TECHNOLOGY INNOVATION AND SOCIETY

FOUNDATION FOR SCIENCE AND TECHNOLOGY

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DEVOLUTION & SCIENCE

The Foundation held a meeting with the Royal Society of Edinburgh on 18 November 1998 on "Devolution and Science". It was sponsored by The Bank of Scotland, Biosis (UK), the Engineering & Marine Training Authority – Scotland and the Scottish Higher Education Funding Council. The Rt Hon The Lord Jenkin of Roding was in the chair. The speakers were Mr Muir Russell, Permanent Under Secretary of State, Scottish Office, Dr Christopher Masters FRSE, Executive Chairman, Aggreko plc, and Professor Sir William Stewart FRS FRSE, Chairman, Cyclacel Ltd.

Mr Muir Russell*

Introduction

It is timely to be discussing this topic tonight as the Scotland Act received Royal Assent just yesterday afternoon. Congratulations to the Foundation on picking this date.

It is 300 years since a Parliament last sat in Edinburgh. Even this august body (RSE) had not been founded then.

At the time of the Union of the Parliaments, we had our own legal system and an education system which included just four universities. Both have since developed in distinctive ways and will return to the Scottish Parliament's control. It is fair to say that science really took off in the 18th and 19th Centuries. And as Science grew, it quickly became an international discipline.

Science in Scotland continues to be part of that international science base. We may be the third most productive nation in terms of papers published relative to our size, but we nevertheless undertake only about 1% of world science. So we cannot in any sense 'go it alone'. Science in Scotland will only thrive in that international context. Yet it must also serve the needs of Scotland. On the eve of devolution, that is the challenge before us.

The Scottish Parliament

Delivering a Scottish Parliament is one of the cornerstones of the Government's plans to modernise our constitution. Its creation will bring tremendous opportunities and challenges. The opportunity to do things differently; the challenge to do them better, to use our resources better. This is true of science policy, with opportunities to generate debate about what is the right science policy for Scotland, to build consensus on how we best meet Scottish needs, to find synergies.

This will not be an overnight task. We have a system of university research and the "Scottish system" in agriculture that have both grown up over a long period. The parliament will inherit a system which has considerable assets in terms of both physical and human capital. Any change will have to build on that investment.

Finally, we must also remember that right across the board the people of Scotland will expect to see the new legislators make a difference to their day-to-day lives. There will be competition for resources. While *we* may be convinced that Science in Scotland is important, the electorate may consider schools or health to be a higher priority. If scientists are to engage politicians and the electorate, they need to demonstrate clearly the benefits that Science in Scotland will bring to the population.

I want to talk first this evening about a number of ways of looking at those benefits: why developing our Science Base is crucial to our economic future; how it impacts on our quality of life; how we apply UK science policy in Scotland: the structural changes that devolution will bring; and the Scottish Parliament's opportunities to change the framework of Science in Scotland.

The Knowledge Economy

It is a truism that the development of Science in Scotland is crucial to our economic future. It is clear that we can no longer expect to

Summary: Mr Russell discussed the changes that would be brought about by the new Scottish Parliament. There would be tremendous challenges and opportunities. He believed that it was a matter of "Science in Scotland" rather than "Scottish Science" and went on to discuss its relationships internationally and with the UK. Dr Masters examined the role of research in the context of the Scottish economy, its funding and the role of the Scottish Higher Education Funding Council in supporting higher education. Sir William Stewart discussed the ways forward for Scotland with respect to science, engineering and technology.

compete in international markets by carrying out routine manufacturing tasks cheaper than countries with low wages. Already knowledge and know-how are overtaking buildings and machinery as the key assets of business. Success is going to those firms and countries who innovate and raise their productivity and profits the fastest.

A healthy science base is essential to deliver innovation. As anyone who has worked on the exploitation of science knows – as the RSE and Scottish Enterprise have found – the relationship is complex. Science delivers the ideas. It also delivers the people who put the ideas into place. But it also provides the framework with which industry can explore solutions to their problems and find a stimulus to innovation.

The phrase 'a knowledge economy' is often used to describe these interactions. If we are to build a knowledge economy, we need to develop a network of relationships between public, private and academic worlds to secure the dissemination of science to a range of sectors as a prime source of productivity growth. I believe that the role of government in this is to try to provide the framework in which these networks develop.

How science impacts on quality of life issues

The second issue is how science impacts on the quality of life.

Advances such as improving health are clearly science-driven. The impact of research on quality of life – in a direct sense – is huge in many areas. Examples include information technology and medical technology applications.

But science also has a crucial role in improving the quality of life by supporting public decision-making. As the Government's Chief Scientific Adviser, Bob May, said, in the introduction to his guidelines on the Use of Scientific Advice in Policy-making:

"Science is playing an increasingly influential role in contributing to policy and regulatory decisions, particularly on sensitive issues involving people's health and safety, animal and plant protection and the environment".

Three factors appear to be increasing the demand for a sound scientific basis for government policy. There is increased public expectation for high standards and the minimisation of exposure to risk. There is the increased complexity in the decisions required of government. And the increase in research knowledge outside government is hard to access or assess without expert support.

The key principles of Bob May's guidance are that:
- departments should ensure that their procedures can anticipate

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Permanent Under-Secretary of State at the Scottish Office

issues for which scientific advice will be needed;

- policy-makers should draw on the best available scientific advice,
- there should be a presumption towards openness in explaining that advice and its interpretation.

The Scottish Office follows those principles as the recent OST report on their implementation demonstrated. But we need to build on our record and improve it. The creation of the Parliament means we need to look at our structures for using scientific advice. We must make sure that they are robust enough to meet the demands the Parliament will place on them.

How do we currently apply UK policies?

Before I begin to talk about the Parliament it is important to say a little about the current UK background and the consequences of devolution.

The last major statement of UK science policy was 'Realising our Potential'. However, the new Government has also made clear the priority it attaches to science, to innovation and to knowledge transfer, focusing not just on the excellence of the science base, but also on translating outputs into real use. It has demonstrated its commitment to science through the additional resources emerging from the Comprehensive Spending Review and a raft of related initiatives, for example the new Science Enterprise Challenge.

It has also demonstrated its commitment to Foresight. Launched – by Bill Stewart no less – to develop an interactive, inclusive process to anticipate future need and inform current decisions, it will soon be relaunched and extended. Foresight is now about preparing for the future – in a very broad sense. It is about future technologies, future markets, and their influence on the prosperity and cohesion of our society. Although its scope now goes beyond science, one of the main drivers is to improve the capacity to match research strengths to likely future need.

The Parliament will inherit a policy for science which shares the over-arching UK policies such as Foresight. But it will also inherit specific strategies for the three main blocks of research spending which will fall to the Scottish Executive:

• The largest block is in the Higher Education Institutions. SHEFC funding of about £120 million "enables research of the highest standards, with relevance to economic development, social needs and the expansion of knowledge' – and will be 'our side' of the dual support system;

• We have a second block of some £40 million to encourage and fund agricultural and fisheries science, and related biological, food, environmental, economic and social science; most of that goes to the Scottish Agricultural and Biological Research Institutes; and

• The third block of £10 million funds the Research Strategy for the National Health Service in Scotland – aimed at securing lasting improvements to the health of the people in Scotland and improving the quality and cost-effectiveness of healthcare services.

The Parliament will also inherit a range of distinctively Scottish activities: the enterprise networks for example which are about science and economic development, or technology transfer. And I should mention the contribution of the RSE, particularly to Technology Ventures which has been successful in raising awareness of the commercialisation of science.

All these activities adopt different approaches to improving the interaction between the research community and business. But it seems clear that the Parliament inherits a solid base on which to build.

What will devolution change?

Let me turn, therefore, to the structural changes that devolution will bring. For science and the scientific community, the most notable element of the Scotland Bill is that the Parliament will be responsible for science policy in Scotland. It will inherit the programmes I have outlined above. This amounts to a considerable science programme over which the Parliament will have direct responsibility.

But that responsibility will have to be exercised in a UK context.

This is surely right. From comments people have made to me as a member of BBSRC and subsequently, I feel there is broad support for that approach within the Scottish research community. I think they see the benefits of scale which a UK context brings, the benefits of testing their excellence in a wider UK pool.

This line of thinking explains why the Research Councils are to be reserved. As such, the Research Councils will continue to be resourced by and accountable to Westminster, and expected, as now, to fund research throughout the UK. They represent the UK research capacity, which allows the pursuit of UK goals alongside and complementary to the Scottish goals which will be the domain of the Scottish Parliament. That dual responsibility will allow for the efficient deployment of resources at UK and at Scottish level. It is mirrored in the arrangements for science even in countries such as the USA and Germany, where both federal and state authorities have responsibility for science policy.

Opportunities to modernise the framework of Science in Scotland

As in so many other areas, devolution will turn the spotlight on the way in which we organise science in Scotland. The Parliament will develop its own priorities for the science programmes, and rightly so. That said, I am on pretty firm ground in assuming that:

- a strong, publicly-supported science base in Scotland will be an increasingly important ingredient of the success of the Scottish economy and in improving the quality of life; and
- the demand for scientific support to underpin Scottish policy-making will not diminish post-devolution, but rather increase.

I think that the Parliament will be looking to maximise the contribution that science makes to the life of Scotland and will be looking to achieve coherence and synergies in our science programmes.

So what are the possible ways in which the Scottish Parliament could take opportunities to modernise the framework of Science in Scotland?

Strategic Approach

I think that the Parliament is likely to want to take a strategic approach to its responsibilities for science. Let us think a little about what a strategic approach to science policy might mean. We can identify some of the likely factors. A strategic approach would need to identify the sort of research strengths which are required to provide:

- innovation in areas relevant to current Scottish economic strengths;
- innovation in areas of potential growth;
- research to underpin devolved policy and quality of life;
- while producing skilled people capable of technological problem solving and innovation.

It would also need to identify the qualities required of the science base to deliver such desirable outcomes.

Once you begin to think about such an all-embracing strategy the challenges become apparent! For example, making choices to invest in electronic engineering could mean less is available for environmental science or sociology. Choosing to invest in a subject which is important today could mean that we lose our research capability in something else – something relatively obscure now, which will be vital in 5 or 10 years – the blue skies research argument.

A strategy is not about a naive concept like 'backing winners'. It would need to concern itself with considerations such as excellence, flexibility, curiosity, networks and the balance of incentives between commercialisation and research.

To be successful, a strategy would also need to be responsive to the context within which science policy is pursued in Scotland. It should, therefore, command assent, build on strengths, be coherent across Scottish programmes, influence funding decisions and be coherent with UK programmes.

No single person's view of the desired outputs of the science base is going to be absolutely right. The key is to devise an inclusive and consensual process which delivers a strategic approach. I

look forward to hearing the discussion this evening with that in mind.

Coherent Policy

Finally, let me say a few words about the related need for coherent or integrated scientific support to underpin policy decisions and ensure a coherent approach to the science base. The Parliament will, rightly, have high expectations of the quality of scientific support available to it.

We need to look carefully at how we supply that scientific support. Devolution will bring new demands and we cannot assume that old ways of doing things will necessarily remain the best. This is something which we are already thinking hard about in The Scottish Office.

But, as with wider strategic thinking about the science base, our thinking cannot be exclusive. Thankfully, the scientific community has not been slow to suggest a range of options which might merit consideration in the coming months. The following list is not, of course, exhaustive and I mention these options not as firm propositions but in the hope of stimulating some debate:

- there could be clear identification of one part of the executive with responsibility for managing the overall strategy for the science base and for policy on the provision of scientific support. An "OST in Scotland", so to speak;

- there could be pooling of some or all of the existing resources for scientific support to create a corporate resource, managed centrally – not quite a Scottish Research Council, but close;

- another option suggested is the creation of a new high-level committee of internal and external advisers, along the lines of the UK Council for Science and Technology;

- and then there is the perennial opportunity to appoint an over-arching Chief Scientist:

And there are many other options.

A key element is to devise an inclusive and consensual approach. I welcome the opportunity that an event like tonight offers to hear what others have to say. What, then, should we be doing about all this? In the run up to the Parliament, in policy-areas right across the board, The Scottish Office needs to be preparing to listen, and it needs to be prepared to think. In relation to science policy, that process of dialogue is one which I am keen to take forward in the weeks and months ahead. Although we cannot implement major changes until the Parliament is in existence, I hope that I and my colleagues can begin to assemble views, from all quarters, on the issues I have touched on – and no doubt others I have failed to mention – so that we are well placed to advise the Scottish Executive on how best to respond to the challenge and opportunity that devolution offers.

Conclusion

Tonight's event is therefore an opportune moment to begin the discussion. I believe the issue is not "Scottish Science", but "Science in Scotland". How do we develop it in UK and international contexts. Can we create a framework for science that meets Scotland's needs, but remains international in outlook and excellence? How do we grasp the opportunity of change while avoiding the temptation to be too inward looking? How can we work together to achieve all that?

Dr Chris Masters*

Introduction

I would like to address essentially three areas. First, and most importantly, what is, or for that matter what should be, the role of science and technology, and – in particular – research, in the context of the Scottish economy and Scotland as a nation as we move towards devolution.

Secondly, I would like to look briefly at some of the issues surrounding the funding of research in Scotland; and, finally, I would like to describe the role of the Scottish Higher Education Funding Council in supporting Higher Education within Scotland.

