basic and final research, academic and industrial research, certain scientific and other domains.

Although we must underline the usefulness of research in terms of economic and social progress, placing the emphasis on the transfer of the results obtained, we must not lose sight of the need to provide resolute support for research deemed unprofitable according to the criteria of the time. I cannot think of a more futile debate than that which aims to oppose basic and applied research. Both forms of research are essential if scientific potential is to be maintained at the

highest level. Japan proved this when it recently decided to expand its research base to a considerable degree.

The above entails very significant financial consequences. It means being capable of undertaking long-term commitments in the field of research as well as being able to maintain activities given a high priority.

A long-term commitment in the field of public research today means not only guaranteeing an adequate research budget, but the capacity to plan and maintain a sustained effort involving the replacement of successive generations of researchers. Do not forget that French public research bodies comprise some 50,000 researchers, all of whom are government employees. This is a matter of fundamental importance for the future of French science. The reality of the age pyramid, with regard to both researchers and teachers-cum-researchers, fully reveals the severity of the challenge ahead. Over the next six years, a great number of young researchers will have to be employed to counter the increasing number of retirements.

More than half of the researchers and research engineers in the public sector are currently over 45. By the year 2005, the number of teachers-cum-researchers retiring will double, while the number of researchers retiring from government bodies will triple. Thereafter, this trend will increase further.

Productivity levels may increase. However, maintaining our research potential depends on the State's capacity to avoid a falling off by ensuring a constant flow of new employees. We currently estimate this flow to be 3% per year over ten years. Quality must also be guaranteed, not only in relation to the young doctors, but also in respect of the support personnel whose importance within the laboratories is acknowledged by everyone.

Following the national consultation, the Government decided to create a plan to run over ten years to enable these people to be replaced. Once again, it is essential to ensure that people are regularly recruited to avoid "bunching", which ruins the communication of knowledge from one generation to the next. This plan will allow the scientific and technical employment policy to be renewed by introducing a future-oriented differentiation in needs by discipline and by organisation. In this way, the State will be in a position to meet the minimum requirement of an average annual 3% staff renewal rate for the period 1995 to 2010.

## NATIONAL PRIORITIES

However, it goes without saying that this commitment must not prevent specific support being given to priority areas. Moreover, the importance of such priorities has been considerably strengthened in recent years for a variety of reasons.

The first reason relates to the increasing complexity of knowledge, which I referred to at the start of this evening meeting. The most complex scientific subjects - I'm thinking of biology, climatology, materials and even process engineering - are nowadays beyond the scope of a single discipline. They require the skills to be combined in a number of different disciplines.

A second reason is that a prerequisite for the implementation of such multidisciplinary skills involves partnerships with public organisations and industry. The French have been undeniably slow in this field, and I have been able to assess the extent of this dilatory action. Of course, there are numerous ties and joint undertakings between the two worlds of public research and industry. For example, in agronomics public research has been able to combine basic research and finalisation in an ongoing dialogue with the farm produce sector. Further examples can be found in the

major sector-based programmes, implying a strong partnership between public research and the largest industrial groups, as in nuclear and biotechnology.

We now need to change up a gear and begin a strategic dialogue between industry and public research bodies on the choice of new, combined programmes and the joint planning of objectives, taking into consideration socio-economic parameters in addition to the spin-offs that the public has a right to expect.

However, there is also a need to apply this type of approach to sectors which have not traditionally been involved in the most recent scientific advances, such as small and medium-sized industries or sectors with only an average use of technology. In this field, the state has a key role to play. In this area there can be no single model: tried and tested solutions are adapted to each case according to region, company size and the sectors in question. If we agree to attach greater importance to reasoning by demand of companies and no longer solely by supply, it emerges that several needs are inadequately met.

Development and industrial research are in conflict with the issue of finance in France. The production of a prototype costs ten times as much as a laboratory model, whilst development and industrial manufacturing can cost between 100 and 1000 times as much. France has managed the financing of laboratory models relatively well, has done less well where prototypes are concerned and has almost completely failed when it comes to development. It is precisely at this latter stage where there is most need. In order to obtain over five million francs for a research project, you either need an industrial group large enough to be able to dip into its cash flow or be part of a major national programme largely financed by the State.

