TECHNOLOGY INNOVATION AND SOCIETY

FOUNDATION FOR SCIENCE AND TECHNOLOGY

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THE FIFTH ZUCKERMAN LECTURE

Madame Edith Cresson, European Commissioner for Science, Research & Development, gave the fifth Zuckerman Lecture on 13 May 1998 at the Royal Society on the theme "Europe needs Research, Research needs Europe". Mr John Battle MP, Minister for Science, Energy and Industry, and The Rt Hon The Lord Jenkin of Roding, Chairman of the Foundation, presided at the lecture and buffet supper event organised jointly by the Department of Trade and Industry, the Office of Science and Technology and the Foundation. It was sponsored by Generale des Eaux in the UK, The National Grid Company plc and The Royal Commission on Environmental Pollution.

EUROPE NEEDS RESEARCH, RESEARCH NEEDS EUROPE

Madame Edith Cresson*

Introduction

It is with the greatest of pleasure that I accept your kind invitation to deliver the Zuckerman Lecture within the hallowed walls of the Royal Society. It is indeed an honour. Great Britain has been at the forefront of science and research for centuries and will I am sure continue to be a pioneering nation in years to come.

I would like to say already at this stage that John Battle has been an outstanding chairman of important discussions on research during the British Presidency. Without his tenacity we would not have advanced in our delicate and difficult negotiations within the Council of Ministers.

It is often said that 'the only thing constant in life is change'. It has never been more true than today. Science is at the heart of many of the changes in our social and economic life. It behoves those responsible for science policy to ensure that science is equipped to rise to the various challenges.

In the course of my lecture, I will address the following points:
1. I will describe those political imperatives that are driving current European Union research policy.
2. I shall outline the main developments that have taken place in Research and Development within the Community.
3. I shall indicate their implications, as I see them, for current and future policy.

The first major step in our present path was the Single European Act in 1986. Then the Treaty of Rome was amended to take account of the importance of research in an advancing European economy. This was a clear response to the competitive challenge from the US and Japan in particular. It is also a firm commitment from the Member States to make research one of the key policies of the European Community.

The Maastricht Treaty on European Union was the next milestone. It set out the blueprint for Political and Economic Union. The historic agreement on 2 May where 11 Member States signed up for the Single Currency marks their faith in this on-going process.

The Amsterdam Treaty removed the right of national veto in regard to Research policy. Once ratified, this will liberate the decision makers to move with the times.

For the period 2000-2006, Commission has adopted the "Agenda 2000" policy. This responds to the desire of our Eastern neighbours to join the European Union following the collapse of communism. This blueprint for the medium term establishes guidelines for the Union's development and covers three basic issues:
1. Enlargement of the Union to bring in new members

Summary: Madame Cresson described the political imperatives that were driving current European Union research policy, outlined the main developments that have taken place in research and development within the Community and their implications for current and future policy. She concluded that co-operation towards a common aim would surely produce the results needed to resolve the challenges ahead.

2. The future of the main Union policies
3. The financial framework for that period.

A particular feature of these guidelines is the emphasis on "knowledge -based" policies. It is important that we develop our knowledge base and harness the pools of expertise that exist in different locations around Europe, including an enlarged Europe. They hold the key to the strengthening of both European competitiveness and quality of life in Europe. To this end co-operation is vital.

Where are we now?

Community research has become a central component of the whole European research "system". Yearly contributions account for nearly 3.5 billion ECU. They have grown threefold in real terms since the first Framework Programme in 1984. This is proof of the tangible commitment of Member States and of their recognition that concrete benefits have been realised. If other funding schemes are added, for instance EUREKA and the European Space Agency, total collaborative research in Europe accounted for 16.2% of government research expenditure, up from 6.2% in 1985.

▲ *Madame Cresson delivering her lecture.*

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* *European Commissioner for Science, Research & Development*
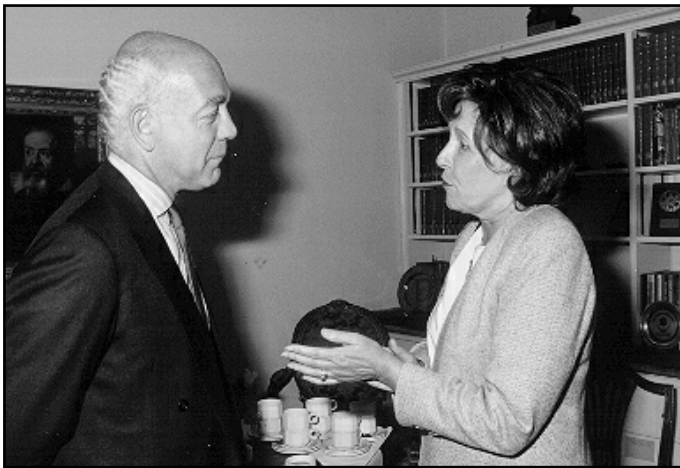
▲ *Madame Cresson in discussion with The Hon Paul Zuckerman, son of Lord Zuckerman.*

▲ *Madame Cresson with representatives of the sponsors.*

It should also not be forgotten that there are still vast disparities between Member States and regions in the levels of expenditure on Research and Development. The significance of Community Research is of course greatest in those countries with low national government expenditure.

Transnational collaboration has become a fact of daily life for researchers in Europe, thanks in large part to Community programmes. In 1997 alone new research contracts supported by the Community created more than 50,000 links between research teams in the 15 Member States. This, I believe, is indicative of the benefits we have achieved with EU research over the last decade or so.

It does not mean, however, that we can rest on our laurels. There remains a crucial requirement for European science and technology to address European problems with European resources. We should focus on consistently appraising the contribution of projects both to science and to society.

The key principles of EU research have proved their worth. These are the insistence on science and technology work of high quality on equal access and on transnational partnerships, so that the complementary skills of Europe can be brought to bear.

There are certainly weaknesses. For example, we have perhaps spread our limited funds around too many research areas. We have too many rigidities in the system which make it difficult to keep up with the pace of scientific and technological change. This has been due in part to legislative requirements. We also need to do much more to improve Europe's record in the uptake or utilisation of research. This brings into play factors outside the research domain. I am referring to such areas as intellectual property rights, venture capital and a culture of innovation to which I shall return in a moment.

Main issues for policy

I should like to focus on three aspects to the EU's current policy on research:
1. We need to bring research closer to the needs of our citizens, making it relevant, at the same time ensuring the highest added value from European efforts.
2. Research needs to be better embedded in the EU economy.
3. We need to develop and improve Europe's human research base.

Relevant research with high added value

The endless frontier of science is not matched by endless budgets. We have to accept the inevitable specialisation and division of labour. This means focusing on questions which are most important to Europe and its citizens.

We need European added value and relevance. Science and technology "push" is not enough; we need to derive our research strategy from an understanding of what is needed by society. This is a question well understood by the UK. Your 'Foresight' programme has inspired much innovative thinking in the UK and

beyond about the future direction of science and technology.