Probably one of the most respected writers on competitive strategy and competitive advantage is Michael Porter of the Harvard Business School. Recognising that we now live – thankfully – in an era where economic performance rather than military might is the true index of national strength, Porter and his associates conducted in-country research in ten leading nations, closely studying the patterns of industry success as well as the company strategies and the national policies that achieved it. In his resulting work *The Competitive Advantage of Nations* he concludes: "Skilled human resources and knowledge resources are two of the most important factors for upgrading national competitive advantage".

Role of Science and Technology in Scotland

A strong science base and a strong higher education sector gives Scotland a significant and increasing competitive advantage on the world scene. An educated population and a strong science base are not things which fall into the 'nice to have' category. They are absolutely vital if Scotland is to continue to prosper in the global economy.

As Helen Liddell – the Minister with responsibility for education in Scotland – said in a recent speech to the Committee of Scottish Higher Education Principals (COSHEP):

"Britain can no longer expect to compete in international markets by carrying out routine manufacturing tasks cheaper than countries with low wages. Already, knowledge and know-how are overtaking buildings and machinery as the key assets of business. Success is going to those firms and countries who innovate and raise their productivity and profits the fastest. And they do so through the rapid acquisition and application of knowledge".

Looking at successful companies, the key determinant of long-term sustainable success is not the product, or even what they do, but how they do it. The key attribute which distinguishes the long-term winners is the quality of their people and closely coupled to this is the real investment they make in these people in terms of training, development and maintaining their practical and intellectual skills. What we know today is not good enough for tomorrow: continuous improvement and continuous innovation are the real keys to sustainable competitive advantage. This is as true for a nation as it is for a company. Continuous investment in knowledge, in education, in science is not an optional extra: it is a vital necessity if Scotland is to continue to grow and prosper. As we approach the new millennium and the reality of devolution, it is absolutely critical that we get this clear and unambiguous message over to all shades of public and political opinion formers.

Not out of a sense of partisan lobbying by those with a particular interest in higher education or research, but because if we fail to get the message through we will have failed not only ourselves but the nation as a whole.

Research funding

Let me now turn to the subject of research funding, and concentrate first of all on those funds which come from the public purse.

As many of you know, public funding for research in Scottish Higher Education Institutions essentially comes through two sources:- The Scottish Higher Education Funding Council which provides money to enable the institutions to employ and provide the basic facilities for academic researchers; and The Research Councils, who are UK-wide bodies, which provide funds for specific research projects building on ideas developed within the institutions.

This is often referred to as the 'dual support system'; it is a system which has the full support of the Secretary of State for Scotland, and it is a system which, hopefully – and I would sug-

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gest, importantly – should not change as a consequence of devolution.

By relying on different means of assessment, by providing funds for different but complementary purposes and with different – but certainly not opposing – agendas, the dual support system provides considerable flexibility.

I am sure that I do not need to convince this audience either about the need for flexibility in research, or about the importance of providing a culture in which researchers have the freedom to develop ideas, the freedom to think creatively and in some instances simply follow their intellectual curiosity.

I would submit that, while most major break-throughs in science were not planned, in many cases they were achieved in an environment which encouraged freedom of thought within a culture of excellence.

I use the word 'excellence' deliberately. As in all areas of life, resources are finite – some might prefer the word 'limited' – and prioritisation in the distribution of research funding is a fact of life. The decision has been taken by the Funding Councils to fund research selectively on the basis of relative performance – relative performance on an international scale, as judged by the Research Assessment Exercise. One can argue about the merits or otherwise of the RAE, but not I would suggest about the merits of supporting and enhancing excellence.

In talking about excellence, let me make it clear that I believe it is very important not to confuse excellence with elitism, and also to guard against excellence leading to elitism. Elitism can too easily become exclusive, while I see no reason why excellence should not be inclusive. As far as Scottish Higher Education in its totality is concerned, I fully support the Government's drive to increase access. However, increasing access must go hand-in-hand with maintaining – or, preferably- improving quality.

Decreasing standards to increase access benefits nobody – neither students, nor the institutions – and certainly not the nation as a whole. Increasing access to excellence is what we should be targeting.

As far as research is concerned, knowledge knows no boundaries – a fact that is more true today than perhaps ever.

In the discussion surrounding devolution, there has been talk of establishing a Scottish Research Council. Although we have not yet had the chance to fully debate this suggestion in the Funding Council, or seek the views of all the institutions we fund, from a personal standpoint I would find difficulty in supporting such a move. I believe, in this particular area, it is essential that Scotland remains firmly part of the UK scene. In terms of research, we need to be extending the boundaries of collaboration, not compressing them. Parochialism in research – as indeed in so many other fields – is short-sighted and, in the long term, unsustainable. This is not to say we should not have a mechanism to deal with the specific needs of the Scottish economy – indeed, we already do through the Council's Research Development Grant; it is to say that we need to jealously guard our world-class standing in research and our ability to demonstrate that clearly to the international community.

Up to now, I have focused on funding essentially from the public purse via either SHEFC in the context of Scotland, or the Research Councils in the context of the UK. However, as you are all too well aware, this is only part of the story.

Of the £193 million that Scottish Institutions received in terms of external research grants and contracts in 1997, about two thirds came from sources other than the Research Councils, in many instances from commercial organisations, and commercial organisations who operate increasingly on a global scale. As I tried to demonstrate earlier, continuous and indeed increasing investment in knowledge, education and our science base is absolutely vital to the future prosperity of the nation. The ability to attract what could be described as mobile money is an important factor in enhancing the international competitiveness of the nation. Having a world-class research base, to my mind, is undoubtedly the key to attracting such support. Again, this is an important fact that we need to get over to all shades of public and political opinion formers as we approach devolution.

We are very fortunate in Scotland to be in a strong position: we have an excellent base on which to build. At the last Research Assessment Exercise, 160 of our departments were rated 4, 5 or 5*, i.e. displaying aspects of international excellence in their work. In terms of scientific publications in refereed journals, Scotland produces just over one per cent of the total which – on a per capita basis – ranks us number three in the world.

This is not in any way intended to convey a sense of complacency, but it is to say that we have an excellent base on which to continue to build, post-devolution.

Role of the Funding Council

So what is the role of the Funding Council in all this? Well, certainly not one of planning overlord. I am most definitely not a fan of centralised planning; at least not on a national scale, and most certainly not in the context of scientific research. I do not see SHEFC as having either the remit, or indeed the capacity, to produce an all-embracing plan for Scottish Higher Education plc. I fully support institutional autonomy and indeed believe that one of the great strengths we have in Scotland is not only the quality but also the diversity of the HE provision on offer. It is up to the governing bodies of the institutions, working closely with their Executives of course, to identify the distinctive strengths of the institutions and then build on these strengths to produce outstanding performance in both teaching and research.

To my mind, the role of SHEFC – put simply – is to support Scottish Higher Education to maintain and indeed improve its world-class standing. I am deliberately using the term 'Scottish Higher Education' to imply the totality of the system. While, clearly, any total is made up of a sum of parts, in this particular instance I believe that the whole is and has the potential to be much greater than the sum of the parts. This said, the parts are obviously extremely important and, in order for the sector as a whole to maintain its world-class standing, individual institutions need also to be outstanding at what they choose to do.

I do not believe, however, that any institution can be all things to all people, and the reverse side of the building-on-strengths coin is addressing weaknesses effectively which – at the end of the day – may well require the elimination of particular areas of weakness, always with the underlying objective of achieving excellence.

An important strength we have in Scottish Higher Education is the compact size of the sector. The fact that there are only 19 Higher Education institutions, and that just about everybody in a given discipline knows (or should know) everybody else, provides the ideal environment to develop collaboration proactively in order to produce international excellence.

I believe that the Council has an important role to play in facilitating such processes and, again, I would wish to emphasise the word 'facilitating' rather than directing or driving. In terms of collaboration, I acknowledge that some of the present funding methodologies could do more to encourage and recognise collaboration both amongst institutions within Scotland and indeed within the UK and overseas. This is certainly an area which the Council intends to examine more closely within the context of our overall review of teaching funding, and also in terms of how we award our own grants in support of research and its development.

As far as the Council's own Research Development Grants are concerned, these have grown out of our response to the original Foresight Programme. The objective of the grants, among other things, is to help institutions improve the fit between their own research capabilities and the long-term needs of society in general and the economy in particular. The scheme is also used – and I would personally hope, increasingly used – to stimulate collaboration between institutions involving both multi- and inter-disciplinary approaches.

As a result of the Comprehensive Spending Review, this particular Research Development Grant Scheme is being broadened and enhanced to provide further support for such developments, and also to improve the infrastructure in areas of excellence aligned to the needs of the Scottish economy. Next year we will be

allocating some £10 million through this scheme, and there will certainly be opportunities for other bodies to provide matching or joint funding to help address the research needs of Scotland through our Higher Education Institutions.

Supporting strategic change is also an area in which the Council has an important part to play. In the current year, we are providing some £11.5 million in terms of strategic change grants to help institutions meet the one-off costs of restructuring to respond to the needs of the next century within the constraints of limited public funds, and the requirement to maintain the highest of standards.

To make the best use of the resources of higher education, we must also make the best use of the people involved in it. The Council is totally committed to helping and supporting institutions in the continuous training and development of their people. In the context of research, there is some quite strong anecdotal evidence that the increasing use of short-term employment contracts for researchers is not always conducive to producing the best research, nor for that matter enhancing the commitment of research staff to knowledge-based careers. I was delighted that Helen Liddell raised this issue in her recent speech to COSHEP and, with her encouragement, we will shortly be instigating a study into the cost-effectiveness of short term contracts.

One of the questions posed in the introduction to this evening's event related to the part to be played by the Government's Foresight Programme. The Foresight Programme itself is probably one of the most important areas of activity in terms of encouraging the science base to consider its role and future agenda in terms of its social and economic context. Simply put, Foresight looks at how the world might develop and how we should position ourselves to take best advantage of a range of possible futures. While the national UK exercise may produce detailed recommendations in a range of areas, as far as the Council is concerned we strongly encourage individual institutions to carry out their own "foresighting". As I said earlier, the diversity of the sector is one of the real strengths we have in Scotland. The contexts in which each of the Institutions operates vary both locally and indeed internationally, and it is therefore appropriate that they should tailor their own approaches to the future within the framework, of course, of the overall UK exercise.

As many of you are aware, the Funding Council has taken an active role in Foresight from the start and will continue to do so as the second phase is developed; indeed, John Sizer, the Council's Chief Executive, is a member of the UK Foresight Steering Group and will be participating in the next stage as Foresight gathers momentum.

Earlier, I talked about encouraging collaboration in the context of the individual HE institutions in Scotland; collaboration is also very important in the context of bodies such as SHEFC and Scottish Enterprise. At the end of the day, we both have a vested interest in encouraging and enhancing a knowledge-based economy and the more we can work together to achieve this goal the better.

Other support areas

The Council already provides support to the national Technology Ventures programme, which is administered by Scottish Enterprise through sponsorship of the associated Newsletter, Website and seminars, together with the Royal Society of Edinburgh. We are keen to continue to develop an active working relationship between the two organisations and, to this end, we have recently set up a regular programme of meetings between the Funding Council and Scottish Enterprise with the aim of identifying common strategic and indeed operational objectives.

As far as Technology Ventures is concerned, one of its key objectives is to increase prosperity and economic growth in Scotland through the commercialisation of our science and technology base – an objective shared by the CONNECT networking programme of which the Council is a founding sponsor. Successful commercialisation of research is clearly important and is certainly something which both the Council and Scottish Enterprise is keen to encourage – not, I would emphasise, by directing the research effort but more by facilitating the commercialisation process.

Another area in which it is important that the Council and Scottish enterprise should work closely together is the practical development of the Cluster approach, actively involving the Higher Education Institutions at an early stage in both the developmental dialogue and the strategic thinking. The objective here is to comprehensively identify existing and potential areas of outstanding expertise – quite possibly involving a number of individual institutions that could form the basis or nucleus for further commercial ventures along the lines of the Cadence project.

Although I would argue strongly against commercialisation ever being allowed to become the sole or, indeed, principal driver of academic research funding, I do believe nevertheless that we should do all we can to facilitate the process of commercialisation where appropriate.

I think back to the time when I was involved at Shell – in what, in those days, was often referred to as 'blue skies' research – and, coming under not a little pressure to justify the budget, one of my colleagues quoted the words of a very eminent scientist of an earlier generation: I think it was Faraday who, on being asked by a politician what was the use of his research, replied "One day, sir, you may tax it", or – in the context of Shell – profit from it!

Conclusion

There is no doubt that we live in interesting times; there is no doubt that change is endemic and the rate of change is continually increasing.

Devolution will undoubtedly offer many challenges and opportunities. There is also no doubt that Science will continue to have a vital and key role to play in the future prosperity of the nation.

As Louis Pasteur once wrote:

"*Science knows no country, because knowledge belongs to humanity and is the torch which illuminates the world. Science is the highest personification of the nation because that nation will remain the first which carries the furthest the works of thought and intelligence.*"

Professor Sir William Stewart FRS, FRSE*

Scotland

Scotland, a country of 5.5 million people, is currently part of the UK, and with that goes many benefits. As part of the UK we are part of the G7 group of industrialised countries. We speak English, the global language of S&T; there is a separate well-funded Scottish Office; we have better than a fair share of the total number of Westminster MPs. Scots represent a disproportionately high percentage of the current Cabinet. We are part of an expensive UK defence system and within the UK as a whole we enjoy the relative stability which is unmatched in most other countries of the world.