Unlike the English-speaking world, venture capital is relatively underdeveloped in France through the lack of a solvent market where shareholdings could be resold: the failure of the second market of the Paris stock exchange is a handicap in this respect. Similarly, we have not sufficiently developed research companies under contract, which have the advantage of working on specific subjects financed by the payer, which is the company requesting the research.

My department is currently studying the possibility of helping small companies to overcome the cost barrier involved in moving from the results of research to actual production by financing the various stages of development. The State must endeavour to create the conditions favourable to this type of mechanism by encouraging the investment of capital in the market to facilitate the financing of innovation. Finally, the leverage effect of public investment must be put to better use through technical expertise and the granting of bank guarantees downstream for the industrial launch and development of successful market-oriented projects.

The need to develop priority actions, the parallel objective of giving more effective support to the partnership between public institutions and industrial research imply the need for those involved in research to adapt constantly. Men and women in research will increasingly follow multi-functional careers. This presupposes that administrative constraints which, as you can imagine, are not small, do not prevent people alternating between research work within an organisation or a university, training in a higher education establishment or innovation in business and internationally.

For this to happen we need to sanction and set in motion a national research strategy.

The national consultation stressed the inadequacy of our national strategy linked to this inflexibility in state decision-making which I mentioned. I decided to address this shortcoming by creating a Research and Technology Strate-

gic Orientation Committee, which began work last week. This committee is also inspired by models in the main western countries and particularly your Council for Science and Technology set up in 1993 as a result of the White Paper on science and technology prepared under the aegis of William Waldegrave.

The members of our Strategic Orientation Committee, like those in the British Council, are leading players in the scientific community, the socio-economic world and business. Furthermore, the make-up of the Committee reflects all fields of knowledge including mathematics and physics, chemistry and the life sciences, social sciences and industrial research.

This Committee will constitute the Scientific Council of the Minister for Research. It will be responsible for helping the Government define, upstream, the main directions guiding French research policy. Our action plan lacked a central axis to develop such a strategy. The Committee is therefore a close-knit structure qualified to think about future developments.

The type of issues it will face will therefore range from the actual strategic forecast itself to the scientific identification of actions to be undertaken on a daily basis by our researchers. One of its main tasks will be to prepare with the Minister an annual report on national research strategy, or what you know as a White Paper. Each year, this report will be the subject of a debate which will take place in Parliament. Presented by the Minister, the report will describe both the activities of the Committee and the leading orientations set up by the Government.

In this way, the Committee will enable the Minister for Research to bring together the universal and unifying will of all endeavours, the will of the whole nation, which will also enable us to forge meaningful international relationships.

I believe by now you have understood that if we in France are convinced that the State still has a major role to play in research, this role must be different to the one it has played in the past. A role of strategic orientation and no longer the tight control of scientific and technological endeavour, a supporting role throughout the long period of financial and human investment to be agreed: in a word, a more competitive national research policy which is more in line with the internationalisation of science.

## THE INTERNATIONAL DIMENSION

It seems to me that as far as the European Union is concerned, basic research has to be considered as a field which cannot a priori lend itself to a transfer of competence at Union level. France would not relinquish such a crucial factor determining its future. It is only when this premise is admitted that a research strategy belonging to each member state becomes meaningful, for it then becomes compatible with building a Europe of research. It is even an essential part of it.

It is only by fully integrating the international dimension in our national ideas on strategy that we will be able to decide clearly how and why carrying out such research activity or constructing such expensive equipment must be a matter for common scientific interests, for the sharing of financing costs or for an addition to national budgets. This decision must be taken in conjunction with the other States, it must correspond to their interests.

This should not be regarded as a backward idea of Europe, but as a rational realism without which the building of Europe in terms of research and technology would risk being engulfed by complicated technocratic procedures. The adoption of the Community framework research pro-

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gramme and the management of invitations to tender are already exceptionally unwieldy and complex. If we fail to react, the very legitimacy of such a noble ambition will be compromised in the long term in the eyes of both researchers and industries.

Since 1 January 1995 France has assumed the presidency of the European Union for six months. We are intending to draw our inspiration from three clear principles in this regard: strict respect for subsidiarity, strengthening of the political role of the Council, preparation for the enlargement of the Union and the inter-governmental conference of 1996. In this spirit, one of the subjects which I believe is of particular importance - and I do not believe I am mistaken in saying that Paris and London are in agreement on this point - is the necessary reform of CREST in order that the Council can finally have a permanent high-level body to debate the major issues of European research.