As you know, it is a question not just of what priorities but of how those priorities are chosen and how to ensure involvement of all the parties. That means the scientists, business people and government have to work together to decide them. Moreover, research is an ongoing process where things are learnt and must be taken into account in further developments. Therefore, a degree of flexibility has to be built into the decision-making procedure.

These issues are at the heart of our proposals for the new Fifth Framework Programme. This is the main instrument for Community research funding, developed through the evaluation of experience here and elsewhere. It contains a great deal of imaginative thinking. A major element of the new Framework programme will be the so-called "key actions" which bring together several important ideas:

More transparency and consultation

There will be a systemic change in the relationship between the Commission and the researcher, user and the industrial community. This will continue throughout the lifecycle of research: from priority setting through to the achievement and utilisation of results.

There has been unprecedented input from external parties on the development of the Framework Programme.

We intend to establish advisory boards made up of eminent members of the research and industrial committees and user groups. They will assist the Commission throughout the implementation phase of the Framework Programme. These advisory groups will have structural links to our established consultative bodies for industry and academics, IRDAC and ESTA, which links will be renewed.

More Integrated Research

There will also be more integrated research with a multi-disciplinary focus which encompasses the various different components of a solution to the problems faced. This does not mean less basic research. The problems often require the understanding of very fundamental issues. Responding to this challenge requires an effort from researchers too. It will no longer be possible simply to pursue a particular line of enquiry without reflecting on its potential application.

Real co-ordination

Also, there will have to be real co-ordination between Community activities and other activities in the same field. This means co-ordination in the first place with national research programmes.

Embedding research better in the EU economy

Europe lags behind the US and Japan in making use of Science and Technology. This is not just an economic issue. It is through the incorporation of science and technology into real products and services that we can improve quality of life.

The impact is ubiquitous: health, communication, transport, environment, water and energy. There are many reasons for Europe's difficulties. They are structural problems, not just a matter of production but also related to the capabilities of individuals as citizens, workers, consumers and society as a whole.

The dimensions of the problem differ dramatically among the various Member States. Through the Commission's Green Paper on Innovation we have identified a number of factors which stand out as needing treatment on the EU level.

The First Innovation action plan responds to these by co-ordinating a number of different relevant policy areas. Innovation requires, first and foremost, a state of mind combining creativity, entrepreneurship and willingness to take calculated risks. In other words: courage. To take an invention or development beyond the workbench and turn it into something beneficial for the maker and others requires co-operation and communication.

The European Commission has identified three priorities:

1. That a real 'culture of innovation' be developed
2. A legal, regulatory and financial framework conducive to innovation, be set up
3. That research must be more closely linked at both national and community level

'The culture of innovation'

This must permeate education policies from the earliest to the latest stages, encouraging a positive attitude to life-long learning. At national level it means reviewing courses and teaching methods with a view to their stimulating creativity and a spirit of enterprise from the most junior stage.

The Commission's contribution will be to set up a permanent "training and innovation" forum to stimulate the exchange of experience and best practice in this area. It will continue to implement the White Paper on Education and Training, particularly where apprenticeships and continuing education are concerned. It will foster links between schools as part of the "Learning in the Information Society" initiative.

In the guidelines for the Fifth Framework Programme, arrangements exist for the transnational secondments of young researchers and engineers to businesses, particularly to SMEs to help with their innovation or technology transfer projects.

One of the biggest obstacles to mobility is language. The Lingua programme of the Commission helps to support language training which in turn makes mobility a realistic opportunity.

The legal, regulatory and financial framework

Intellectual property rights are an increasingly important part of the development process. Failure to protect the rights of our researchers will cost us dearly. In this respect it is important that public authorities invest in patenting the work of the research they support. This will allow the inventions and results to remain in the public domain for the benefit of the public and the world at large.

▲ *Some of the audience at the fifth Zuckerman Lecture.*

In the private sector it is extremely important too. Studies have shown that exclusive know-how is strongly correlated with share performance. Businesses with patented or proprietary products perform substantially better in gaining or retaining market share than those without.

The patenting of products in Europe is a complicated and expensive business. In a rough comparison between the US and the EU, the cost of a single European patent in 15 Member States is about 35,000 ECU in official fees alone while the cost in the US is about one sixth of that.

I am pleased to announce that the Commission has decided on a fundamental reform of patents and later this year will present a proposal for a Community Patent Regulation with the objective of creating a patenting process which costs less than in the US. The conference on patenting computer software held in March of this year under the aegis of the British Presidency brought home the need for such a system.

The vexing question of finance is always with us. There has to be more and better co-operation between industry and academia so that we are financing the right type of research to meet the needs of industrialists and businessmen as well as for the needs of our citizens. In the years ahead we are bound to see an increase in the joint funding of projects from public and private sources. Academic standards do not need to be compromised.

Venture capitalists too have to be encouraged to be innovative in their ways of finding capital to help fund research development from the work being done in the labs. Seed funding through 'business angels' and other innovative strategies have helped young companies. However, serious risk capital is required when an enterprise has fully developed at a local level and needs investment to develop. Risk capital investors need a stream of good investment opportunities as well as fair reward for risk taking.

The Amsterdam Council authorised the use of Community funding via the European Investment Bank specifically for venture capital to encourage high technology companies.

The Innovation and Technology Equity capital or I-Tec initiatives of the Innovation Action plan offer assistance to venture capital operators. It is an initiative to encourage early stage investments in technologically innovative SMEs.

Financial contributions of up to 500,000 ECU can be made and access given to networks of like-minded investors for professional development, joint project appraisal, financial syndication and refinancing purposes. This initiative has an impressive leverage effect. Together with the growth and employment initiative recently adopted, it might direct more than 2 billion ECU of funds towards investment in innovative firms in the course of the next three years.

Research and innovation at national and EU levels need to be better linked

The whole thrust of the Framework Programmes has been to improve links across borders between researchers. This effort will continue in the Fifth Framework Programme. We have refined a number of techniques, of which the best known is perhaps the "shared cost actions" to foster this process. Shared cost actions support research projects involving participants from more than one Member State. They are supported by EU funding up to 50%. But there are other ways of encouraging networking and collaborative research.

For instance, the Commission in December launched a technology transfer initiative based around its own Joint Research Centre which is designed to promote collaborative research through telematics.

I would like to mention, too, the CORDIS database of EU research projects and funding as a support service. Its availability free over the Internet helps researchers and businesses follow Community initiatives, obtain assistance with collaborative ventures and the necessary information about funding opportunities and programmes.

There is a fund of success stories and examples of best practice within it which can help stimulate ideas.

The third main aspect of policy is developing and improving Europe's human research base.

Scientific and technological capabilities are the product of knowledge and reside primarily in individual scientists and engineers. Again, the statistics show that Europe as a whole is less well endowed with researchers than its competitors. Like research expenditure, their distribution around Europe is very uneven. Success breeds success. This is so because knowledge increases the capacity to learn and thus to increase the stock of useful knowledge. Our investments in people now will condition the fortunes of Europe for decades to come.

In this context, I would like to mention the role of women in the field of science. With the demographic downturn human resources will be scarce. It will be increasingly important, therefore, for business executives and policy makers to be aware of this. They will have to make provision for trained women scientists to be able to participate fully in the research and working environment.