But as a nation, we, the Scots, are not happy. There is a fer-

* Chairman, Cyclacell Ltd

menting lust for more independence, perhaps even total independence from the rest of the UK. Much has been acceded by the current Westminster government. Scotland, once more, will have a parliament of its own, bringing with it the opportunity for more control over its own affairs coupled with potential disadvantages. Nineteen ninety nine will be a watershed for the people of Scotland. The extent of the watershed will depend on the political composition of the Parliament. Whatever the political outcome, it is likely that there will be change in the way in which science is run in Scotland. The extent to which change will occur may vary from the minimalist approach of the last government to the possibility of much of the funding of Scottish science being funded from within Scotland and the European Union if there is a political surge towards nationalism.

However, science alone will not determine the political fate of the country at the May elections. That is likely to be dominated by major issues such as health, education and economic performance. Nevertheless, Scotland in the 21st century, like other advanced countries, will depend for success on the products and processes of science, engineering and technology and on the intellectual capital of its people in harnessing these. Equally, the May elections will influence the fate and international standing of the science community within Scotland and, more generally, within the UK.

The backcloth against which Scotland must operate in the 21st century

As a nation Scotland will be on the global periphery of an expanding world population base. We currently represent about 0.1% of the world's population, and that percentage is declining. We are located in northern temperate climes, whilst world population growth will be centred in the southern hemisphere and in the east.

Globally, manufacturing industry is moving towards consolidation. Global multinationals are clustering, concentrating and downsizing. The success of a country will increasingly depend on its ability to negotiate against the global multinationals. Take, for example, the North Sea oil industry of today. It has been driven by the major oil companies and their scientific, engineering and negotiating capabilities rather than by the intellectual prowess of the UK government, important though the latter may have been.

It is thus difficult to imagine in the cold light of day that Scotland with its current industrial base will be anything other than a global minnow. But minnows have in many cases successfully survived the ravishes of evolution. There is also the question in the years ahead of whether a global minnow of 5 million people is likely to be any less competitive than a UK minnow of 55 million people. It is a question of alignment – and time!

Whatever the long-term future holds, we live in the present and there will be change as the Scottish parliament beds down. There is also the highly important need to set in place quickly an infrastructure for science, engineering and technology which will contribute to our international prosperity and the quality of life of our people.

It is sensible to learn from good practice elsewhere. So let me take two examples.

The NHS in Scotland

This is a positive example from within the Scottish Office. The NHS in Scotland is being radically reshaped for the 21st century. The approach has been very similar to the approach that was used when the 1993 White Paper on Science, Engineering and Technology and the ensuing Technology Foresight Programme were set in place. A crucial factor to its success was the overarching team: a Scottish Health Minister who had been a consultant surgeon and knew what he was talking about, an able Chief Medical Officer who thought laterally and pragmatically and a capable Management Executive team.

The Chief Medical Officer established a steering group which set up key sub-groups covering the entire area of health care and implemented a huge consultative process which harnessed the views of the professionals and the public more generally. The ensuing White Paper *Designed to Care* was rapidly produced, was well received and brought forward recommendations for a radical and pragmatic restructuring of the Scottish Health Service for the 21st century.

It focused on the need to consider Scotland as a single entity. Three clear clinical priorities for attack were identified: cancer, coronary heart disease and mental health. The number of NHS Trusts was to be halved to reduce the administrative burden and for the money to go in to front line patient care. Two trust types were clearly identified for the future: *primary care trusts* which focused on health care in the community and at the GP level, and *acute services* trusts to deal with acute, emergency and tertiary care. There was to be a research and training focus with the establishment of 5 high-tech teaching hospitals trusts. Clinical networks were to be established across Scotland with equity of access for patients and clinicians

An overarching implementation scheme has been set in place and major changes such as the reduction in the number of trusts, the establishment of clinical networks and the focus on priority areas is already in train. Scotland leads the way with a radical policy which has benefited from the relatively small size of the country and thus the opportunity to treat it as a single entity.

Taiwan

My second example is the country of Taiwan. Taiwan is a small island with a population of about 21 million people which has largely escaped the recent south-east Asia financial crisis. It has no natural resources: no oil, gas, coal or other mineral reserves. All it has are its people and its brainpower. But the Prime Minister and most of the Cabinet are scientists/engineers and there is an acceptance by the electorate generally that a successful future depends on the use and exploitation of science, engineering and technology. There is a view among thinking officials that the future depends on turning the entire island in to a hi-tech science park!

Currently there are two massive science parks: one Hsinschu and the other at Tainan. The Hsinschu Science Park, for example, has about 245 high-tech companies; almost a third are owned by returnees from the US; about 20% of the companies are foreign companies; there are nearly 70,000 employees. The average age is 31. There is $3.6 billion on site capital. The extensive infrastructure includes kindergarten, elementary, junior and bilingual schools, a customs centre to facilitate imports and exports, banks, a post office, a transportation company, a medical centre and a comprehensive local and global information and communications network.

The Industrial Technology Research Institute, for example, has a Nobel Laureate as Chairman. There are medium- and long-term research programmes to develop generic advanced technologies; research to improve industrial processes, to develop new products, to facilitate mass production and to support SMEs. Over 500 patents have been taken out.

It is worth considering against these two examples how Scotland's education and industry sector is progressing.

Scotland's education and industry sector

Scotland's education and industry sector within the Scottish Office has taken a different approach from the above two examples. It is less dirigiste with science, engineering, technology, medicine, business, law, etc., being left largely to the country's 14 universities and to the Scottish Higher Education Funding Council and to the further education sector. Responsibility for industry has been left to Scottish Enterprise, Highlands and Islands Enterprise, local enterprise councils, etc. There are separate ministers for education and industry and none for science. The numerous research institutes

▲ *Professor David Cope, Director of the Parliamentary Office of Science & Technology, with Gerald Wilson, Secretary and Head, The Scottish Office Education & Industry Department, and Sir Lewis Robertson, Hon Treasurer, the Royal Society of Edinburgh.*

are largely agriculture and fisheries oriented and under a separate minister. There are now no publicly funded physical sciences/engineering/research institutes in Scotland. The research councils fund Scotland as they do other parts of the UK.

This more difficult area of education/industry/science/technology is likely to attract attention by the new Scottish parliament and with that in mind it is also relevant to consider the current Whitehall structure. In Whitehall there is a Parliamentary Committee on Science and Technology, a House of Lords Committee on Science and Technology, a Parliamentary Office of Science and Technology, a dedicated Minister for Science, a Chief Scientific Adviser to the government heading up an Office of Science and Technology with over a 100 staff, and a Director General of the Research Councils. There is none of this in Scotland. Whatever the future, the Scottish Parliament, as things stand at present, will be hugely dependent for underpinning on the Whitehall provision.

The future

The aim of this meeting tonight is for the audience to consider the ways forward for Scotland with respect to science, engineering and technology. Let me mention but one option.

One option for Scotland would be to continue to harness the benefits which Whitehall and Europe can provide, whilst setting in place locally an underpinning structure for science, and a science policy, in which science is embedded as a core component of corporate thinking on the way forward for Scotland. Our small size, and the ability of the Scottish Office to operate as a single functional unit, makes this possible in a way which, because of current departmental autonomies, is much more difficult to achieve across Whitehall. There are additional and other options and opportunities if our politicians are convinced that these options meet the needs of the tax-paying public – and if the politicians are bold enough to grasp them.

CLOSER IRISH/UK COLLAB-ORATION IN FP5

The Royal Dublin Society and the Foundation for Science and Technology held a joint symposium, reception and dinner discussion in Ballsbridge on 28 October 1998 on the subject: "Building Closer Irish/UK Collaboration in the Fifth Framework Programme". The sponsors were Glaxo Wellcome plc and Unilever Research and the chair was shared by The Rt Hon The Lord Jenkin of Roding, Chairman of the Foundation, and Professor Dervilla Donnelly, Professor of Chemistry, University College Dublin, and Past President of the Royal Dublin Society. The speakers were Mr Liam Connellan, President, Royal Dublin Society, Mr Noel Treacy TD, Minister for Science, Technology and Commerce, Dr Susan Hedigan, Office for Funded Research Services, University College Dublin, Professor Frank Hegarty, Vice President, Research, University College Dublin, Professor Robert Freedman, Deputy Vice-Chancellor, University of Kent, Professor R B Leslie, Programme Manager, External Research, Unilever Research, Mr Kevin Goggin, Director, Strategic Planning, Eli Lilly SA, Mr John Travers, Chief Executive, Forfas, and Mr Michael Fahy, Head of Management Support, IRMM/JRC, European Commission.

Mr Noel Treacy TD*

Introduction

I am delighted to have this opportunity to address all of the participants of this symposium on building closer Irish/UK Collaboration in the Fifth EU Research Framework Programme. In particular, I offer a warm welcome to our UK colleagues to this distinguished venue, where, on 25th June 1731, the Royal Dublin Society was formed for the advancement of agriculture and other branches of industry, science and art within Ireland. The Society's showgrounds are the venue for the world-famous Kerrygold Dublin Horse Show and where Sir Harvey Smith and Mr Eddie Macken experienced many competitive and exciting show jumping moments which could not be described as building closer Irish and UK collaboration, at least in the arena!

I would like to congratulate you for your choice of topic. The next two months will be important ones – there remains a lot of work to be done in finalising the Fifth Framework Programme, but in the meantime we need to alert researchers to the opportunities which will be available.

Summary: Mr Treacy noted that UK and Irish researchers had been partners in many project consortia. Meetings such as the present one helped to build networks and foster increased co-operation between the two countries. He looked forward therefore to the opportunities presented by the Fifth Framework Programme.

Framework Programme

We have had fourteen years' experience of EU Framework Programmes. Under the First Framework Programme (1984-1987) the Research and Technological Development (RTD) activities of the Union were, for the first time, co-ordinated as part of a single, structured framework. All Framework Programmes since then have built on this. The Fifth Framework Programme will build even further.

The Community's research and development activity has the clear economic objective of underpinning the competitiveness of European business. The Programmes are intended to promote co-operation not only between companies but also between companies and third level institutions and research organisations, in order to achieve a critical mass enabling Europe to compete globally.

Minister for Science, Technology and Commerce.

The Programmes emphasize pre-competitive research covering priority topics, which are better tackled collaboratively than individually, given their complexity and cost.

The funding provided by the Framework Programmes is a very modest 4% of the EU budget. Nevertheless, such funding is very important.

In terms of support for scientific and technical jobs, I have seen a figure which illustrates that 8% of total R&D staff in the 15 EU member states are involved in various projects under the Framework Programme.

In terms of networking between research players, in the 8- year period up to 1995 EU measures have helped to create over 150,000 international co-operative links between large enterprises, SMEs, universities and research centres.

There are clear opportunities presented to business, both big and small, and the Framework Programme is a positive stimulus to both the European and our respective national systems of innovation.

Practical results

There are many practical results that have been achieved by those who have participated. Among them are world firsts, such as

• the complete sequencing of a chromosome of a living organism achieved under the Biotechnology Programme as a result of 147 scientists being mobilised within a network of thirty-five laboratories. Over and above the immediate application in the food industry, this research should make it possible to understand how living cells function and, in particular, the ageing and cancer mechanisms.

and

• the production of thermonuclear fusion reactions. The hope is that, one day, fusion energy can be harnessed for electricity production. From my limited knowledge, I believe that someday it will be achieved.

Under the current Framework Programme, UK and Irish researchers have been partners in many project consortia. In fact, approximately 20% of all the links created by Ireland with other countries under the FP4 are with the UK.

Ireland/UK links

Examples of the Programmes where the highest number of Ireland/UK linkages occurred are:
• Industrial & Materials Technologies – 273 links (of which one was with Northern Ireland)
• Telematics – 266 links (of which four were with Northern Ireland)
• Agriculture and Fisheries – 226 (of which nine were with Northern Ireland)
• Information Technologies – 140 (three of which were with Northern Ireland)

These are the sectoral areas and the numbers which can be built upon in the future and every effort must be made by all of us to achieve this.

FP5 Programme

As I have already indicated, this is the year in which we expect that negotiations on the Fifth Framework Programme to cover European research and demonstration activities for the years 1998-2002 will be concluded. In this regard, a conciliation procedure between the Council and the European Parliament is under way with a view to reconciling the positions of both sides.

This is not an easy task and time is not on our side. However, we are all agreed on the importance of arriving at a conclusion so that the process of the publication of calls for proposals and the submission of applications can commence as soon as possible.

Shortly, Ireland, like other Member States, will appoint its National Delegates to each of the FP5 Programme Management Committees. These delegates will play a crucial role in representing the national view in Brussels, in promoting the Programmes at home, in maximising the benefits of these Programmes to Ireland, and by acting as a source of advice for potential participants, particularly small- and medium-sized industries.

A chart listing these delegates and the areas to which they have been appointed will be published and will be widely distributed. It will also be available through "The CORDIS-Ireland R&D Information Service". This is a specialised information window, created jointly by the European Commission and our Office of Science and Technology at the Department of Enterprise, Trade and Employment. Its goal is to help, develop and support communication between the EU Member States and Ireland in the area of R&D. There is a similar service between CORDIS and the UK.

As the Framework Programme is wider than the EU, it can also be accessed by those beyond the EU. But this is just one of many sources of information for those researchers seeking partners.