Beyond the Community aspects, it is a question of conducting consecutive multilateral negotiations on the worldwide application of research in disciplines requiring large-scale equipment. Due to the co-operative mechanisms they require, their large budgets or problems of future prospects and assessment, we must be particularly vigilant as to the position and status of European science within these multilateral programmes.

I will take the example of the European Synchrotron Radiation Facility, which has just begun operations. The ESRF represents a considerable investment. It proved possible to construct this just within the budget initially set, which is unfortunately exceptional for major international projects. All this is evidence that an undeniable scientific advance has been taken over by common political will.

The European dimension of science is today a reality. From the creation of CERN (European Organisation for Nuclear Research) in the nineteen fifties to the more recent prominence of Community programmes, four decades have seen Europe become the second largest power in science and technology, after the United States but ahead of Japan. This effort must be sustained as it affects our common future in international competition.

Despite the fact that in numerous fields Europe has become a natural area of co-operation, does the road we have taken mean that we have a true Europe of science, able to face the challenges of the future? For my part I am convinced that much remains to be done to combine our strengths, consolidate our experience, launch new initiatives and, particularly, to breathe into all of this a true strategic vision equal to the global scientific challenges.

We will have to approach this endeavour in a different context to the past. Such a context undoubtedly has more difficult considerations, which must clearly be taken into account. As far as institutions are concerned, since the Maastricht Treaty we have entered into a phase of doubt over the destiny of Europe, which affects the Community's capacity for mobilisation. The gradual opening of the framework programme to third countries alters its foundations. It is inevitable that the structures and mechanisms of Community research will have to be adapted to the threefold imperative of the globalisation of fundamental research, the opening up of the Union to central European countries and the consideration of new social challenges.

Despite our often well-founded criticisms of Brussels, we must both prevent Community enthusiasm turning into inertia and invent new institutional, financial and political forms for European scientific co-operation. Our priority must be the scientific optimisation of all projects which are necessarily undertaken by means of an agreement between Europeans. It is this scientific optimisation which must play

a determining role in the definition of forms of co-operation and not the reverse.

Everything must be done to avoid the construction of a scientific Europe being locked in too formal an institutional approach, which creates problems rather than solving them.

The dimensions of new projects involve investments and operating costs beyond the scope of each European nation taken individually. My belief is that the Europe of research must lean on this will to give heart to large scale projects, projects which give rise to ad hoc, effective organisations even beyond the framework of the Community. In the future, we must do our utmost to explore this logic of free association for each case and institutional modularity according to the scientific fields in question and both interests and capabilities. To this respect the ESRF is a model.

The promotion of a strong tie between leading edge research and industrial innovation presupposes the existence of scientific and technical centres of European dimension for the installation of large-scale equipment. The promotion of a Europe of science involves the creation of such centres which enable a critical mass on an international scale to be concentrated in one place, capable of gathering together scientists and industry regardless of their nationality, discipline or field of activity.

You are well aware that the question of the choice of a site for a major project of this type is generally the subject of bitter discussions. I read with interest the recent report of the House of Lords on international investment in British science. The European choice of France as host country to the ESRF and the national choice of a site such as Grenoble within mainland France undeniably represent major gains for our national development policy. These factors demonstrate that France has made an exceptional effort as the leading participant in the construction of this machine. They also explain our recent decision to agree to make an exceptional effort in building the LHC, which guarantees the future of CERN and Europe at the highest level worldwide for high-energy physics.

In addition to the exemplary nature of the original forms of European scientific co-operation, the CERN and ESRF ventures must encourage us to reflect on the general problems of large-scale international scientific equipment. For large-scale equipment, which can only be constructed by means of global co-operation, Europe must also be in a position to exert influence as a major player in multilateral negotiations.

Our governments must take into account the changing form of the multilateral scientific challenges facing us. It is particularly important to ensure Europe's place in these projects and to prepare to allow the Americans and Japanese to participate in European large-scale equipment, without changing the nature of our objectives, neither from a scientific nor an institutional viewpoint. At the same time we must respond to the aspirations of the countries of central and eastern Europe which wish to benefit from gradual access to this equipment.

To achieve this, the Europeans must be able to speak with one voice, when they so wish, in negotiations with Washington and Tokyo. This is what we did with the recent decision on the LHC, a decision which demonstrates the resolution of the member states of CERN to move forward, among Europeans, prior to discussions with third countries.