There are around only 6% of women working in the fields of physics, chemistry and engineering and less than 10% at promoted level. Greater efforts have to be made for that 50% of our population to participate in helping to resolve the problems that are facing us. The problems for women raising children whilst working full-time in the laboratory and continuing to publish extensively are considerable. The solutions demand good child-care facilities and a high level of commitment, energy and support from the institutions that employ them.

At a recent conference in Brussels on the subject, many of these issues were highlighted. As a result I shall be launching a Communication later this year. It will announce two initiatives: First, the setting up of a 'genderwatch' system within the Fifth Framework programme. This aims to encourage research BY women, FOR women and ON subjects related to women. Second, it will promote a network for women in science throughout Europe.

I am pleased to say that the Fifth Framework Programme will encourage Equal Opportunities. This arrives through the legal requirement of equal access to funding and support. It will mean that we all stand to benefit a great deal from women's distinctive viewpoint and their contribution to scientific research and development.

Improving Europe's human potential in research is a major concern of the Community's research policy. It is a truly European endeavour to support training through research. It does this by bringing researchers into contact across national borders, to learn from one another. They can thereby gain access to skills and infrastructure which may be unavailable in their country of origin. Symbiosis across EU Member State borders brings added value.

To conclude, the important developments I have described need an EU contribution which is sufficient to the task. The Commission proposed 16.3 billion ECU for the Fifth Framework Programme to run from 1999 to 2002. The European Parliament supported an even higher figure, 16.7 ECUs. But, so far, the Member States have only agreed to 14 billion ECU, which would mean a decrease in real terms in EU research funding. If maintained, such a decrease would have serious implications for EU-funded research in national institutes and universities. (UK research has particularly benefited from this funding.) Moreover, some of the Commission's own research laboratories, known collectively as the Joint Research Centre, might have to be closed down.

The JRC works to support EU policies in the interests of the citizens at large. It is a unique service where economies of scale allow important European medical, biotechnological and industrial research to be carried out in a politically neutral environment by quality researchers. The type of work carried out by the JRC cannot be done at a national level. The cost of its seven institutes to the Community is less than 26% of the subsidies given to the tobacco growers, or 12% of that given to support olive oil.

While I have concentrated to a large extent on the mechanics of the research policy in Europe, I must emphasize that the focus of the policy is Europe's citizens and their needs. If we are willing to co-operate towards a common aim then I am sure that the synergy of our efforts will produce the results we need to resolve the challenges ahead. It is on that note that I wish to conclude.

Minister, Lords, ladies and gentlemen, I wish you luck, inspiration and courage in the search for a better world.

FOUNDATION NEWS

Industrial, Business, Science & Engineering: The Foundation Finds all in Geneva

The World Trade Organisation and CERN were the places visited by a team of 22 from the Foundation on 26 June 1998, with contrasts: from massive engineering to support high energy particle physics, hearing highly motivated scientists describing their experiments and work, and learning about the role and work of the largest international trade body.

The team was welcomed to the World Trade Organisation (still shown on the map as GATT), on the side of Lake Geneva (Lac Léman), by Dr Chulsu Kim, Deputy Director General. He had with him Mrs Clarisse Morgan, Counsellor Rules Division, and Mr Matthijs Gauze, Counsellor IPR & Investment Division, all of whom were able to brief the team and answer many questions both during the talks and later over lunch.

The World Trade Organisation (WTO), with 132 nation members and still on the increase, is the only international body dealing with trade rules. It succeeded the General Agreement on Tariffs and Trade (GATT) in 1995, and was created as a result of the Uruguay Round. In principle, WTO's purpose is to allow the free flow of trade between nations, thus creating economic development and reducing world poverty. It acts as a forum for trade negotiations and aims to settle international trade disputes. One area of particular interest to the Foundation was WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) where it attempts to narrow the gaps in the way the rights are protected around the world. The agreement covers five broad issues:

• how basic principles of the trading system and other intellectual property agreements should be applied

• how to give adequate protection to intellectual property rights

• how countries should enforce those rights adequately in their own territories

• how to settle disputes on intellectual property between members of WTO

• special transitional arrangements during the period when the new system is being introduced.

WTO has a hand in many other issues such as foreign investment policies, and has achieved liberalisation of services such as telecommunications and financial services. It takes account of such issues as the environment, security and public health. It has taken more than 120 cases since it was formed in 1995, this being three times the number taken during the lifetime of GATT. (Further information can be obtained from WTO on *http://www.wto.org.*)

IT IN THE CRIMINAL JUSTICE SYSTEM

"Information Technology: Towards an Integrated Criminal Justice System" was the theme of a Foundation lecture and dinner discussion held on 12 November 1997. The Rt Hon Lord Jenkin of Roding was in the chair and the evening was sponsored by EDS. The speakers were Mr Geoffrey Hoon MP, Parliamentary Secretary, Lord Chancellor's Department, The Rt Hon Lord Justice Brooke, Chairman, Judges Standing Committee on Information Technology, and Professor Richard Susskind, author of "The Future of the Law".

Mr Geoffrey Hoon MP*

Introduction

As you have heard, I have certain modest responsibilities in the Criminal Justice System and Information Technology is a subject in which I take a keen interest. My last job on Labour's Front Bench in Opposition was as Shadow Technology Minister and I have had the considerable privilege in meeting many of you here today previously in that capacity.

It is, I believe, self-evident that the proper use of IT in both the private and public sectors is vital to the effective operation of organisations and businesses. This applies not only to the automation of routine manual processes, but, perhaps more importantly, as a vehicle for the dissemination of information and for high-speed communication.

Not to be too unfair to the civil service, I think it is fair comment that the public sector has not always matched the achievements of the private sector in meeting the challenges of technology. Many of the problems on IT that we are now grappling with in Government are those which the private sector has already come to terms with. However, there are benefits arising from this tardiness. We in the public sector can learn from the successes, and indeed from the failures, of the private sector.

We can exploit the experience of the private sector and can bring those experts from outside Government in to help us. From a technological point of view, we are also in a position to see what has worked and what has not; although we could go out and invest billions in the latest 'whizz-bang' systems, we might find that we got a bang rather than a whizz. To some extent, therefore, our delay can help us avoid the pitfalls that others have fallen into.

Reducing delays in the Criminal Justice System

As you will be aware, a central promise in the new Government's manifesto was to reduce delay in the Criminal Justice System. Whilst the priority is in the area of youth justice, it is important that we have an impact across the whole system. It is essential that the whole process operates as effectively and efficiently as possible without detriment to the quality of justice itself. I believe that IT has a crucial role to play in delivering a better and more responsive system of justice.

The obstacles that we need to overcome are not primarily ones of technology – they are, however, about its delivery and implementation. The technology presently exists to deliver the improvements that we are seeking. The real problems that we face fall, I suggest, in four areas: firstly, the structure of the Criminal Justice System; second, the disparate development plans of the organisations involved; thirdly, the funding arrangements; and, finally, the need for the service as a whole to take a wide view in developing strategies and making decisions. If we are to have a real debate we need to understand the nature of these problems and issues.