In January, we will be holding a "Fifth Framework Programme Fair" which will be held in Dublin. This will be the main national event for those researchers wishing to participate in the various thematic programmes and in seeking to find suitable partners. We have invited leading speakers from the Commission to speak about the Fifth Framework Programme in detail and anyone interested will be very welcome to attend.

Ireland/UK similarities

Ladies and Gentlemen, events such as today's are highly important in helping to build networks and foster increased cooperation between our two countries. Ireland and the UK are very similar in a lot of ways. We can all think of the obvious ones – an element of shared history; a language; and we are both islands.

In terms of our respective policy approaches to the Fifth Framework Programme, we have shown similarities in a number of areas – our concern to ensure that the role that SMEs might play could be optimised; our concern to ensure that the Programme is well-managed.

We have also had some differences of opinion. But nothing that cannot be overcome. For example, we have concerns in regard to the proposed aeronautics research activity. The EU aeronautics industry comprises just four big players and this has the potential to exclude researchers who do not belong to the "club". However, properly managed and implemented, this will be an opportunity for researchers in all Member States to contribute to the European research effort. The club can and should involve the whole supply chain: it can and should look across all Member States for potential partners. This should ensure that the European taxpayer is getting value for money in optimising the opportunity for excellent research and its positive economic consequences.

Conclusion

I would like to finish with a thought from the American economist, Mr Kenneth J Arrow. In his contribution to the recent publication "International Perspectives on the Irish Economy", Professor Arrow describes knowledge as a productive resource in the economy which is different in a fundamental way from other resources in that it is not used up. The implication of this, of course, is that knowledge can be shared and passed around, firm to firm, country to country, without it being lost to anyone.

This is a powerful message. So fundamental, yet so powerful. It is the very basis on which the whole Framework programme is built – the notion of co-operation and sharing knowledge for mutual benefit and well-being.

LIVING AND WORKING SPACE

The Foundation held a lecture and dinner discussion at the Royal Society on 14 July 1998 on the subject: "Quality of Life for the Millennium Generation – 'Living and Working Space'". The Rt Hon The Lord Jenkin of Roding was in the chair and the event was sponsored by the Department of the Environment, Transport and the Regions, the Health & Safety Executive, and the Foundation's Share Sponsorship Scheme (Comino Foundation, Esso UK plc and Glaxo Wellcome plc). The speakers were Dr Geoffrey Robinson CBE FEng, Deputy Chairman, Foundation for Science and Technology, Professor Martin Boddy, Director, Urban Centre, School of Policy Studies, University of Bristol, Mr Dave Hampton, Head of Environment Group, ABS Consulting, and a speaker from the day's workshop for younger scientists and engineers.

Professor Martin Boddy*

Introduction

The 20th century has, above all, been the century of the city. In 1900 no more than a dozen cities world-wide had a million or more inhabitants. As we move into the next millennium, around 500 or so cities will top the 1 million mark and more than half of the world's entire 6 billion population will live in urban areas.

What then of the 21st century? Focusing here essentially on the UK context, it is worthwhile, at the outset, reminding ourselves of some of the ambiguities over the ways in which cities have been seen historically. There is the long-running counterpoint between 'the country and the city' – as the late Raymond Williams argued so eloquently in his book of the same title – urban dystopia counterposed to the rural idyll. The countryside and the rural has over many centuries been portrayed as, variously, virtuous, ordered and, in some ways, innocent. The city, on the other hand, 'the city of the dreadful night' has been portrayed as dark, malevolent and alienating.

On the other hand, we have the historical notion of the city as the cradle of civilisation and culture through the ages. Cities have been seen as the focus for artistic, architectural and intellectual endeavours, as the locus of governance and, indeed, as the focus for economic expansion and innovation.

If one then looks to the experience of recent decades, the picture is interesting. The 20th century may have been the century of the city, but in the UK and elsewhere many city dwellers have been voting with their feet. The conurbations and the larger urban areas have been losing both employment and population. The smaller towns and more rural areas on the other hand have been growing. The less urban the area the faster the growth, the more urban the more rapid the loss of people and jobs. And the inner areas of the largest urban areas have generally seen the most rapid decline.

There are variations of course. There has been some migration back to the cities, particularly of the younger age groups – though insufficient to offset the overall loss of people and jobs. Most recently inner London has stemmed the tide. London, it would have to be said, however, is a world city and dances to a different tune. Overall, this pattern of 'counter-urbanisation', as it has been called, looks set to continue well into the next millennium.

Where shall we live in the next millennium?

Against this overall context, the conundrum set to be *the* national planning issue for the next millennium is, to quote the title of last year's government consultation document: *Household Growth: Where Shall We Live*. Official forecasts predict an increase in the number of households in the UK between 1991 and 2016 of 4.4

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* *Director, Urban Centre, School of Policy Studies, University of Bristol*

Summary: Professor Boddy commented that in 1900 no more than a dozen cities world-wide had a million or more occupants. Now, around 500 cities would top the one million mark and more than half the world's entire 6 billion population will live in urban areas. He discussed recent and likely future trends, concluding that there could be some counter-urbanisation and limited de-concentration but no demise of the cities as we know them today. Mr Hampton examined how the best quality of life might be achieved for those working in offices.

million. Much of the predicted growth is focused on the already expanding areas of the outer south east, East Anglia and the South West. And much of the pressure for growth is likely to follow the patterns of counter-urbanisation identified earlier, threatening the smaller urban and the more rural areas. It is a threat, moreover, which has seen potential target areas for new development up in arms, and government and opposition, earlier this year, engaged in a bizarre kind of Dutch auction arguing down the amount of greenfield development which would be needed to accommodate the projected growth.

This really is, however, an issue which is not going to go away. The figures, for all the argument there has been, remain robust. It is an issue, as well, which many observers believe cannot be accommodated in a piecemeal fashion by one-off battles over new greenfield developments. Something closer to the planned, post-war development of new or expanded towns may well be the only way of addressing the issue.

What drives the shifts?

But what of the economic and technological imperatives driving these shifts.

First: *economic changes lie at the heart of urban change and the geographies of where we will live and work.* The major cities of the UK which grew so rapidly in the latter part of the 19th and the first two thirds at least of the 20th Century, the high density housing and successive innovations in transport and communications were linked, above all, to the growth of manufacturing industry.

It was the rapid collapse of domestic manufacturing in the 1970s and 1980s and the closure of the associated docks and harbourside facilities, for example, which left so much of the urban infrastructure, not to mention established skills and working patterns, redundant – this too was a key factor behind inner city decline.

Much of manufacturing for the UK market shifted overseas as innovation in the transport and communications of goods, people and information allowed for the increasing globalisation of economic activity. Newer manufacturing within the UK as well was geographically more dispersed. The cities which did best were those which captured new service-based activities, finance and business services in particular: the rise of the 'post-industrial city'.

Second, as this suggests: *many if not all of the major shifts in pat-*

terns of urbanisation have been shaped by innovation in transport and communications. There is a view that we are just in the early stages of an upsurge of innovation and growth based on the microchip, satellite communications and convergence around digital technologies. Knowledge and communication will themselves be the drivers of growth and development in the information age. This immediately poses the question as to the likely impact on patterns of living and working in the next millennium and for the future of the city.

There have been and will be massive increases in the speed, effectiveness, cheapness and what might be called 'smartness' of communication and information flows, both corporate and individual. This has already freed up patterns of corporate location and facilitated much greater dispersal and de-concentration nationally and globally, and more is to come. Francis Fukuyama in a much referenced but I suspect less often read book predicted 'The End of History'. It is becoming equally fashionable to talk of 'The End of Geography'. Is it also the end of cities as we know them?

There clearly has been considerable dispersal of economic activity. In the UK, call centres, 'back office' functions and a whole range of transaction and data processing have dispersed to lower cost locations with friendly regional accents. On a global scale, Swiss Air's accounting and ticketing services are located in Bombay, American Airlines in Barbados. Financial transactions for New York are processed overnight in Ireland while the financial masters of the universe sleep.

Cities and city-based office complexes will remain, however, a key focus for economic activity and seem set to continue as such, because the benefits of agglomeration and of scale remain strong in many ways. The major agglomerations are centres of innovation at the core of global networks. Many activities, moreover, continue to thrive on face-to-face contact – increasingly so in a fast moving and uncertain world requiring learning, innovation, flexibility and collaboration. The professional and managerial workers in the younger age groups on whom businesses increasingly rely, are attracted by an urban lifestyle. Major office complexes such as Canary Wharf also continue to offer considerable benefits in terms of economy and efficiency.

At the other extreme, home-working and 'tele-commuting' have prompted many column-inches in the press as the coming pattern of work for the 21st century, a panacea for stress, traffic congestion and quality of life. It does happen in some professions. Recent research, however, shows little evidence of any real growth overall. In the information and data processing sector, the control and work discipline of centralised, office-based employment combined with dedicated computer systems are seen as the keys to high productivity – the new 'call centres' are closer in this sense to rou-

tinised factory production.

Third: *the continuing importance of planning and urban containment.* One of the great successes of the 1947 Town and Country Planning Act and subsequent legislation in the UK has been its capacity to contain and concentrate urban growth and to counter wholesale dispersal. This will continue to be the case, notwithstanding the question of the 4.4 million households and the recent furore over threats to the greenbelt. The planning system gives us the capacity to steer and to shape the pressures for growth and de-concentration. The ideal might well be the channelling of growth into compact cities within growth corridors.

Finally, three aspects of urban change which look set to continue well into the next millennium – and which to some extent pull in different directions:

• First, increasing peripheral or 'edge city' growth around and between existing core urban areas including office campuses and out-of-town retail and entertainment complexes: what is emerging is more of a multi-centred pattern of living and working less focused around downtown.

• Second, the selective revival of core urban areas: this includes increasing emphasis on arts, cultural and recreational activities. It has also included some increase (led by London) in urban living and the attractiveness of urban lifestyles, particularly among younger age groups and the better off.

• Third, an increasing polarisation and fragmentation, economic, social and spatial, between the urban poor in both the inner cities and the 'outer estates' on the one hand and the majority of the urban population.

So counter-urbanisation and limited de-concentration: yes. Changing patterns of living and working: yes. But wholesale dispersal, the end of geography and the demise of cities as we know them: clearly no.

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Mr Dave Hampton*

(Based on speech given at the event)

The year 2050 is only some 50 years away. We know that much has changed in the past 50 years, but not necessarily as we predicted. Predicting the future is not easy.

Mankind has been caught napping by the Millennium. The inevitable has taken us by surprise. We consider the 'here and now' and ignore the big picture, for fear of scary home truths. We need a vision that works and that we can all share.

Insiders know greening is essential. But do we know that it is businesslike? Why? More and more customers expect 'corporate greenness'. But, more important, it can contribute directly to the traditional financial 'bottom line' as well as to the more modern measures of sustainability or corporate citizenship. Single-minded greenness has brought us to where we are today. But the greatest gains can now be achieved by convincing the big players in our multi-national economies of the benefits of being 'respectably

green'. The big players are not only multi-national corporations. The consumer, as an economic class, is the biggest and most powerful single player of all.

But here comes a scary home truth: we have run out of space! The 'ecological footprint' of a city like London is the size of the United Kingdom. It takes that much land to support it. In an environmental sense, there is no space left for living or working. This unpalatable reality must be communicated to others in ways which will not lead to panic, denial and conflict, but which will inspire everyone to seek workable consensus solutions.

The first place to look for solutions may be in our buildings. Buildings are for people. Concern for people, their purpose, their business and their enjoyment is the first step. Those concerns form the basis on which to plan and design the built environment in as sustainable a way as we can.

Quality green buildings provide amazing spin-off benefits. Occupant delight. The pleasure of a waste-free zone. Positive attitudes. Even enhanced performance from a positive feeling about the building. But can this be quantified? We think it can, at least at

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* Head of Environment, ABS Consulting

a simple level. We use an analytical technique we call 'OLS', or the *Overall Liking Score* (fig. 1). It is a structured way of asking occupants what they like about their surroundings. The process by its nature engages the occupants. "No-one has bothered to ask us before". It is a common response.

So, what does this say about buildings for the year 2050? Author of the widely regarded *Factor 4*, Amory Lovins has suggested that buildings should "create delight when entered, harmony when occupied, regret when departed". It has been said that the environment in which we house ourselves eventually shapes us. Our buildings (and how we manage them) are perhaps more important than we might imagine. Sustainable Development is a vital balancing act that we are just beginning to understand (fig. 2). And 50 years isn't that far away.

We chose a simple system called the *Office Toolkit* for a broad-ranging environmental review of our own offices (fig. 3). As a result, we are improving our energy efficiency, using less paper and changing our commuting and business travel habits. We will look again and again at our business lifestyle and keep learning until we know it is truly optimised.