As for other large-scale equipment planned - I am thinking of the thermonuclear fusion with ITER or even the space programmes of tomorrow - they are increasingly the subject of multilateral discussions in the OECD Megascience forum and at informal meetings of the Carnegie group. Taking into consideration the importance of the scientific issues raised and the growing financial cost of the equipment in question,

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it seems to me essential that the Europeans are able to co-ordinate their position in these negotiations. To this end, I will propose to my European colleagues in the near future the idea of organising an annual meeting of ministers responsible for research on the question of large-scale scientific equipment. The objective would involve exchanging our points of view on this subject on a regular basis and improving co-ordination of our policies in order to develop common positions to assure the status of European science within major multilateral programmes.

## CONCLUSION

We all know the difficulties which arise with regard to the organisation of an economic and monetary Europe. We know the obstacles the political construction of the Continent must overcome. I believe that in this area we have much to learn from European science on a daily basis. It teaches us that there is a Europe which works, a Europe of which relatively little is known but which constitutes an increasingly powerful reality. This Europe is the Europe of Research and I am convinced that on this subject, France and Great Britain have much to do together.

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# Foundation News

## JOINT EVENT WITH THE ROYAL SOCIETY

*"GROWTH IN  
COLLABORATION OF  
SCIENCE AND TECHNOLOGY  
FOR INDUSTRIAL GROWTH IN  
CHINA AND THE UNITED  
KINGDOM"  
1 DECEMBER 1994*

Professor Hu Qiheng, who had visited Britain a year before and spoken to the Parliamentary and Scientific Committee, flew from China specially to address the joint evening meeting of the Foundation and the Royal Society. The talks were held at the Royal Society, and the dinner discussion at the nearby Institute of Materials. The Chinese Ambassador in London introduced Professor Hu at the joint meeting.

Professor Hu spoke about the development of science in China, and she was followed by Professor Kuma Bhatlacharyya from Warwick University. Both had close dealings with scientists and with industry in China. Then Mr D'Arcy Payne, Director, Corporate Services from Rolls Royce, joined them both for answering questions during the discussions. The talks provided the basis for the discussion at the dinner which was given a Chinese flavour by a gift from the Chinese Embassy of Great Wall white wine.

The Foundation's Council is grateful to Dr Richard Haas for his assistance in organising this event.



*From left, Baroness Platt of Writtle, Professor Hu (Vice President of the Chinese Academy of Sciences), Mrs Ma, wife of the Chinese ambassador, and Dr Nancy Lane at the joint event with the Royal Society.*



*The Chinese Ambassador, Lord Butterworth and Dr Richard J Haas enjoy an exchange during the joint event.*

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# PROFILES OF COUNCIL MEMBERS

## Sir Richard Sykes

Sir Richard Sykes, a member of the Foundation's Council since 1994, has been much in the news since his move in 1993 from Chairman and Chief Executive of Glaxo Group Research Ltd to Deputy Chairman and Chief Executive of pharmaceuticals giant, Glaxo plc, now Glaxo-Wellcome plc, the transition from scientist to businessman inspiring such headlines as: "From Labcoat to Pinstripes" (*Telegraph*) and "From Bunsen Burner to Boardroom" (*Observer*). Media interest has been particularly keen since Sir Richard Sykes masterminded Britain's largest takeover with a £9.1 billion bid for Wellcome plc, securing for Glaxo-Wellcome the position of world leader, overtaking Merck, with 5.3% of the global drugs market, although Sir Richard is ambitious for a "not unreasonable 10%" in the future. "Suddenly the market has turned 180 degrees" explains Sir Richard (Wellcome's anti-herpes drug Zorivax will go off patent in 1997). "The protected market for pharmaceuticals was breaking down and the industry had to consolidate. We decided to be the leaders in that process rather than being swept along by it" he explains. "This merger will create a world leading pharmaceutical group at the forefront of research and technology and product innovation."

Although, he says "I have not worked directly in a laboratory since the early 1980s", Sir Richard Sykes considers his scientific background a definite advantage: "We are a Research and Development driven organisation. If that is the future of our business the Chief Executive had better make sure he gets himself directly involved with that part of the business." Glaxo and Wellcome spend nearly £1.5 billion a year on research, "The new products are our future. Once a molecule is created or discovered, we move to development and manufacturing and marketing and sales. However, we must never lose sight of the fact that innovation is what Glaxo is all about."