The problems

Let me turn first to the organisation of the Criminal Justice System.

Summary: Mr Hoon said a 'criminal justice system' did not exist as an organisational entity in its own right. Rather, there were a number of 'key players' including the police, the courts, the judiciary, the legal profession and local authorities. There were complicated problems that had to be tackled in any attempt to reduce delays in the administration of criminal justice. He went on to outline the government's present IT plans, the major capital investment for which, he said, would follow the private investment route where appropriate. Lord Justice Brooke gave numerous examples of the lack of IT compatibility between the various criminal justice agencies involved. There was a great need for greater co-ordination of effort.

We talk, as I have just talked, about a 'system' but the criminal justice 'system' does not exist as an organisational entity in its own right. There are a number of key players, separately and individually organised. There are the police, the prosecutors, the courts, the magistracy and judiciary, the legal professions, the probation service, the prison service, and local authorities. Three Government Departments – the Home Office, the Lord Chancellor's Department and the Attorney General's Department – share the main political responsibilities for the system, and each set their own key objectives for the agencies in their own jurisdiction – but in addition, I must mention as well Government colleagues from Education, from Health and from Environment who each have an interest.

To complicate matters further, the police, the magistrates' courts and the probation service are not centrally managed, and all have some statutory independence. There are currently 43 police forces in England and Wales, 96 Magistrates' Courts Committees and 54 Probation Committees. All are funded through a mixture of central government grant and local authority finance. Indeed, in a statement to Parliament two weeks ago I indicated that we believe that there are too many Magistrates' Court Committees and that the numbers should be reduced to improve their efficiency and management. I expect that this will provide some limited help in the context of our subject this evening.

In addition, whilst the Crown Prosecution Service handle most prosecutions, there are other prosecutors, such as the Inland Revenue, Customs and Excise, the Serious Fraud Office, local authorities, and even TV Licensing.

And whilst the magistrates' courts handle by far the majority of criminal cases – some 97% – the more serious cases are heard in the Crown Court, which itself is separately organised and funded, this time on a national basis.

There are, of course, historical reasons for these disparate structures, not the least of which is to ensure that the system provides an independent and fair judicial process. But it certainly complicates decision-making: it makes it very difficult to consider the construction of an effective IT Infrastructure and system across the board, across such different organisations.

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* Parliamentary Secretary, Lord Chancellor's Department

Present IT plans

Having set out some of the background problems, and perhaps explained why we have not made more progress to date, perhaps I can now turn to present IT plans. Most of the key players are in the process of developing or planning the development of new IT systems within their organisations. The investment costs of these programmes are significant. The previous Government introduced the Private Finance Initiative for major projects requiring capital investment. The new Government has reviewed the Initiative and will continue to look for private partnerships where this is appropriate. Many IT developments in the Criminal Justice arena will therefore follow the private finance route.

Within my own department, the Court Service has already awarded a PFI contract for IT services in the civil courts and in the Crown Court. Under the terms of this contract, the service providers, EDS, took over the Crown Court IT systems and are currently upgrading the hardware and software. At the same time the Court Service, in partnership with EDS, is evaluating further opportunities to use IT to improve the efficiency of the Crown Court.

In particular, work is being undertaken to see how IT links with other agencies could be developed. A pilot project has been established to look at the transmission of information electronically between the Magistrates' and Crown Courts. There is some way to go before we have all the information necessary to plan for the future, but the Court Service is now in a position to begin considering the options.

In the magistrates' courts, there are three different IT systems providing the main applications for the courts and these date from the 1970s and 1980s. I have to say that when I first saw the draft of this speech I put a question mark over the reference to the 1970s. When the second draft came back, I again questioned this. Officials explained to me that there are, in fact, systems dating back to the 1970s. I find this quite remarkable. Whilst some MCCs have developed links with other local agencies, the vast majority do not. For some years the strategy for IT in the Magistrates' Courts has been to develop a single national system to replace the existing current systems.

Originally intended to be designed and developed by suppliers using traditional type contracts, a decision was taken last year to deliver the strategy through a PFI service contract. The project, called Libra, is designed to replace the three ageing systems with a single national IT service capable of being linked with all of the other main agencies. It consists of a mandatory set of core services covering case preparation, hearings, results, finance and enforcement. Under PFI, the service has been widened to include as options, office automation products and resource management systems operating on a common infrastructure.

Negotiations with two bidders are now taking place. The project is being conducted as a partnership between my Department and the Magistrates' Court service. It is complicated, not least by the fact that there is no single Magistrates' Courts' service body, and each MCC will need to enter into separate agreements with the successful PFI supplier. Whilst all MCCs have now signed expressions of interest in taking the service, the final decisions remain with the separate Committees. I am confident that all MCCs will take the new systems and services once they have been developed and demonstrated, although the timescales do need to be agreed with the individual MCCs.

Such a single system will work only, however, if it can link easily with all other relevant agencies.

Police forces, for example, have a range of different systems to meet their information needs. They, however, have also recognised that a corporate police approach is needed if best use is to be made of IT. As a result they have developed a national strategy for police information systems, and a PFI-type contract has been awarded for the development of a case preparation system, which will provide links with the courts and the Crown Prosecution Service. The CPS themselves are planning a PFI programme to meet their IT needs and provide the infrastructure to enable links with other agencies. The Prison Service is also conducting a PFI

exercise for IT and related administrative services.

Each of the organisations is attempting therefore to ensure that the requirements of other organisations are taken into account in defining the requirements for their new systems. For example, a considerable amount of work is taking place to ensure that the interface between the police case preparation system and the Libra system in the courts is specified fully for development by their respective suppliers. This is encouraging, although the timetables for the implementation of the new systems are such that it will take time to provide significant improvements in the exchange of, and access to, information between the component parts of the Criminal Justice System.

As I hope I have made clear, there is a great deal of activity taking place within the criminal justice system to develop new systems and new services. You might well, of course, ask why we don't stop everything now and start from scratch. The scale of the task of building a single IT infrastructure and the systems to run on it would be too great and would be beyond any one organisation's capacity to deliver, and certainly beyond our ability to manage its implementation.

Priorities

The first priority therefore must be to get the new systems that are planned up and running so that the considerable benefits to each organisation can be realised. An even greater challenge is to make the system-to-system links that will enable information to be shared and exchanged.

A further crucial issue to be resolved is who pays for and who benefits from the transmission of data, or access to it. For example, electronic access to police case information is of very considerable benefit to the CPS and the courts as well as the police. The police investment will be high, but there will be considerable benefit to the system as a whole. This situation is repeated throughout the Criminal Justice System. With tight cash limits applying to individual organisations there may well be little incentive to spend to save when the saving accrues to another organisation, or indeed to a different government department. This is an issue that needs careful and protracted inter-departmental co-operation.

The new approach

Having described the problems and issues, perhaps I can now turn to how we are trying to approach their resolution.