Guiding principals for rethinking and combining greening with innovation are emerging such as minimalism, elegance, delight, diversity, holism and mutual respect. We are beginning to understand more fully the ecology and metabolism of our buildings and our immediate surroundings. The next step is to learn more about our own human ecology to shape our environment, so that it may start to shape and delight us. Then we all may well discover that it is 'cool' to be green, and surprisingly delightful to be sustainable.
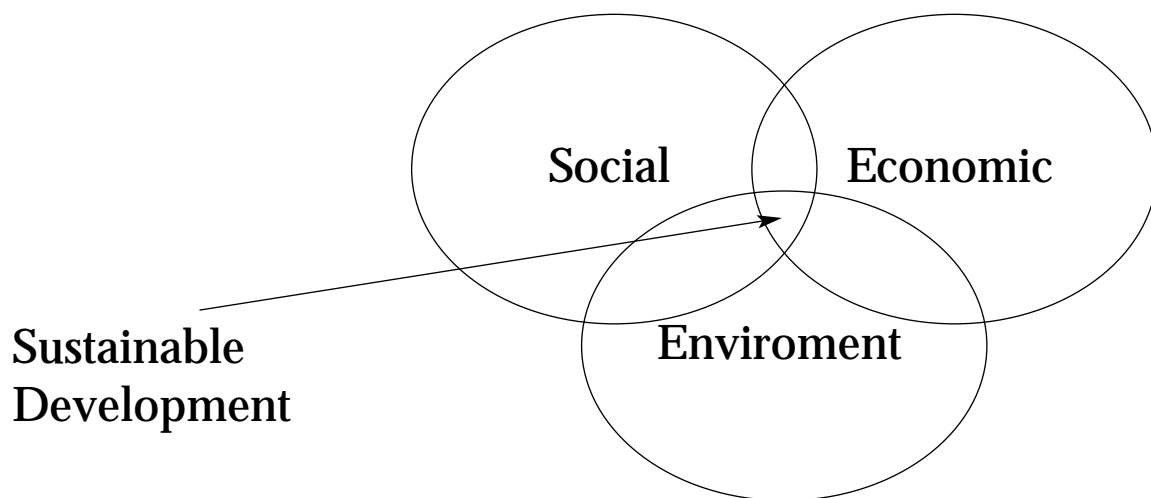

Delighted by daylight

Occupant delight of working near a window
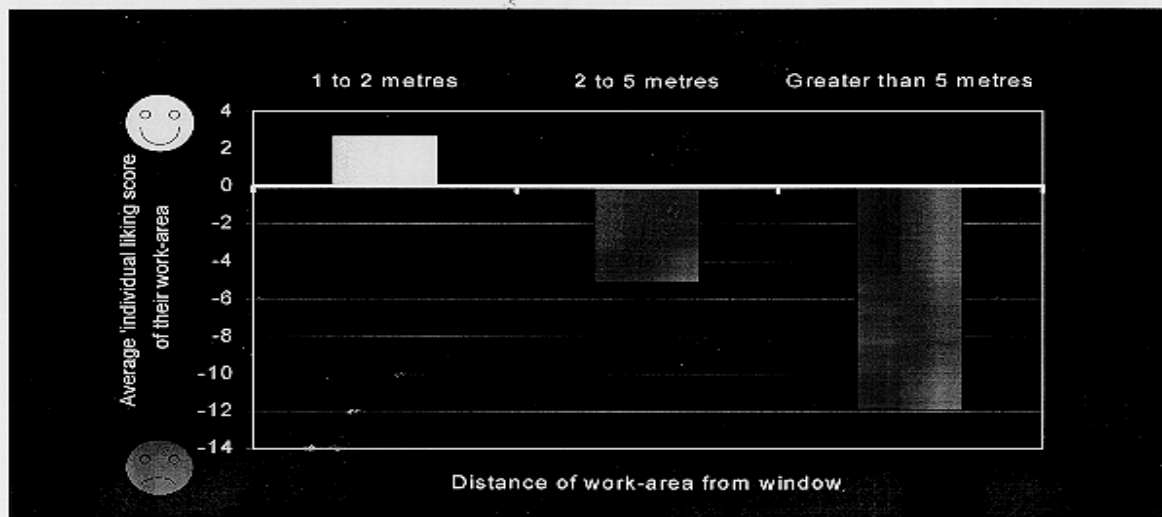
▲ Fig. 1. Evidence of a strong link between daylight and building occupant delight.
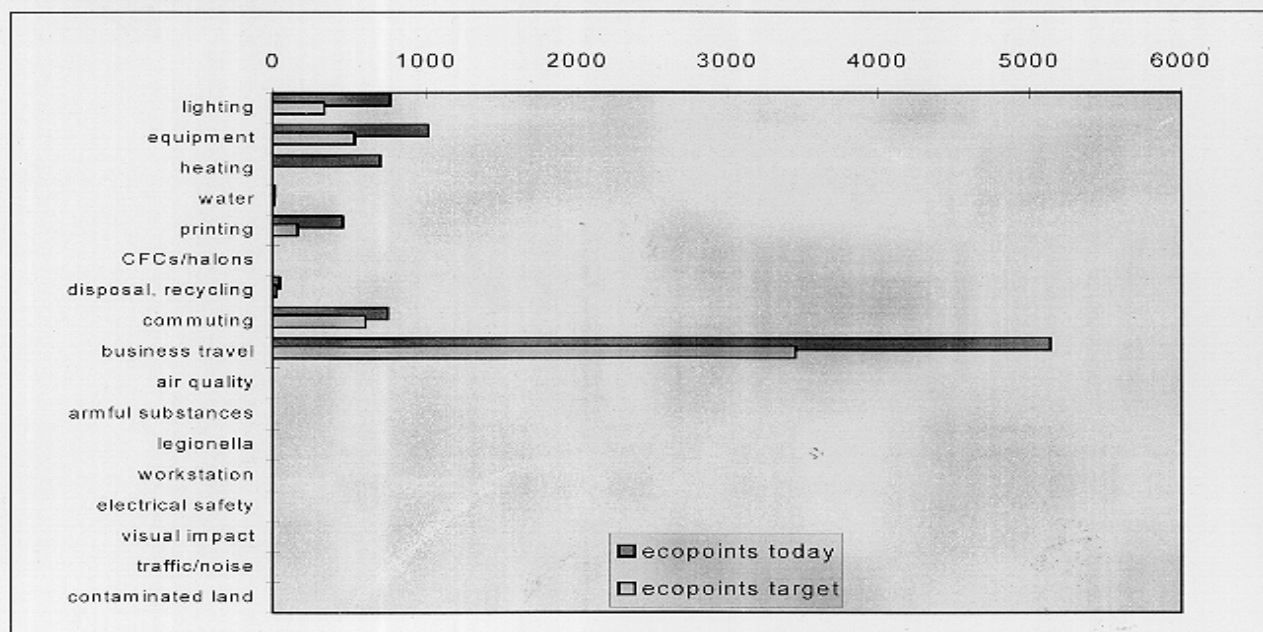

Green & Businesslike

Social

Economic

Enviroment

Sustainable Development

Balancing social, economic and environmental needs

▲ Fig. 2. The vital balancing act of sustainable progress – a simple model.

Environmental Impacts – Axe & Bottle Court

▲ *Fig. 3. Sample 'Fingerprint' results from ABS Consulting's own office using the Office Toolkit.*

THE THIRD AGE

The Foundation held a lecture and dinner discussion on 3 November 1998 at the Royal Society on "Quality of Life for the Millennium Generation – 'The Third Age'". The event was sponsored by British Telecommunications plc, Department of Health, Department of the Environment, Transport and the Regions, and The Rt Hon The Lord Jenkin of Roding was in the chair. Mrs Elizabeth Mills, Director, Research into Ageing, introduced the evening for which the speakers were Professor Anthea Tinker, Director, Institute of Geronotology, King's College London, Dr Peter Greenaway, Chief Scientific Officer, Department of Health, Professor Peter Lansley, Faculty of Regional and Urban Studies, University of Reading, and Dr Sally Caims, ESRC Transport Studies Unit, University College London.

Dr Peter Greenaway*

Introduction

The ageing population will create major challenges and opportunities. Society and its expectations may need to be redefined. The compression of morbidity must become a major objective for all those involved in health and social care. New coalitions of researchers are needed to deliver the agenda set by the ageing population.

Our increased life expectancy and the decreased birth rate are together conspiring to increase the proportion of the elderly in the population (fig. 1). This should be viewed as a success story and a triumph for the various health and social care policies introduced by successive governments. But there are some obvious implications with larger numbers of retired people being supported by a reducing employment base.

Launching the UN International Year of Older Persons the UN Secretary General, Kofi Annan, argued that the elderly should be viewed as a resource rather than a burden. His message was that governments should develop active ageing policies and explore

Summary: Dr Greenaway discussed the major problems and opportunities that the ageing population would create. There was need, he said, to redefine society and our expectations within it, undertake work to compress morbidity, overcome the disability barriers created by the ageing process, and create new coalitions of researchers. Professor Lansley discussed construction design and the contributions that could be made by a very wide range of researchers in apparently disparate fields.

situations where older people can make continuing contributions to society. He suggested that "life is becoming less like a short sprint and more like a marathon".

It is easy to get complacent over our increasing life span. It is a fact that in two short decades the AIDS epidemic alone has reduced life expectancy in parts of South Africa by over 20 years – from around 60 to below 40. A similar reduction in life expectancy is also occurring in some of the former States of the Soviet Union. Long life is a fragile achievement and only relatively small changes in our environment could well have significant effect and undo the good work of several generations. For exam-

* Chief Scientific Officer, Department of Health

ple, we do not know the effects that climate change or the increased incidence of multiple resistant bacteria will have on life expectancy.

This is where the government's Foresight Programme may be able to add value and help us identify where scientific and technological developments are needed to accommodate at least some of the major changes that could influence the quality of life of the older generation.

Although we may be living longer, are we healthier as a result or does the prospect of old age merely bring with it the prospect of a greater number of years of ill health and consequential financial burdens? There is insufficient evidence to make firm conclusions on this point.

The biological processes involved in ageing are far from being understood, but their physical effects are pretty obvious (fig. 2). The incidence with which these effects occur vary depending on personal characteristics – including genetic background, time and even geography. This is good news as it means that there is scope for identifying best practice and designing interventions that will prevent or delay the onset of disease and, where these are not available, to ameliorate the consequences. It is the compression of morbidity, the reduction in the number of disability years experienced during the end game of life that represents one of the greatest research challenges of today.

It has been said that research has for far too long concentrated on the major killers and on health improvements associated with the acute diseases. Research on the chronic diseases, the diseases which make daily life tiresome for the elderly, has been the poor relation. This might have been because of difficulties in attracting research funding equally, it might have been because the problems posed were too difficult or too intractable with the technology then available. Happily, this trend seems to be changing.

This is not a comprehensive list of chronic diseases experienced by the elderly but it is sufficient to make a point (fig. 3). It has been shown, for example, that 56% of adults in residential or nursing homes had some form of cognitive impairment, 37% had a musculoskeletal disorder, with the largest proportion having some form of arthritis, 30% of residents had suffered a stroke or had epilepsy or Parkinson's disease, 17% had visual impairment and 13% were deaf or had impaired hearing. Incontinence is the single main factor which precipitates entry into institutional care; arthritis and deafness are major issues affecting quality of life in the home.

These are all areas where compression of morbidity will have significant effect on quality of life. They are all incredibly important areas where there are great opportunities and challenges for modern science and technology. And no single institution can be expected to tackle them alone. Government and industry, the public, private and charitable sectors need to work together to devel-

op the improved interventions needed.

The Technology Foresight Programme can take some credit for diverting at least some public sector research funding into the ageing area. The major Research Councils, the MRC, EPSRC, BBSRC, NERC and ESRC, all have new initiatives related to ageing, generally badged up under the EQUAL initiative – a programme launched by the Director General aimed at extending quality of life and which responds to one of the recommendations made by the Health and Life Sciences Panel of the Technology Foresight Programme. And, as David Metz will confirm, there has been at least one Foresight Challenge in the area, in this case AgeNET which is funded through a combination of public sector, private sector and charitable funds and which aims to stimulate the formation of networks in this area.

In addition, the coming Fifth Framework for European research will contain a key action specifically directed towards healthy ageing and the generation of competitive advantage for a range of health related industries and sectors.

But if activity in this area has increased as a result, is it enough and is it going in the right direction? It is probably too soon to say. A forum is still needed to facilitate interactions that would not necessarily or easily take place. Communication between the different sectors involved in ageing issues was, and still remains, poor and cross-disciplinary opportunities are being missed as a consequence.

A Swedish study recently showed that wearing hip protectors could give a 56% reduction in hip fractures in the vulnerable old: a good preventative measure that was unpopular amongst the target population because the devices were bulky and unsightly. This is but one example where cross-disciplinary working, this time between the rehabilitation engineers and fashion designers in the clothing industry, could produce highly innovative products and desirable benefits. Many of our great technological advances have come from working at interfaces between sectors, and this is what we need to encourage.

But in the brave new world we may also have to redefine society as we now know it. Whether we like it or not, the use of public versus private finance to accommodate the cost of growing old and the cost of caring for the elderly population is something that has to be keenly debated. Regardless of the outcome, the scientific and technological innovations that we all hope will come along to prevent, cure or ameliorate the ravages of old age will need to be paid for and innovative ways of doing this will need to be sought.

A cultural revolution, perhaps spearheaded by the financial institutions, may be needed and clarity will be required to differentiate the true needs of an individual, the costs of which might be regarded as a legitimate call on the public purse, from their wants, hopes and aspirations which might be regarded as something that should be paid for through private finance.

One of the likely innovations during the next round of Foresight, due to start next year, is the creation of a thematic panel on ageing. This can only be welcomed as we clearly need to identify and develop strategic alliances across different sectors if we are to improve the quality of life of the Millennium generation whilst, at the same time, identifying new market opportunities and improving industrial competitiveness.