Sir Richard left school at 16 to work in the Pathology Laboratories of Huddersfield Royal Infirmary. He graduated from Queen Elizabeth College, University of London, with a first class Honours degree in microbiology. He obtained his doctorate in microbial biochemistry at Bristol University where he read for his PhD with Sir Mark Richmond as his tutor, who recalls Sir Richard's tremendous commitment and energy and his important research into the transfer of antibiotic resistance between bacteria. "I knew exactly what to do and that was read for a PhD in antibiotic research", says Sir Richard Sykes.

He joined Glaxo Research at the age of 29 in 1972 as Head of the Antibiotic Research Unit, where he developed an antibiotic which is now used throughout the world. His achievements during his five years at Glaxo led the American group, The Squibb Institute for Medical Research, to offer him the appointment of Assistant Director at the Department of Microbiology, becoming Director of Microbiology in 1979. He then went on to become Associate Director of The Squibb Institute and was made Vice President of Infectious and Metabolic Diseases in 1983. Of his decade in the US, Sir Richard recalls being infected with a dynamism peculiar to the place: "The enthusiasm there is amazing - if you tell a New York taxi driver that you earn £1 million, he says 'Great, I'm going to night school to learn what you're doing!' If you tell a London cabbie, he just swears at you."

Sir Mark Richmond remarks on Sir Richard's tremendous drive, which he demonstrated on rejoining Glaxo in 1986, when he astonished the gate staff by turning up before 7.00 in the morning each day (something they were not used to).



*Sir Richard Sykes*

Speaking of his current managerial position, Sir Richard is enthusiastic: "Obviously I found my job interesting before - it was fascinating - but now I am able to have all the pieces. I am much more informed than I was so it is much easier for me to operate with greater information and, in a sense, more influence. It makes the job even more interesting and exciting." Of his style of management he says: "Management is about responsibility. My style is open and interactive. My job at the top is to foster communications, and if that is occurring at the top, it will send out a very clear message throughout the organisation."

He has been Chairman of the British Lung Foundation Business Leader Group since 1993, Chairman of the British Red Cross Corporate Patrons Scheme and Chairman of Task Force, Inward Investment in UK Pharmaceutical Industry since 1994. Sir Richard was appointed Director of the British Pharma Group in the same year. A member of the Centre for Exploitation of Science and Technology (CEST) since 1990, of the International Advisory Panel of National Science and Technology Board (NSTB) since 1991, and of the Central Research and Development Committee for the NHS (CRDC) between 1991-1993. Sir Richard is also a member of the Council for Science and Technology, and of the Advisory Council for Save British Science since 1993. Since 1994 he has been a member of the Board of Management: London School of Hygiene and Tropical Medicine and the Court of Governors (LSHTM). As well as being a Member of the Board of Governors at the University of Hertfordshire since 1988, Sir Richard Sykes holds an Honorary Doctorate in Pharmacy at the University of Madrid and Honorary Doctor of Science degrees at the Universities of Brunel, Hull and Hertfordshire.

Sir Richard says: "The future belongs to the innovators. If you frame innovation with responsibility, a sense of purpose and energy, you cannot be stopped." In the 1994 New Year Honours list Sir Richard Sykes received a knighthood for services to the pharmaceutical industry. He is a visiting Professor at both King's College, London and Bristol University; and a Fleming Fellow at Lincoln College, Oxford.

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# CHAIRMAN'S REPORT FOR THE YEAR ENDED 31 DECEMBER 1994

## Chairman: The Lord Butterworth CBE DL

The Foundation for Science and Technology had an active year in 1994 continuing in its role in science and technology by organising some 20 lecture and dinner discussions on a wide range of subjects. These events have provided an important neutral platform for the exchange of ideas, and have also enabled many to make useful personal contacts. Sponsorship has been a great support and we owe special thanks to all our sponsors for contributing towards the costs of our events.