The new Government set up a series of Comprehensive Spending Reviews in each Government Department shortly after the election. The purpose of the reviews is to align Departments' objectives more closely with the new Government's priorities and to identify the most effective use of taxpayers' money in the administration of Government activities and services. In addition, in a number of areas, separate but complementary reviews have been established covering areas of Government business spanning Departmental responsibilities, and the Criminal Justice System was included in this programme. This cross-cutting review, as it is known, is under way and will report in the new year. The review is examining the roles, responsibilities and processes within the Criminal Justice System and will identify those areas where improvements can be made across the system. It includes systems – both business processes and the IT needed to support them – and the issue of funding between the justice agencies.

For many years the main players have attempted to address many of the problems inherent in the system and with some success. The three main Government Departments involved – the Home Office, the Lord Chancellor's Department and the Attorney-General's Department – have met at senior official level to discuss policy issues and determine policy co-ordination. The Trials Issues Group, consisting of representatives of the organisations involved, have tackled a range of matters to improve the operation of the system.

On IT matters, the Home Office, supported by the other two main Departments, set up the Co-ordination of Computerisation in the Criminal Justice System Unit – or triple-C JS – to identify opportunities for collaborative exercises in the use of IT. Some of

the successes include the automation of links between the courts and DVLA for the two-way transmission of driver information, considerably reducing the number of adjournments for driver related cases, and a pilot e-mail network involving all of the criminal justice organisations in Suffolk. The experience of the Suffolk pilot will help in delivering the faster processes we are seeking in the youth justice initiative.

Bilateral co-operation has also yielded successes. An example is the jointly funded project to deliver a system for the issue of fixed penalty notices by the police and their enforcement by the Magistrates' Courts. This system is now operational in 15 forces and their local MCCs, and is saving paperwork and time for both parties.

Clearly, the will is there, at least at the national level, to co-operate to achieve the wider benefits for the system as a whole. There remains, however, the fact that there is presently no national IT strategy for criminal justice. Indeed, no such strategy can exist without a comprehensive approach in terms of policy and business which IT should support. It is exactly this type of approach which our cross-cutting Comprehensive Spending Review is aimed at achieving. By ensuring that all of the elements in the system work together, and towards the same ends, we will provide the necessary platform on which to build for the future. This is no mean challenge, and we in Government may well have to involve those outside with experience of developing such comprehensive IT structures.

In the meantime, it would be foolish to stop all developments on the IT front until such strategies are developed. The need for new systems is paramount and cannot be delayed. Those responsible for delivering these systems, whether in the public or the private sectors, must ensure that the systems delivered and the contracts that determine delivery and support are constructed in such a way as to provide flexibility and responsiveness to change, not only in the business of criminal justice but also in keeping pace with the rapid changes in the technical arena and recognising the opportunities available through these developments.

The courts, and the IT systems supporting them, are central to the improvements we are seeking. I will ensure that my Department will play a leading role in helping to overcome the obstacles I have described this evening and, in co-operation with my colleagues from other Departments, deliver modern, effective and integrated IT systems for the benefit of the Criminal Justice System as a whole.

As is only right for the guardians of the taxpayers' purse, we must be cautious and pragmatic in our approach to this issue. That said, we now have a strong platform on which to build. Our ultimate goal is, and must be, for all of the elements of the criminal justice system to effectively interact with each other, to create IT systems which are fully compatible one with another. In this way we will, effectively, have the 'system' that in many ways is currently lacking. The benefits which will accrue to all of the elements are too important for us not to achieve.

The Rt Hon Lord Justice Brooke*

Introduction

I have come to tell you about my perception of the problem as a serving judge for the last nine years. I had originally hoped to speak before the Minister: I have been grappling with some of these problems for the last 12 years, and I had hoped to set before you the issues and the difficulties, as I saw them, so as to open the way for the Minister to tell you how he views things and to explain possible solutions to some of the problems we face. In the event, he wished to go first because he may be called back to Westminster at short notice, so that you have already had the cart, and the horse is left wondering what to say without repeating things!

I agree that at the heart of our difficulties is the fact that there is no such thing as a criminal justice system. In his report on the prison riots, Lord Woolf identified some of the problems that arose from the lack of co-ordination between different agencies. Now there is a Criminal Justice Consultative Council chaired by Lord Justice Rose, but it has no executive powers and no power to dictate to all the different agencies how they should spend their budgets.

The Minister has spoken of all the different government departments and agencies involved. They include not only public sector services – the police, probation, and so on – and the magistracy and the judiciary, but also, as he said, the legal professions – 8,000 barristers and 60,000 solicitors, a lot of whom practise in the criminal courts, and who tend to be forgotten by some departmental planners who think only of public sector agencies. I have no doubt at all that the two-way information flows between courts and barristers' chambers and solicitors' firms have got to be taken more seriously into account in planning future IT systems. In the United States, for instance, an over-arching corporation called the JEDDI Corporation, which includes representatives from all these bodies and the corporate sector as well, has been created to find solutions to the problems of standardisation and compatibility that confront us all.

The view from the courts

When I was asked to speak to you tonight, I e-mailed an experienced judge and asked him to tell me how integrated he felt out there in his Crown Court in the country. He replied: "not at all". He said that some of the major problems are lack of compatibility. Information pours into the Crown Court and out of it, but it does not go down the wire. It all travels by hard copy. No wonder the public complains about the delays in criminal justice. They have a back-office system called CREST, but those who designed it ten years ago did not take into account the need for the Crown Court to talk to others by computer, although I remember complaining about this at the time. As a result of all this, he said:

"One CREST Court cannot talk to another CREST Court, so we cannot bowl out the busy Defendant.

A Crown Court cannot talk to magistrates' courts, so that we do not know what is coming except by old snail mail.

Nobody can talk to Probation from the Crown Court as we do not even have e-mail.

The Crown Court cannot talk to the police, so that we cannot input reasons for a sentence in order to update their sentencing

▲ *The Rt Hon Lord Justice Brooke (left) speaks with Mr Charles Cox, Director, Civil Government and Health Care of EDS, sponsors of the event.*

database.

Judges cannot access a sentencing database held at the Criminal Appeal Registry, let alone read judgments posted on the Internet unless they subscribe privately."

People with eyes to see in other agencies – and I know there are a lot of them here tonight – will tell you the same story. The other day I visited a new Victims Unit run by the Probation Service in one of our great cities. It was their job to contact the victim of anyone convicted of a serious sexual or violent crime in one of the local Crown Courts. They had to make their first contact soon after sentencing, and without IT systems at the Crown Court they weren't sure that they were in fact being told about everyone who fell into this category. Victims, they told me, were always anxious to know exactly what the judge said on sentencing: they were pleased when they heard that the judges showed they understood the impact of the crime on them. The unit was dependent on notes taken by a probation officer who happened to hear the sentencing remarks: very often there wasn't one there. Although these comments are now regularly transcribed in this class of case, there is no way of sending them electronically as a matter of course to a unit like this.

I asked what about appeals? They told me it is hard to find out whether leave to appeal has been granted, when an appeal is to be heard, and what its outcome was. Sometimes if a conviction is quashed, a victim meets the offender in the street before the Unit has a chance to give the victim a warning. At present the prospects of electronic links between the trial and appeal courts and a unit like this are light years away, although they would make an enormous difference to the Unit's ability to serve their frightened clients.