There are four main challenges, two societal and two techno-

logical, that we will need to face as we harness new technology to do this (fig 4). We will need to redefine society and our expectations within it, we will need to undertake further work to compress morbidity, we need to smash through disability barriers created by the ageing process and have inclusive design of the tools and environments that we all consciously and subconsciously use for daily living and we will need to create new coalitions of researchers to take forward this broad and challenging agenda.

Challenges for the future

Redefining society and its expectations
Developing new coalitions of researchers
Compressing morbidity
Removing disability barriers

▲ *Fig. 4.*

Professor Peter Lansley*

Introduction

The case for greater attention to be given to research for the Third Age is both pervasive and persuasive. But, despite the need, can scientists and engineers achieve worthwhile returns on any research investment? Even before this, we might ask about the level of interest in undertaking research in ageing-related fields.

To answer these questions I will give an example of how some scientists and engineers have responded to opportunities to work in the area.

However, I should first declare that I am a newcomer to research for the Third Age and into ageing, an enthusiastic newcomer. The reason is quite simple. In my world of construction, straightforward engineering and environmental research are well supported, so too is competitiveness research which has the aim of helping the clients of the industry. But quality of life research, that which relates directly to the needs of users, especially older people, has been neglected. Apart from the high profile but small budget work of some charities, the rest is negligible and quite fragmented. Regrettably, much construction research and education reflects what we see in practice, a weak understanding of the needs of users and, at times, even a lack of recognition of the end user. Much design is based on the capability of a six-foot, right-handed male with perfect hearing and vision able to compensate for the deficiencies in the built environment by a combination of strength and guile. There are too many examples of dangerous or inconvenient planning and construction which increases the problems of social isolation and health risk for older people

Design for all

Of course, we should be careful when thinking that it is the older person who needs better design. We all do. When I asked an older friend about the benefits of moving to a sheltered home with many thoughtful design features, she responded "Well, when my daughter comes with the twins she doesn't knock the paint off the doors with the buggy. I don't have to worry about the grandchildren being frightened by the noise of the cistern, falling down the stairs or dropping food on the carpet, and they love to do the washing up".

The new home, a flat, had wide doors, easy clean carpets, modern plumbing and a sink with adjustable height.

But what an interesting reply! It was not about how she used her home but about the able-bodied visitor. Her reply echoed a point frequently made by experts in the field of ageing, that we shouldn't make assumptions about how people assess their environments. Indeed, in this case my neighbour hardly mentioned those very features which were so important to her comfort. She lived in a non-handicapping environment, an environment where the design is so sensitive that it is almost invisible to the user.

However, when asked about the locality, there was a different story. My neighbour could not go out of her new home because of the state of the pavements; the transport system couldn't cope with her wheelchair; and, besides, the bus timetables did not mesh. She was denied the pleasures of the banter of the butcher's shop, the delicious smells, sights and memories when passing the bakery, and the small miracles (to which only older ladies can attest) which take place in the hairdressing salon. She was marooned, the victim of a handicapping environment.

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Yet many professionals in the construction industry will tell you that we can do better than this. We can design and construct buildings which are better for all comers, not just for clients, and we can improve the existing building stock and transport system. These two areas are always at the top of the agenda for actions which would improve and extend the quality of life for the greatest number of people. They will also say that by designing for the less mobile we can improve the quality of buildings and the environment for everybody

Closing the gap through research

Despite my concerns about the imbalance in priorities for construction research, the pendulum has started to swing back towards a healthier concern for quality of life issues. For example, recently EPSRC has taken a much broader view of its remit, enthusiastically embracing interdisciplinary research. Its traditional wariness of social scientists and health experts has evaporated. Indeed, in late 1997 it was the first Research Council to take an EQUAL (Extending Quality Life) initiative, and this happened to focus on the Built Environment. This had a broad remit, although most proposals were related to ageing and the needs of older people.

The initiative, which required researchers to work in collaboration with user groups, led to some remarkably good proposals, from academics across the full range of construction, engineering, social sciences, medicine, health and other disciplines. Indeed, there were over 40 disciplines and sub-disciplines represented amongst 57 applications for funding (fig. 1). And it involved an exciting range of collaborators (fig. 2). The proposals confirmed that there are many people and organisations from across the board who are keen to contribute to research which will benefit older people and more generally improve the quality of life.

Whilst new technology figured often in the proposals, largely as an enabling technology, especially for dealing with the existing building stock and environment, at the heart of most proposals were basic and traditional design issues. They emphasised the potential for solutions which can be achieved through existing professional practices (fig. 3).

EPSRC and EQUAL – Some of the Fields Represented

Architecture, Building, Construction Management, Surveying
Engineering – Audio, Automative, Civil, Corrosion, Design,
   Electrical, Electronic, Materials, Mechanical.
Urban Planning, Geographic Information Systems,
   Transportation, Environment
Computer Science, Mathematical Modelling
Anthropology, Sociology, Psychology, Science Policy
Clinical Psychology, Opthalmology, Podiatry, Gerontology,
   Human Ageing
Medical Rehabilitation, Human Sciences, Child Health,
   Community Medicine
Clinical Biochemistry, Rehabilitation Engineering,
   Bioengineering
Cybernetics, Acoustics

▲ *Fig. 1.*

As this initiative was EPSRC's first rather tentative step into a new field it did not give the call for proposals a high profile. Yet if such a modest call was able to generate so many good ideas, imagine what talent would be attracted by bigger calls and by those for research in other fields.

Building a New Research Community

One of the reasons why the response was so good is that many of those making proposals were attracted by the intrinsic value of the issues which need to be researched. This can be illustrated by contrasting the richness of the environment of quality of life research with that of competitiveness research in the construction field through the eyes of young researchers with whom I have spoken (fig. 4). Competitiveness research in construction has served me well. I have had a fascinating time working with a legion of larger-than-life characters. But, despite its attractions, the construction industry and its clients find it difficult to benefit from research. And, for example, young researchers often find themselves in an unnecessarily hostile environment with too much energy being expended on gaining trust and co-operation to secure a modicum of data. In the ageing area the opposite seems the case. Here we find a rich multi-dimensional world. Usually the collaborators and subjects are intensely interested in the research with which they are involved and in the careers of the younger researchers with whom they work. Overall, the environment appears as more stimulating and developmental; quite simply, as more attractive. That's a good basis for building any community.

There is another important difference. In this highly interdisciplinary field, each contributing discipline and profession feeds off each other. Collectively they push up expectations and standards. This was brought home to me very forcibly at the meeting of the panel which assessed the EQUAL research proposals. Until then, I thought that I had a good feel for the standards expected by users of research. Executives can be very severe judges, especially of work from universities, but they are left standing by those who represent the field of ageing. The traditions of the medical and

health sciences coupled with the social sciences, and the focus on evidence-based policy and practice, leads to standards which are very high indeed. The practitioners, those who work with older people and apply solutions from research, are particularly demanding. This strikes me as good for the training and development of new researchers, although it may be off-putting for those with more experience whom we want to attract from other fields.

Here there is an important job to be done by the Research Councils. They need a sympathetic approach to spawning new interdisciplinary communities. Just as companies choke new ventures by applying the same systems to fledgling businesses as to mature ones, so the Research Councils could do irreparable damage to research for ageing by basing expectations on what happens within well established fields. An even greater threat comes from the inappropriate handling of applied interdisciplinary research in the Research Assessment Exercises beloved by the Higher Education Funding Bodies.

Environment of Research: A Comparison

	Competitiveness Research	**Quality of Life Research**
Stakeholders	Limited	Many and varied
Beneficiaries	Managers, Professionals	Older & Disabled People
Users	The Beneficiaries	Health Specialists, Designers
User Demand	Limited and fickle	Unlimited
User Agenda	Dominant but unclear	Open and negotiable
User Experience	Often limited	Generally strong
User Standards	Unpredictable variable	High
Information Providers	Often distant, guarded	Generally close, open
Disciplinarity	Single & Multi	Multi & Inter
Culture	Technocratic	Helping People

▲ *Fig. 4.*

From policy to practice

However, there are many reasons to be optimistic. Firstly, there already exists a good foundation on which to build a major initiative, laid down by some remarkably resourceful national and local charities. They sponsor research enthusiastically yet prudently, they network efficiently, they lobby with conviction, and they understand the issues involved better than any other type of agency. For example, they have recently produced some very well argued and balanced reviews as evidence to the Royal Commission on the Long Term Care of the Elderly. Secondly, there are a number of well-established research groups, with either a sole or a part interest in ageing. Thirdly, there are the enthusiastic but to some extent untutored academics and researchers who are keen to become involved but have yet to seize the opportunity.

One example of the level of interest in the area comes from a rather informal survey of academics across a wide range of non-medical fields. Overall, although they had not given much thought to ageing research, they could point to a list of tempting issues which would capture their attention and commitment. Whilst valuable but rather predictable replies were received from engineers, bio-scientists and social scientists, there was a big surprise from those working in the humanities. It wasn't just the historians looking for living testaments to major world events, but linguists, lawyers, political scientists and artists. They were interested in, for example, the changing nature of language, right and wrong, value systems and the interpretation of art and design.

It is responses such as these which make me even more enthu-

▲ *Professor Anthea Tinker, Director, Institute of Geronotology, King's College London, pictured at the meeting.*

siastic for research into ageing and for older people, because they show that there will be a strong and genuine response to EQUAL and similar initiatives from scientists, engineers and other researchers. Even the present planned initiatives of the Research Councils are unlikely to tap the full reservoir of interest and talent available.

So, can scientists, engineers and other researchers rise to the challenge of research for the third age?. Well, the evidence is that they are already doing so and with much enthusiasm.

FOUNDATION NEWS

Younger Scientists and Engineers at the Foundation's Events

The Foundation's Council had felt that the lecture and dinner discussions needed a greater injection of younger opinions and ideas. Associate Members were encouraged to be represented or to bring younger members to the events, and some did so. However, that was insufficient and so a plan proposed by Dr Geoff Robinson was adopted to run a series of eight events under the general theme of "The Quality of Life for the Millennium Generation" during 1998, 1999 and 2000.

Each evening event is being preceded by a day's workshop for 18 to 22 younger scientists, engineers and leaders of 25 to 35 years of age from the many different sectors covered through the Foundation's broad membership. All then attend the evening event, and one of them reports the views of the workshop. At a

recent workshop facilitated by Professor Chris Elliott and Dr David Metz, the spread of expertise and experience included people from DTI, Rolls Royce, HSE, Racal, Hertfordshire University, Forum for the Future, DETR, Railtrack, Oxford University, BUPA, London Transport, OST, Norweb, WS Atkins, Royal Commission for the Exhibition of 1851 (Scholar) and others. The workshop team brought much to the evening's event after a fascinating day's workshop.

Three of these special events have already taken place: "Living and Working Space", "The Third Age" and "Mobility in the Future". At the time of writing preparations are in hand for "The Millennium Consumer".

Summary Sheets

The Foundation provides a neutral forum for the discussion of matters concerning science, engineering and technology. The Foundation can have no opinion, and it is rare that it can itself follow up an event with a working party and report. While many speakers at the Foundation's events kindly produce short papers afterwards for publication in the Journal, a need was identified for reminding people who attended of the discussion held under the Chatham House Rule. This would enable them to take forward any action they wanted to after the event. However, some asked for more than the articles in the Journal, which, for practical purposes, often follow many months later.

Early in 1998 the Foundation introduced a system of producing summary sheets of the discussions after the talks. The summaries have all been restricted to two sides of an A4 sheet, and are circu-

lated to all those who attended within two weeks of the event. After a year of producing them it is clear that they are extremely popular, and an example of a recent one will be published in the next issue of the Journal. The summaries have to maintain the 'neutral' nature of the event, and, of course, must not mention names other than speakers since the discussion is conducted under the Chatham House Rule.

Sir Geoffrey Chipperfield and Jeff Gill take turns to produce the summaries, and the Foundation is greatly appreciative.

While copies are sent to all who attended, the Foundation is happy to send members who could not attend a particular event a copy of summary sheet, but does ask for a stamped addressed envelope.

EXPLOITING RESEARCH

The Foundation held a lecture and dinner discussion on 14 October 1998 at the Royal Society on "Exploiting Research – ingredients for success". The event was sponsored by Amadeus Capital Partners Ltd, Microsoft Research Ltd and Zeneca plc, and The Rt Hon The Lord Jenkin of Roding was in the chair. The speakers were Professor Roger Needham FEng FRS, Managing Director, Microsoft Research Ltd, Dr Hermann Hauser, Director, Amadeus Capital Partners Ltd, and Mr Simon Anderson, Chairman, The Greater Cambridge Partnership.

Professor Roger Needham*

Introduction

I am here speaking on behalf of a body that doesn't exist – it has no legal existence but a very real existence in other senses and it is known as Cambridge plc. There is a very real sense of mutual support among the various different players in that area. However, I should hasten to say we are not saying 'do it like we do'; you may want to interpret what we say as a cautionary tale rather than an example, but I hope it will be interesting.