During 1994 we held the majority of our events in London, and despite the Royal Society having to refurbish their main lecture theatre and dining room, we continued to meet there, using the smaller lecture theatre and to dine down the road at the Institute of Materials. As usual, we organised our annual event at the Royal Society of Edinburgh, and last year we held a controversial evening on: "Bioethics and Public Opinion - Do they Meet?" While north of the Border, the Foundation organised a visit to Sun Microsystems at Linlithgow. There were also visits in 1994 to the New British Library building at St Pancras; to John Brown plc, introducing the Foundation in a dramatic way to the practical use of information highways, and to the Natural History Museum to see some of the impressive science behind the scenes there. The Foundation also organised a lecture and dinner discussion at the Science Museum during the Euro-tunnel Exhibition there on the safety of the Channel Tunnel.

For our industrial theme subjects for our events included: "The Growth of Small Companies - Too big to manage", and "Innovation in Manufacturing Industry", also intellectual property, industry in Japan in 1995, the use of diesel fuel, and, of course, the Competitiveness White Paper. On subjects related more closely to science we looked once again at marine science and technology and at biotechnology. We held a meeting jointly with the Royal Society on science in China, and the Rt Hon William Waldegrave joined us to look at progress following the Science White Paper. We had a somewhat unique meeting with Ambassador Elinor Constable, the United States Assistant Secretary of State for Oceans, International Scientific and Environmental Affairs, on "Environmental Policy and Achievements of the Clinton Administration". We also addressed the subject of NVQ/GNVQs; and on the subject of information technology we looked again at Computers and the Law. We held our first event on information super highways with promise of more to come on that subject. Once again the Foundation organised jointly with the Office of Science and Technology the 1994 Zuckerman Lecture when Monsieur François Fillon,

the French Minister of Higher Education and Research, spoke on the Strategic Directions of French research policy. This was especially appropriate in view of our plans for an event in Paris this October when we shall learn more about a partner in the European Union.

The annual Lloyd of Kilgerran Prize for the application of science and technology for the benefit of society was awarded to Dr Bridget Ogilvie, Director of the Wellcome Trust.

The Foundation's role with learned societies has continued to be active during 1994 with many seminars and workshops being organised on a wide range of administrative matters from Value Added Tax to National Vocational Qualifications. Perhaps the most important event was the seminar for Honorary Treasurers at a time of change and development of policy from the Charity Commission. The Harold Silman Fund has been helpful to a number of learned societies in assisting with some costs for those attending the Foundation's events.

In the last days of 1994 the Foundation moved to new offices near Victoria where there is much more space for half the rent.

The Foundation is indebted to the Royal Society, the British Academy and the Royal Academy of Engineering for their general support as well as their grants in support of our work during 1994.

I would like personally to thank the members of the Foundation's Council and Committees who have played such an important role during the year; and special thanks must go to my honorary officers: Sir Richard Morris, Professor Chris Elliott and Mr David Andrews. This is the last meeting at which David Andrews presents the accounts to us as Honorary Treasurer. He has been a tower of strength both to Council, and also to David Hall. We are most fortunate that Council intends co-opting him for a further year. We are sad to be losing from Council on completion of their terms of office: Dr Ray Clark and Mr John Pascoe, both of whom have greatly helped over the development of the Foundation.

Finally, I would like to thank our small staff of David Hall, Jennifer Grassly and Lucy Stopford for all their hard work during the year, and I am confident that we can look forward to another fulfilling and successful year.



FOUNDATION FOR SCIENCE AND TECHNOLOGY  
INCOME AND EXPENDITURE ACCOUNT  
FOR THE YEAR ENDED 31st DECEMBER 1994

	<u>1994</u>	<u>1993</u>
	£	£
INCOME	167,830	142,207
Administrative expenses	<u>(133,559)</u>	<u>(125,748)</u>
OPERATING SURPLUS	34,271	16,459
Loss on disposal of fixed assets	-	(21)
Income from Investments	7,110	4,840
Interest receivable	<u>12,524</u>	<u>13,218</u>
RETAINED SURPLUS FOR THE YEAR	53,905	34,496
RETAINED SURPLUS BROUGHT FORWARD	341,625	309,118
Transfer to The Harold Silman Fund	<u>(263)</u>	<u>(1,989)</u>
RETAINED SURPLUS CARRIED FORWARD	<u>395,267</u>	<u>341,625</u>