It is not very useful to discuss where we might be going unless we understand clearly why we are where we are today. In most of the agencies, IT support services have traditionally been run by back-office staff for back-office staff, and indeed some of the back-office systems they have developed have proved a great success in cutting down delays and reducing the cost of routine administrative processes.

The impact of budgetary problems

Tonight's discussion is centred on public sector organisations which were not allowed, until very recently, to go out into the market to raise the capital they needed for investment. Investment in IT was treated as a fringe activity, and a Department never knew for certain from year to year how much money it would be receiving in the next public sector round. Short termism was the order of the day. Government IT managers used to come and weep on my shoulder when they told me their budget had been cut again just when we thought we were getting somewhere.

In LCD, the department I have had most dealings with, the remorseless annual rise of the Legal Aid budget very often created a consequential cut in the IT budget for the following year. It was pointless to investigate whether a long-term strategy for using IT would lead to long-term savings in expenditure on Legal Aid, because there was no way of obtaining long-term money. There was therefore no hope of devising a long term IT strategy for any part of the justice system. All hands were to the pumps to keep the leaky ship afloat. Each of its independent outposts had to do their best with what money they had to look after their own. Integration with others was not, on the whole, the name of the game. The French name for it would have been *chacun pour soi*.

As a judge for the last nine years I have been in as good a position as any to watch the expensive inefficiencies this short-term thinking has brought in its wake. IT is very good at enabling information to be communicated swiftly, enabling it to reach the people that need it, in time for them to make efficient use of it. Every day in every criminal court we see the cost penalties the taxpayer has to pay because the courts are not yet supported by appropriate IT systems. The eight-page pre-sentence report which we see for the first time when we sit in court, after reading all the other papers the night before. Obvious inaccuracies in police antecedents which can't be checked by a quick search of the central information database. The magistrates given out of date information about an offender's driving record with no means of accessing the Swansea centre to ascertain the up-to-date position. No hope of the judge or magistrates being able to access the recent seminal judgment by the Lord Chief Justice, briefly reported in the news media, on the legal point at issue in the case. No way that we can find out if there is actually any room in the prison system within 100 miles of her home for the 16-year old girl we are thinking of sending to custody for the first time. Every hour of a Crown Court trial costs over £1,500 when I last looked at the figures; it is probably more now. And we judges have to hold things up, with lots of expensive people waiting around, while we try to absorb complicated information which it would have been much easier for us to absorb in our rooms beforehand.

When I chaired the Law Commission I spotted the anomaly that whereas the Home Office is responsible for the criminal law, it has not hitherto regarded it as a priority to make it comprehensible because it does not have to pay much of the bill if the law remains complicated and difficult to use. The cost of this falls on others. The Home Office itself pays very little of the cost of the average day in an English court, and its budget is not nearly as badly affected as LCD's by the cost of adjournments and unnecessary delays.

It is the same with IT. These inefficiencies often lead to adjournments or to wrong decisions being taken, which have to be put right on appeal, sometimes after the defendant has wrongly spent time in an expensive prison. I see some of these cases in the Court of Appeal. But the service which is responsible for the inefficiencies does not always have to pay for them, so that they do not affect their record as measured against their key performance indicators. I was not surprised to learn last week that the new Drivers Link connection with Swansea we are getting at long last is expected to save 170,000 adjournments a year. Just think of the savings.

Some progress has been made

This is not to say that the last ten years have not seen valiant attempts to harness the power of IT to help criminal justice as a whole, in contrast to helping the individual agencies meet their internal objectives. I was a founder member of ITAC, which first met in 1986. Three times a year, two representatives of the Bar, the Law Society, the Home Office and LCD used to meet under the chairmanship of a judge with exactly the same agenda as we have tonight, except that we were looking at the needs of civil justice as well. We had no staff, no budget and no executive responsibility. It is hardly surprising that we did not achieve much, except to keep a flickering candle alive. Other agencies joined us later, but we did little to alter their corporate thinking which was centred on their back-office systems.

In those days there were over 100 magistrates' courts committees. Some of them were developing their own free-standing IT systems as a means of combating inefficiencies and delays. It was-

▲ *Mr Geoffrey Hoon MP (left) was a speaker at the event, sponsored by EDS whose Managing Director, Mr David Courtley, is seen with the Minister.*

n't a very sensible way of doing things, although it was better than nothing. A lot of money was then spent in trying to develop a standardised system which they could all use. I am afraid the first attempt ended in tears, as first attempts of this kind often do, but they are now trying again, in collaboration with a PFI supplier.

I was not surprised to see that one of the lessons learned from the first fiasco was that it was essential to get senior front office users of the system involved in overseeing the teams doing the development work. On the civil justice side, similar mistakes have often been made because the IT specialists do not always understand how the real world operates when they design their systems. The other day I picked up on the judges' conferencing system a cry of despair from a district judge who had made a fine-tuned discretionary order only to find that the court computer resolutely altered it because it knew no other. This kind of thing makes it rather difficult for us to transmit our enthusiasm to our more sceptical brethren.

Another gleam in the darkness, with rather more candle power, has been the work of the CCCJS unit, of which the minister has spoken. In a recent letter the Head of the Unit wrote that "the development of effective links between IT systems so that information can be transferred electronically, thus maximising efficiency and minimising delay, is a goal which all the criminal justice organisations share". As a practitioner in the field, I only wish these organisations could have done more in the past to put their aspirations into effect.

There can be no doubt that things are now looking up. The minister has told you something of what is going on at the Whitehall end. The latest reports from the CCCJS Unit are very encouraging. Six months ago EDS and the Court Service identified areas where IT investment was bound to cause significant savings in cost or improvements in the quality of criminal justice. There is at last a growing awareness in Whitehall that the message we first tried to trumpet feebly 11 years ago is a true message, and not the enticing message of the IT sirens. So why is my Crown Court judge doing his very difficult job still so bereft of modern IT support systems?

A judge mustn't involve himself in politics. We can only observe what we see and leave it to others to devise the solutions. As Alexander Hamilton said, the judiciary is the weakest of the three arms of government, and on this side of the Atlantic we are very much weaker than our federal American counterparts. They were voted US$70 million direct by Congress in 1990 for computerising their arrangements on a judge-led basis, with the marvellous results I saw when I was over in Washington last May. In Singapore, much the same things are happening on a judge-led basis, with equally marvellous results. As an English judge, there is no way that I could be allowed time out of court to contribute to the thinking of the inter-agency groups. It would be regarded as bizarre if I were to suggest that very senior people in each agency should be directly involved in working out solutions for the monumentally difficult problems of IT compatibility that confront us all.