If you are going to exploit research, the first thing that you have got to do is do it, and in Greater Cambridge there is an enormous amount of research done. Because people tend both to start and finish with the University, I want to start off actually by mentioning some of the enormous spread of other organisations which do research in Cambridge. Some of them are associated with official bodies or have been – the Babraham Institute, there is The Welding Institute, there is the Sanger Centre, and so on it goes. There are a number of industrial and commercial places – there is Glaxo, there is Parke-Davis, there are many more. Some of these are actually in university buildings, but they belong to and are operated by their companies. There is Hitachi, there is Toshiba, there is Xerox, there is Olivetti Oracle, there's SRI, there's Microsoft, and I have only named the ones which came to mind when I thought about this issue in the Tube. Now, some of these, of course, have their own exploitation channels for their research. The industrial places obviously exist primarily for the benefit of the companies that own them, but even there it is not unusual for such places to come up with things that are good and useful and exploitable but don't fit within the business plan of the parent body; at which point they go and do a start-up just like the University might. The striking example here is the Olivetti-Oracle research lab which has generated some number of start-ups. It might be said that that is the principal outlet of what they do; and I think that this is a most splendid achievement. It is a little odd that the people who own them don't seem directly interested in exploiting what they do, but it contributes to the general atmosphere of liveliness and activity.

Importance of research to Cambridge

Research is a very widespread activity in Cambridge and you are quite liable to find that the person next to you in the pub does it, for example. It is part of the atmosphere, which brings me on to the universities, though I concentrate mainly on the larger of the two universities (which I know better), which is of course a very major centre for research. Research is part of the duties of the university's academic employees and, in some sense, they are in breach of their contracts if they don't do it. What is, if anything, more serious is that research is the university's living. Of the grant it gets from the Funding Council, considerably more than half is on account of research rather than of teaching, and means that it is of very great importance to the university to regard research as serious and not something that people do when they have got time. It is the institutions's bread and butter and, of course, if you

Summary: The fact that Cambridge was highly research orientated and that the exploitation of research (and the by-products of research) was well accepted, were among the features mentioned by Professor Needham. For his part Mr Anderson discussed the infrastructure that had led to high economic growth in the Cambridge area. Considerable improvements were necessary if, as was hoped, Cambridge was to become the major European centre for excellence for learning- and knowledge-based business.

can succeed in employing good people they have a passion to do it anyway. Now all that would be true of any good university.

What I think may be truer of Cambridge than of some others is that there has grown up a culture in which exploitation of what you do is considered natural. It hasn't always been like that. As recently as twenty-five years ago, speaking of a piece of work we did in the computer laboratory, my predecessor as head said 'we don't want this exploited, we want it used'. And what he actually meant was he wanted it used around the world, and if it was easier to get it used around the world by not trying to make money out of it, so be it. We wouldn't do that now, I believe. Where this culture came from, I don't quite know. It has always been the case that – well, always is a big word but within living memory it has been the case – that Cambridge has had a very relaxed attitude to outside activities by its academics. It judges its academics by their output not by their input and, to take a concrete example, Professor Hopper, when he worked in the computer lab, which he sadly no longer does, did an above-average amount of teaching, had an above-average amount of research students, had an above-average amount of grants, published an above-average number of papers, did an above-average amount of departmental administration. If he does that, I didn't care if he is Corporate Director of Research for Olivetti. Well, after all, look at me: Managing Director of Microsoft and Pro-Vice-Chancellor. I look in the shav-

▲ *Mr Anderson (left), Chairman of The Greater Cambridge Partnership, with Professor Roger Needham FEng FRS, Managing Director, Microsoft Research Ltd.*

* Managing Director, Microsoft Research Ltd

ing mirror in the morning and say 'who do you want to be today?'

The practical effect of that freedom has been that, if people want to exploit their ideas by starting a company, they can do so without burning their boats with the University at all quickly. Many people, if they start companies successfully, do resign from the university, but they do not need to be in a hurry to do that before they know or have very good reason to believe that the operation is going to succeed. This, of course, applies to relations with large companies as well. We are probably the only university that doesn't know with which companies our academics have commercial relations. Sometimes it is actually very inconvenient not to know.

Equally, we don't assert any rights over the intellectual property that our people generate. This raises a lot of eyebrows. It is a freedom that is very greatly valued by the academics, although, in fact, as a route to making a whole lot of money buying tickets in the National Lottery is probably better. Certainly, having an endowed entry in the National Lottery would be a better bet. And, of course, a very great deal of research is done which is sponsored by the Research Councils and by other bodies who have their own ideas as to the exploitation of intellectual property and insist that the University and the department be involved. But, nevertheless, the principle remains and is valued and a general belief is that it is a good investment by the University because we don't lose very much money thereby.

However much freedom you have got, there has to be the idea, the culture, that exploitation is what you want to go for. And that has grown up, and I have seen it grow up, in the forty years I have been in computing at Cambridge. Today, if you get a computer science degree at Cambridge, you will go to a course of lectures with the operational title 'How to start and run a computer business', and Herman Hauser gives one of the lectures. None of the lectures is given by an academic. All of the lectures are given by people who have done it. And that, I am sure, has an effect.

Finally, of course, the academic staff themselves. We have all been subject to a huge amount of 'jawboning' by the government – if you are familiar with that American expression which is 'trying to change people's attitudes by talking at them' – on the subject of exploitation. What really matters is money. If you find that the guy in the next office is knocking off early to go and see his architect and you know why he is going to see his architect – he can afford a new house – this causes you to pay slight attention to what he might have done to get himself in this satisfactory position, particularly if you are in Cambridge where we are paid about the worst of any British university.

Starting new businesses

I have been talking here from the point of view of the subject I know best, which is computing and information technology, and it would be wrong to take that as too much of an example. In some areas, noticeably in chemistry and pharmaceuticals, bio-technology things, there is a large, prosperous and efficient indigenous industry and, if you look at the exploitation of the university's inventions, and I do because one of the things I do is chair the committee that looks after that sort of thing, you find that, in that sort of area, exploitation is done by licensing to Glaxo, to SmithKlein Beecham, to Unilever, to whoever. When you come to the computing and information technology area, there isn't much prosperous, successful indigenous industry – we all wish good luck to Hermann in his attempts to generate one – and that is why the route of the start-up tends to be very much favoured as there isn't any obvious alternative. So I think that it is no accident that the start-ups are very much concentrated on that area: it is choosing the exploitation that is right for you, right for you personally but right for your subject, which is liable to cause something actually to happen.

As time has gone on, exploitation has become more widespread and, surprisingly often, it has been exploitation, not actually of research but of the by-products of the research. In the course of research in many things, in engineering or physics, you find yourself having to make instruments or apparatus which are incidental to the intellectual knowledge you are trying to gain, which is what research is about, but may turn out to be valuable artefacts of themselves. I want to close by drawing attention to that point. One of the computer lab's most recent start-ups which was passed on very successfully by way of trade sale a couple of years ago was of something which was a by-product of some research. And when people say 'everyone has a duty to exploit the results of their research', I think this is a seriously misleading remark. They should exploit the effects of their research because it is often not the results that have the cash value. What you must never do in a university – and here is the Pro-Vice-Chancellor speaking – is allow what research you do to be perverted by your hope of being able to sell the answers.

So I have said a bit about where the research comes from, where I think the exploitation culture comes from and why, in many circumstances, starting new businesses is the obvious way to exploit it. When you have got to that point and you are sitting in my office as a young researcher or a head of department, I would say 'go and listen to Hermann Hauser' and I will say the same to you.

Mr Simon Anderson*

Some key facts:

• The economic growth in the area is faster than the rest of the UK and there is very low unemployment, about 2.3% in Cambridge which is well below the national average although there are some pockets of high unemployment. This has an impact because there is certainly not enough skilled labour and other labour shortages are starting to emerge.
• There is a growing global reputation for high tech in the area since the original Cambridge Phenomenon report was produced in the mid-1980s. As we have heard, Microsoft is a major boost and we are hopeful that some of the other big players will follow in locating part of their R&D activities in the Cambridge area.
• Interestingly, the high tech community provides 11% of all employment in Cambridgeshire and 15% in Cambridge itself. Looked at on a regional basis, which is all we have, the Eastern Region is the highest in the UK at 4%.
• It is also true that more people want to come to Cambridge than leave, but is high tech sustainable in all senses? Certainly from an environmental point of view the kind of activity in the Cambridge area is clean, but, if you look at the 1980s, most of the Cambridge Phenomenon was computers/hardware and electri-

cal/electronic engineering and R&D led, but since then telecom and biotech have come through as leading elements. R&D has grown 60% over the past 7 years, computer services 70% and telecom and biotech have had dramatic increases but from a very low starting point.
• But the infrastructure is beginning to creak and this is where I have doubts on the sustainability and where something needs to be done.

In summary, there is, in my view, a tremendous opportunity for the Greater Cambridge area to be the European Centre for Excellence for learning- and knowledge-based businesses; for example, Hinxton is the World Centre for genome sequencing, Addenbrookes has enormous potential for medical research and, of the biotech companies, Cantab was the first biotech company to go to NASDAQ and effectively change the rules of the London Stock Exchange to allow companies to be listed that had no profit record whatsoever. In fact, one-third of the listed biotech companies in the UK are on the Cambridge Science Park. Of course, biotech, by its very nature, leads to collaborative links with major pharmaceutical companies.

In terms of size there are some 1,150 high tech businesses in Cambridgeshire, of which 10 have employees of more than 500 and 863 are very small with employees of less than 25. However,

* Chairman, The Greater Cambridge Partnership

this does encompass 37,000 jobs and that excludes those businesses that are outside the actual county boundary.

Some key ingredients

Roger Needham has talked about the enormous importance of the University of Cambridge and the part that it has played which is of extreme significance. Other significant factors include the Cambridge Science Park which, set up by Trinity, was the first Science Park in the UK. It limits those that are there to being involved in scientific research associated with industrial production and possibly some light production needing regular consultation with scientific staff together with appropriate ancillary activities. It started over 25 years ago, now has some 3,675 employees and covers some 23 acres with 5 more to be developed jointly with Trinity Hall. Then there is the St John's Innovation Centre started some 10 years ago which now has about 1,000 employees but, unlike the Science Park, has no room to expand. The policy here was designed to minimise entrepreneurs' financial commitment by supplying services such as secretarial support and specialist advice. Some 15% of the high tech activity in the county and some 80% of telecom business is taken up by the three hundred businesses resident on these two parks.

An interesting change since the 1980s, when there were many entrepreneurs inexperienced in management, is that internationally experienced managers are now coming to younger companies, perhaps attracted by the excitement, challenge and, indeed, options. Other ingredients include the Cambridge name, which is an enormous plus but also a minus in that people want the Cambridge postcode and that does restrict where they wish to locate, although people are getting round this by putting the Cambridge name in their address. Proximity is also important although it is not quite clear in my mind how close you do need to be to network with others in the same field and, therefore, how far the Cambridge footprint should stretch to make networking and the cluster effect work to full advantage.

But there does have to be a good infrastructure and I take that up as a later issue. In a nutshell, the concern is that the speed of decision making in the whole planning process is too slow for those involved in high tech where things can change dramatically over, say, a 6 month period. Then the quality of life is clearly key and Cambridge is seen as offering that, but congestion is becoming a serious issue.

Some key issues

As I said, infrastructure is a crucial matter now in terms of sustainability. I find it curious that planning decisions are mainly housing-led and that where employment should best be located is not seen as more of a primary factor, but there it is. The government's housing requirements are that by the year 2016 there should be a further 106,000 in the county and there are currently 123,000 – by natural growth perhaps some 48,000 would come – but it is not just the question of not enough houses but the difficulty over affordable housing which is starting to cause a social barrier. The cost of a house in South Cambridgeshire is something like double the cost of a house north of Peterborough, and this is causing people who work in South Cambridgeshire to commute much wider distances. Part of the reason why South Cambridgeshire costs are so high is that with the electrification of the two lines from Cambridge to London it has become very much a London commuter area and, accordingly, prices have been pushed up. Cambridge is also surrounded by a greenbelt that stretches some 10 km beyond the city in parts and this forces housing out beyond and has restricted the natural business development and again put strains on the public transport.

The transport itself is crucial and those of you who travel on the A14, in particular, will know that it is getting clogged up on a regular basis. The problem here is that a duelled road between Huntingdon and Cambridge is not only a national and international trunk route, of which some 50% of all traffic is lorries going to Felixstowe/Tilbury, but it is, and always has been, an important local route. The government has withdrawn the promised funding to widen this road, despite planning permission having been granted on the basis that it is to be improved, and a multi-modal study is promised instead. This is not to take place in the first phase of such studies and consequently we cannot expect much action over the next few years, by which time we could be in a deadlock situation. The rail system, as I have already said, is extremely good between Cambridge and London, but to other outlying areas around Cambridge it is not at all good and plans to improve do not look cost effective. We also need a US airline providing direct flights from the West Coast to Stansted.

A further vital issue is competition from overseas and this is, in my view, perhaps the most severe problem that we face in that other governments in Europe are pouring money in, and have a very much "hands on" policy for initiatives, to such places as Sophia Antipolis in South of France, which started from scratch endeavouring to replicate what we have achieved in Cambridge and elsewhere, and Otaniemi in Finland. There are important lessons to be learnt from this and the one message that I would like to leave today is: why do UK governments not invest in success? I will return to that in a moment. Then there is the "Cambridge is full" syndrome. This view is put forward by those south of the city who believe that there has been enough development and things should be left as they are, mainly because of environmental concerns, whereas those north of the city, which is not so attractive to those coming into the area, would like the development. That has caused quite a lot of noise.

Hermann Hauser has discussed the lack of funding available to start-ups and growing companies and what is being done to improve that. There is also the question of infrastructure funding. Cambridge, because it is seen to be a high employment area and successful, has suffered from the lack of funding which means that there is less to put into infrastructure and into infrastructure improvements. Cambridgeshire does not get the area cost adjustment – those counties near to London get this London weighting because of the higher cost of living than elsewhere – Cambridgeshire deserves it on all counts but has lost out on many millions. In fact, the Eastern region gets 2% of the government's economic development cake, and of that Cambridgeshire gets nothing.