FOUNDATION FOR SCIENCE AND TECHNOLOGY  
BALANCE SHEET  
AS AT 31st DECEMBER 1994

	<u>1994</u>		<u>1993</u>	
	£	£	£	£
FIXED ASSETS				
Tangible assets		4,566		4,236
Investments		<u>99,993</u>		<u>99,993</u>
		104,559		104,229
CURRENT ASSETS				
Debtors	39,371		17,830	
Cash at bank				
- on deposit	282,002		239,568	
- current account	1,814		348	
- The Harold Silman Fund	10,354		10,117	
Cash in hand	<u>91</u>		<u>4</u>	
	333,632		267,867	
CREDITORS -				
amounts falling due within one year	<u>32,705</u>		<u>20,515</u>	
NET CURRENT ASSETS		<u>300,927</u>		<u>247,352</u>
TOTAL NET ASSETS		<u>405,486</u>		<u>351,581</u>
Financed by:				
CAPITAL AND RESERVES				
Accumulated fund		395,267		341,625
The Harold Silman Fund		<u>10,219</u>		<u>9,956</u>
		<u>405,486</u>		<u>351,581</u>

The council has taken advantage of special exemptions conferred by Schedule 8 to the Companies Act 1985 applicable to small companies in the preparation of the financial statements on the grounds that, in their opinion, the company is entitled to those exemptions.

Approved by the Council on  
15th March 1995

THE LORD BUTTERWORTH  
MR D R G ANDREWS



COUNCIL MEMBERS

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# SPONSORED LECTURES, LEARNED SOCIETY SEMINARS AND FOUNDATION VISITS

## 1 JANUARY 1995 - 31 MAY 1995

LECTURE TITLES	SPEAKERS	SPONSORED BY
“Transport and the Environment in the Light of the Royal Commission’s Report”	Sir John Houghton CBE FRS Professor T M Ridley CBE FEng Professor Peter Hills OBE Mr David Rowlands CB	Brown & Root Ltd Department of Transport Railtrack plc University of Hertfordshire
Zuckerman Lecture - “Strategic Directions of French Research Policy”	Monsieur Francois Fillon	Amersham International plc AEA Technology Generale Des Eaux UK Rhone-Poulenc Ltd
“Women in Science, Engineering & technology - The Opportunities”	The Rt Hon David Hunt MBE MP Mrs Lynda Sharp Mrs Marie-Noëlle Barton Mrs Betty Barratt Dr Bridget Ogilvie	The Engineering Council Glaxo plc Office of Science and Technology
“Achieving and Keeping World Class Industrial Success - The Real Challenge”	Mr Alec Daly CBE Mr Dick Seymour Mr Bernard Preston	Coopers & Lybrand Department of Trade and Industry KPMG
“Today’s Challenges For National Laboratories”	Dr David Clark Dr Brian Eyre CBE FEng Sir William Stewart FRS FRSE	Department of Trade and Industry Health & Safety Executive Ministry of Agriculture, Fisheries and Food
“Realising our Potential: Can it be Done Without the Social Sciences?”	Dr Geoffrey Robinson Mr John Breckenridge	Economic and Social Research Council South Bank University
“Is There a Need for a National Digital Archive?”	Sir Anthony Kenny FBA Sir Roger Elliott FRS Dr Graham Cameron	Ordnance Survey Unilever plc Foundation’s Shared Sponsorship Scheme
“The Information Age - A Global Debate”	BY SATELLITE: Deputy Secretary David Barram Dr Arthur C Clarke CBE	British Telecommunications plc Mercury Communications Ltd Foundation’s Shared Sponsorship Scheme
	OTHERS: Mr Martin Bangemann Mr Malcolm Laws	
“Science, Engineering and Technology. A Focus on the Future”	Sir William Stewart FRS FRSE Dr K W Gray	Zeneca Group plc

## FOUNDATION TECHNOLOGY VISITS

- “Engineering the Future” - Visit to John Brown plc
- “Science and its application at the Natural Science Museum” - Visit to the Natural History Museum - Sponsored by Thames Water Utilities Ltd
- “Hands on Medium-Range Weather Forecasting” - Visit to the European Centre for Medium-Range Weather Forecasting - Sponsored by Cray Research (UK) Ltd

## SEMINARS FOR LEARNED SOCIETIES

- SORP 2 & Parallel Regulations - The Near Final Drafts
- Information Networking and Learned Societies - Present & Future
- Appraisals & Staff Development
- CD-Roms & Learned Societies
- Lifecycle of an Employee of a Learned Society

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## ASSOCIATE MEMBERS & MAJOR DONORS

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

1 MAY 1995

3i plc	Fraser & Russell	Parliamentary Office of Science & Technology
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