A new approach is needed

I believe that one of the weaknesses of our present arrangements has been the failure to recognise, at a very high level indeed, that the growing complexities of the problems that face us in an IT age require a quite new approach to the approaches that have been tried and failed in the past. We need new strategies. We need new

▲ *The Rt Hon Lord Saville, Lord of Appeal in Ordinary (centre), speaking with Mr Geoffrey Hoon MP (left), one of the speakers.*

ways of attracting medium- and long-term money. New ways of persuading major suppliers, like our sponsors tonight, to risk their money without being frightened off by the dreadful short-termism they have witnessed in the past. New ways of involving the key people at the top of all the agencies in a well-informed and co-ordinated effort to meet the challenges we are discussing tonight

Today you will not find a senior member of any of the agencies present on the boards or groups involved in encouraging greater co-ordination. As I have said, there is a central council, chaired by Lord Justice Rose, which receives reports of all the inter-agency discussions that are going on, but it has no executive powers or any resources with which to commission expert IT advice. In other words, the senior members of all these agencies know about the problems, but they have no effective voice when it comes to providing solutions for them. And in the absence of a coherent long-term national IT strategy which might attract outside investors, it is hardly surprising that we are moving crabwise. Every time I talk to my contemporaries on the Bench in other countries which took IT seriously between 1985 and 1995, I become more and more embarrassed by the contrast.

For our court systems we now have a PFI supplier, our sponsors this evening. We hope that in three years we may have an Intranet within which we may communicate with our support staff, even if we cannot communicate through that system with magistrates' courts. This will be a step forward. But until very recently there has been no sign of a willingness to embark on the long-term strategic thinking which would go beyond this inner Intranet and look in a co-ordinated way by means of an Extranet at an outer concentric circle populated by the others who work in criminal justice agencies, the police, the probation services, the Prison Service, the CPS, the Legal Aid Board, barristers and solicitors. They need their own Intranets, but they also need the means of achieving two-way communications with the courts without yet another system to cope with. And beyond that outer circle are the public, who need to be able to access relevant information about criminal justice through kiosks at libraries or the courts, or through the Internet which we will be able to access quite soon through our TV sets at home.

THE DEARING REPORT AND THE RESEARCH BASE

The Foundation held a lecture and dinner discussion at The Royal Society on 25 November 1997 under the title "The Dearing Report and the Research Base". The evening was sponsored by the British Council, British Petroleum Company plc and The Royal Society. The Rt Hon The Lord Jenkin of Roding was in the chair. The speakers were Sir Richard Sykes DSc FRS, Chairman, Glaxo Wellcome plc, Professor David Watson, Director, University of Brighton, and Professor Martin Harris CBE, Vice-Chancellor, University of Manchester, and Chairman, CVCP.

Supporting the Science Base — Ensuring the Future

Sir Richard Sykes DSc FRS*

Introduction

The Dearing Committee Report marks a landmark for not only Higher Education in the UK today but also for Government, which must carry the prime responsibility for ensuring the health and well being of the Research Base in our universities. Industry and commerce in this country also have a part to play because we also are, or should be, users of the research outputs from the universities.

We need to understand very clearly that there is, in today's world, a clear link between a nation's economic success, and thus its ability to provide a decent standard of living for its people, and its capacity to carry out research of an international standard. Our success in the UK will depend on our ability to provide new products for the global market place. If we invest wisely in our public research base we will create those new products that we can sell at home and abroad, and earn the revenue we need to maintain our investment in university research – and also provide for the other needs of our society. If we fail to take the need to invest seriously then we will not be in a position to earn our keep in the world and to obtain the goods for society. It must be realised that our research base – both public and industrial – is the engine which will drive and determine our economic success as a nation.

Funding for academic research

There is at present something over £2.6 billion available for the support of research in academia and this is contributed from a number of sources, the most significant amounts coming from the HE Funding Councils and the Research Councils. The charities and industry also make a contribution to the funding of research to the tune of about £340 million and £180 million respectively.

When we examine the total expenditure on R&D in the UK we find that by far the largest contributor is industry – nearly half of the total. The Research Councils and HE Funding Councils, the major sources of public funding for university research, contribute only about 15% of Gross Expenditure on R&D. Although funding for the science base from the Research Councils and Funding Councils appears to have increased in recent years, this increase has been modest. However, we must also bear in mind the speeds at which science and technology are advancing, and thus the need for greater investment if we are to be able to keep up with our competitors. Altogether, the UK devotes 2.02% of its Gross Domestic Product (GDP) to Research and Development, which is less than many of our competitors. This has been the case for a number of years. As a nation therefore we are failing to invest sufficiently in science and technology. Cracks in our university research base are now beginning to become serious.

* Chairman, Glaxo Wellcome plc

Summary: The speakers each dealt with different aspects of the Dearing Report. Sir Richard discussed ways of ensuring the future of the science base with particular reference to funding. Mr Watson discussed institutional diversity, concluding that it was essential to be rigorous about funding research according to its various intended outcomes. Professor Harris surveyed the postgraduate scene, calling attention to areas needing attention in that rapidly growing and important area.

In most Universities today "research" is a particularly prominent feature. There are several reasons for this:-
• Research is believed to be the only hallmark of the "proper academic"
• Research seen as route to extra funding for universities
BUT they generally have to pay more to do the research than they receive from funders
• Research output – publications – determines university finances via RAE, Research Council grants, etc, appointments in academia and the promotion of academics
• Research is believed to be essential for high level teaching
However, it is clear that there is insufficient funding to provide the support that academics expect for their research activities – which in case of the sciences can be very costly.

The Committee saw four main reasons for supporting research in UK universities – which we believe to be strong and valid ones.
• to add to the sum of human knowledge;
• to inform and enhance teaching;
• to generate useful knowledge and inventions that could contribute to both wealth creation and an improved quality of life; and,
• to create an environment in which researchers can be encouraged and given a high level of training

However, to qualify these reasons, we suggested a number of principles that should be applied in deciding future funding for research. The central, and most important, of these is that only research which is excellent should be supported. We also suggested that the different types of research being undertaken in university departments should be funded by different funding streams to ensure that a balance between them is kept. Then, when decisions are taken to fund any research project, it must be *fully* funded with adequate provision to ensure the maintenance of the infrastructure and equipment elements required for high quality research and training.

There were two other points we regarded as important. Firstly, the current trend for chase for funding for research, often at the expense of teaching activities, should be avoided in the future. Policies related to research funding must be such that teaching is not devalued by their promotion. For example, the recognition of funding for "private" research and the acceptance of this as a valid

academic activity will support and enhance teaching. Secondly, funding mechanisms must be clear and transparent. Where the money comes from, how it is used and who benefits must all be quite evident.

Research requiring separate funding

The main areas of research activity which should have their own separate funding streams include the following:
• High quality research of international standing extending frontiers of knowledge;
• The provision of the infrastructure for research;
• The provision of resources for applied research to service the needs of local/regional economies;
• The encouragement and practice of scholarship;
• The encouragement of innovation to provide new products, processes and high tech companies.

These cover all the different types of research, including the more applied type of activity, and clearly indicate the importance of funding the research infrastructure. The last stream – to encourage innovation – is a new one and recognises the need to provide resources to allow work in academic laboratories to be taken to the point where evidence of potential commercial utility can be gathered: thus filling the gap between invention and exploitation that has plagued this country for so many years. Only the first three of these will be discussed here.