Then there is the tax regime which is not, in my view, fair on young companies that are not yet profitable. Hermann Hauser has talked about this, but there is one other point I would like to mention. The R&D cost in a profitable company is a charge against profits. Young companies whose main rationale is R&D, and biotech are particularly hurt in this, pay 100% of all their R&D costs because they are not yet profitable and therefore cannot set R&D costs against profits. Now in the USA in such situations a tax credit is given. I believe this is an approach that should be adopted here in order to encourage rather than penalise younger start-up companies.

Greater Cambridge Partnership

Now I promised to tell you a little bit about the Greater Cambridge Partnership and how it is set up to try and tackle some of the issues that are facing the Greater Cambridge area. It is a public/private sector partnership supported and represented at steering group level by the 5 local councils involved in the Southern half of the county of Cambridgeshire, Business Link and CambsTEC and the Government Office for the East Region, together with 7 senior business people all involved in high tech in one way or another and the Vice-Chancellor of the University of Cambridge; Hermann Hauser is a member of the steering group, as is Paul Auton, one of your members here tonight.

Our mission is to encourage and facilitate a balanced framework for the structural, economic and cultural development of the Greater Cambridge area well into the next century. This takes into account the potential for the Greater Cambridge area to be the European Centre of Excellence for learning- and knowledge-based businesses and the desire to protect and enhance the environment. We aim to achieve all this by building a culture of sustained enterprise and wealth creation to provide a high quality of

life of benefit to all of those who live and work in the Greater Cambridge area.

This mission is supported by some 11 objectives and we have set up four working groups to look at the individual issues that impact on: 1. business development and what business needs and wants. Whether those needs and wants are achievable is considered by 2: the planning and strategy working group from a planning point of view. And 3. the skills working group from the people perspective. Then the fourth group is a marketing and inward investment group because, surprisingly, until recently Cambridge has never really done very much about marketing its own abilities. We see ourselves as an umbrella organisation and we link with other groupings that are working on similar agendas to ensure that there is no overlap or duplication, and we see our area as covering not just the southern half of the county but stretching out into Suffolk, Essex, Hertfordshire, for example, because the towns of Newmarket, Saffron Walden and Royston see themselves as being very much, for different reasons, part of the Cambridge area. But our main aim is to try and achieve a cohesion of views as to how the future development of the Cambridge area, taking into account our desire to see it as the high tech and knowledge learning centre for Europe, should be taken forward and to influence and lobby those who are in a decision making position both locally, nationally and, indeed, from a European point of view.

For example, we are working closely with a group called Cambridge Futures which is looking to see what the impact would be based on certain assumptions of 7 options for the development of the Greater Cambridge area looking at the past 50 years and ahead for the next 50 years. These options are no growth, densification, necklace villages, greenbelt swap, transport corridors, virtual highway and new town. They consider it from the point of view of population growth, economic growth and such matters as the impact on housing, commuting and schools. Their report is due out in early 1999 and should take the debate forward a step; in practice, a combination of options is the likely way forward.

It can be seen that we have much to do. We are endeavouring to co-ordinate the drivers in order to make the clusters and networks work better for the good of all, but we are also helping to promote the national and international awareness of what Cambridge has to offer; we wish to develop a common voice and develop a strategy for the Greater Cambridge area which we see as pivotal to and linking into the strategy for the Eastern region and the work of the Regional Development Agency. The strategy will give the teeth to our desire and belief that Cambridge can and should be the European Centre for high tech. We have to work to ensure that the infrastructure is improved and at least that we catch up on the infrastructure deficit – and that is not just transport: it is health, education and services – and hopefully get ahead.

If I may leave you with some key messages they would be these: the Greater Cambridge area must be the European Centre for Excellence for learning- and knowledge-based businesses. We owe it to the UK. Cambridge is a national asset and a jewel in the crown. But if this is to be achieved, considerable improvement is required to the infrastructure or else high tech business will simply just go elsewhere. And they will not go to elsewhere in the UK, they will go to Europe or other places. And not only will they not come but some that are here already will probably leave. We are getting our act together in Cambridge with a view to moving towards a cohesive local strategy; all the constituent players are involved at a very senior level and everyone wants to make it work. Perhaps the most important thing is that we have to persuade government to invest in success. If government does this, I believe that the exponential return to the Exchequer should be far higher, and thus allow more funding to go into regeneration, than by following current policies; and the private sector has to play its part. Hopefully, at a seminar in the summer, we scotched the idea that Cambridge is full. Of the 180 people that attended, and these were public and private sector people including elected members and leaders of councils involved, 97% were in favour of planned growth; so that is what we are going for.

FOUNDATION NEWS

▲ *Professor John Allen, seen here with Dr Monica Smith from HSE, gave one of the first lectures to the Foundation in the early 1980s, and participated in the Anniversary event the Foundation held at the Royal Institution on "Man and Flight".*

PROFILES OF COUNCIL MEMBERS

THE RT HON SIR BRIAN NEILL

It may be thought that Sir Brian Neill is an improbable member of the Council. He is a lawyer by training and cannot claim to be either a scientist or a technologist. But the activities of the Foundation cover a wide field and, as the programme of lectures organised by the Foundation makes plain, its work includes the study of the impact of science and scientific thought on the rest of the community and of the changes brought about by advances in technology.

Brian Neill was educated at Highgate School and at Corpus Christi College, Oxford, where he is now an honorary fellow. From quite an early age he was attracted to the law and he originally planned to read for the Bar after enjoying a few years at Oxford studying classical literature and philosophy. But the War intervened and this plan had to be changed. He was able to spend the Trinity Term of 1942 immersed in Aeschylus and Sophocles, but, as his nineteenth birthday approached, he had to move to the less congenial surroundings of an infantry training battalion. Nearly five years later he returned to Corpus but he decided that neither his age nor his family circumstances could allow him to resume where he had left off. To the dismay of Sir Richard Livingstone, the President of the College and a fervent advocate of a classical education, he changed course and embarked on a shortened degree in jurisprudence under the tutelage of the remarkable Theodore Tylor of Balliol.

He was called to the Bar by the Inner Temple in 1949 and thereafter practised in the Temple as a barrister for nearly 30 years, taking silk in 1968. He was very fortunate in the extraordinary variety of his practice. One day he would be studying the bridleways in Berkshire at the time of the Diamond Jubilee; on another the more intricate pathways followed by international bankers; on yet another the claims to accuracy in a television programme. He was also lucky to be able to spend a little time abroad, his most extended visit being to Hong Kong to examine as arbitrator (fortunately with a distinguished Scottish engineer as an assessor) the rock structure of a quarry north of Kowloon. In addition, whilst in silk he served on one or two government committees and, as a member of the committee set up to consider the reform of section 2 of the Official Secrets Act, had the chance to appreciate the special gifts of Oliver Franks, who was the chairman. Somewhere in Whitehall, no doubt, the several volumes of the Franks Report stand, like Samuel Butler's Discobolus, dusty and cobweb-covered.

In 1978 he was invited to become a High Court judge. In this role too he had a wide variety of cases to deal with, sitting not only in the main part of the Queen's Bench Division but also as a judge of the Commercial Court and, for a time, as a judge of the Employment Appeals Tribunal. At the end of 1984 he was asked to join the Court of Appeal and he sat in that Court as a Lord Justice until he retired in 1996. He was appointed a member of the Privy Council in 1985.

It is now necessary to try to trace the rather winding path which led him to the Foundation. As a schoolboy he had to specialise and, having chosen classics, he was largely cut off from an education in science, though he kept alive his interest in mathematics and achieved a very sketchy understanding of some of the laws of physics. But his experience as an officer in an armoured division in North West Europe introduced him at a modest level to some aspects of mechanical engineering and, more particularly, to the possibilities presented by modern systems of telecommunications. Over 50 years ago even a junior subaltern could receive and give directions on the field of battle at a speed which would have astonished a commander in earlier wars.

In later years both as a practitioner and as a judge he found that to an increasing extent the courts have now to grapple with problems which require some understanding of the natural sciences. The vibrations caused by forklift trucks on a warehouse floor, computer programmes designed to monitor surges of liquid in a pipeline and the techniques employed to repair a defective heart are examples of the factual backgrounds to cases where the lawyer who has no expertise in the field is obliged to embark on an intensive course of study. Usually the court will be assisted by acknowledged experts in the field, but the more distinguished the experts the more difficult it may be for the judge, whose knowledge is superficial and recently acquired, to reach a decision which involves the rejection of a hypothesis advanced by one side with perhaps the support of one or two professors. It is a task to be approached with great humility.

However, the experience which led Brian Neill to realise that not only did the law have an effect on the work of scientists and technologists in many fields but also that science and technology might have an impact on the way in which lawyers worked was a visit to Harwell about twenty five years ago. He went with a few other lawyers to see the work of Norman Nunn-Price who was developing the Status system to be used for the storage and retrieval of legal material. It at once became apparent that lawyers, who inhabit a world of words and paper, might have an invaluable tool to help them, not least in the task of legal research where ordinary indices are often an inadequate guide. This was the beginning of a new area of interest for him, though it cannot be said that at that time lawyers in general were enthusiastic about the help that computers might give them. As time went by, however, and as computers decreased in size and cost, the atmosphere changed. Today the lawyer's office, like other offices, is likely to have a PC on the desk and a modem link to the outside world. Faxes, the Internet and intranets have revolutionised the methods of exchanging information between lawyers and their clients and the
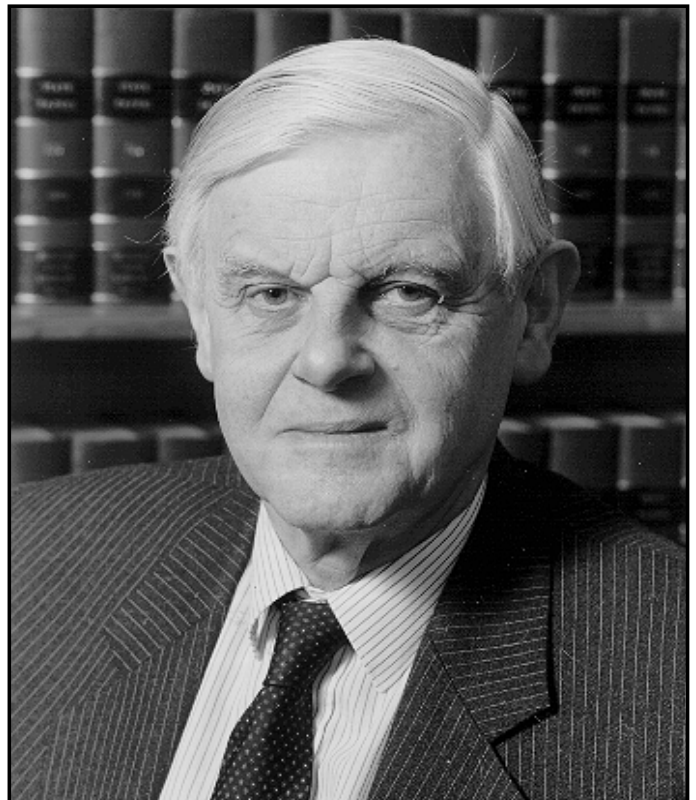
▲ *Sir Brian Neill (Courtesy of Universal Pictorial Press & Agency Ltd)*

courts, and video-links and other developments may modify the methods of working of the justice system as a whole.

It is now more than ever imperative that lawyers should seek to keep abreast, albeit at the level of the layman, with the astonishing advances in science and technology which in the future will affect society as a whole as well as the work of the professions. Lawyers will need to consider, as few do at present, the way in which the law itself may need to adapt to the changes in the world around them. The use of Space and the control of satellites, the developments in gene therapy and genetically modified foods and the supervision of the Internet and other means of electronic communication are some of the topics which lawyers need to scrutinise. It is in this environment that he finds the work of the Foundation so valuable and stimulating and his membership of the Council such a privilege.

FOUNDATION NEWS

Learned and Professional Society News

The recent seminar, the first within the Foundation's 1999 programme, has been on employment law entitled 'Employed by Trustees' and, as an experiment, a Saturday workshop is planned to be held at Buckingham Court on a general review of matters of interest to trustees entitled Trustees Briefing. Plans are being made for the resurrection of the once-popular Societies' Annual Luncheon at which a well-known guest is invited to speak on a matter of importance to learned societies.

The annual salary survey will be published in the summer and the Register of Learned and Professional Societies (published every three or four years) should be ready after Easter. The bi-monthly Newsletter continues its publication with an occasional paper on cybergovernance. Its printer, Chameleon Press, has produced once or twice each year a useful list of meetings rooms (with details of capacity *et al.*) for use by societies but has now decided to discontinue publication. Following negotiations with Chameleon Press, the Foundation has accepted responsibility for maintaining and publishing this list.

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FOUNDATION TECHNOLOGY VISITS

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FOUNDATION VISITS ABROAD

"Company Innovation and the Role of Government" – a lecture and dinner discussion held at the British Embassy, Tokyo

CERN and the World Trade Organisation, Geneva

"Building Closer Irish/UK Collaboration in the Fifth Framework Programme" – A symposium, reception and dinner discussion held at the Royal Dublin Society in Dublin

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