Dual support system

At present there are two main funding streams for academic research – which together form the "dual support system". The Higher Education Funding Councils (HEFCs) provide the funds which should provide essential resources to enable high quality basic research to be carried out. This research – usually of the basic type – may then be able to attract grants from Research Councils. It may also lead to grants from the charities and to collaborative projects with industry. HEFC funding is also intended to provide the "seed-corn" funding for new ideas and also to support young researchers at the start of their careers – before they have a record sufficient to attract grants for their projects. These two arms of the "Dual Support System" use different approaches in coming to decisions regarding levels of funding for institutions and research projects.
• The Research Councils assess projects in a prospective way and are responsive to applications coming from the research community – the same principles apply to much of the research funding arising from industry and the charities.
• The HEFCs on the other hand assess departmental research performance retrospectively and base their funding level on past performance as determined through the Research Assessment Exercise – RAE.
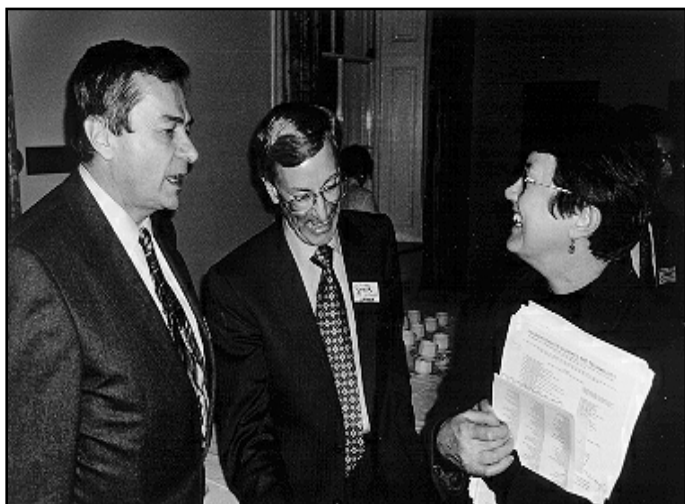
The two arms also provide for different elements of research. Thus the RCs provide for specific projects, or programmes, and studentships for research training, whilst the HEFCs provide the salaries for university staff, and funding for infrastructure, and to allow "undirected" – blue sky research. The Dual Support System is, however, far from perfect and has come under increasing pressures in recent years. In some of the evidence to the Committee its continuation was questioned. The problems identified in the system include the following:
• The lack of sufficient funding from the HEFC side has lead to an increase in numbers of researchers employed on short term contracts – 3 years.
• There is evidence that the transfer of funds from the HEFCs to the RCs, which occurred in the early 1990s to meet the overhead costs of RC funded projects, has resulted in some increase in *volume* of research funded – which was never the intention.
• There has been no increase in real funding to meet this increase in volume.
• There has been a serious run-down of the infrastructure for research as money has been diverted to meet the recurrent costs of research.
• Changes in funding practices have lead to researchers getting project funding to support technical staff for their projects. The result of this is that established university technical staff are underused but must still be paid for or removed.

The Committee came to the view, however, that the System still has a value and should be retained. We saw a number of reasons for keeping a Dual Support System. Its most valuable feature was seen as being its ability to allow universities some degree of freedom to support its research activities that are not funded by specific grants. They can thus use HEFC block grant money to
• create new research initiatives,
• provide longer term research support,
• take independent actions in the research they support, particularly in allowing the prosecution of unfashionable or unconventional research, and,
• find the funds to support the "unknown" brilliant researcher.

How far these reasons are really valid today could be questioned. However, we recognised that there is now a funding gap in the support for basic research projects. This is due to a large degree to the inadequate provision made by grant providers to meet the indirect, or overhead, costs of the projects they fund. This underfunding has contributed lo the present "infrastructure problem".

The various research funders contribute varying amounts towards the indirect costs of the project. Following the transfer of funds from the HEFCs to the Research Councils they increased their contribution to overheads to 45% of the salary elements of the grant. Industry also makes an indirect costs contribution – ranging from 45-65% of salaries – for its collaborative basic research projects. Companies will usually, however, pay the full costs of work done for them under contracts with universities. The charities make no contribution to overheads and the European Union will only contribute to indirect costs up to 20% of the salary elements.

Meeting the shortfall

The problem for the universities is, then, where to find the money to meet the shortfall. In the past, this was to have been met by the HEFC's contribution to the research of a university. In fact, their contributions are now not sufficient and the result is the funding gap at present in the system estimated to be between £400-£500 million which is largely due to the failure of investment in university infrastructure. The problem is how to close this gap!

This funding deficit is now putting our centres of research excellence in jeopardy. The problem is, first, to prevent this gap getting bigger and then to take urgent steps to close it to ensure the health of our major academic research departments. The first measure we proposed to achieve this is that the Research Councils increase their overheads contribution to at least 60% of salaries – and that they should receive extra money to allow this to happen. They, on

their part, must ensure that the research they support is adequately funded and that, if new money is made available to them to achieve this, then it is important that it should not be used to increase the volume of research. To enable this better funding to be achieved it is estimated that about £110 million is needed for the Research Councils per annum.

We saw three possible ways in which this could be brought about. Firstly, and the option we favour, is to increase the Research Council budgets by this amount using *new* money. The other two options are either to decrease the volume of research by an equivalent amount – which is not generally favoured – or to make a further transfer of funds from the HEFCs: that is, robbing Peter to pay Paul! and, again, not something that we would recommend. There is a serious problem here, and unless it can be addressed and solved there will serious consequences for our public science base. This will impact sooner or later on our industrial competitiveness and economic health.

As mentioned earlier, the mechanism used by the HEFCs to assess research quality in university departments is the RAE. The outcome from this exercise is the award of a Rating for each department, which is determined according to their national or international research quality. The Rating then forms the basis for calculating the level of funding they will receive. After the 1996 exercise most funding went to the "4", "5" and "5*" scoring departments – and none for the 1s and 2s. This had the effect of increasing the degree of selectivity further.

The RAE methodology is not without its problems. It pays scant attention to work done with industry and, we suspect, it works against inter-disciplinary and collaborative research. It also barely recognises the "Private" research – or scholarship – activities of academics in the sciences. The RAE pushes scientific departments in HEIs towards undertaking hands-on research activities – whether they are up to it or not.

We therefore proposed the earmarking of a fund by the HEFCs to be distributed on a *per capita* basis to University Departments who stay out of the RAE. This fund will, it is hoped, encourage private research and other scholarly activities in academia, and will diminish the imperative to carry out expensive research. One consequence of this scheme is that departments submitting for the RAE but achieving a low score will receive nothing for their research from the HEFCs – but neither will they have access to the *per capita* fund. Thus, taking part in the RAE will carry with it a "moral hazard". Whether this new concept will be implemented remains to be seen. It may be suggested that its fatal flaw could be that the *perceived* level of funding – at £500 *per capita* will be too low to be attractive. However, this was regarded by the Committee as the lowest, and not actual, value of an award.

Maintaining research infrastructure

A major funding problem is that of providing for the regeneration and maintenance of the research infrastructure and equipment. To meet this need we prepared the establishment of a "Revolving Infrastructure Loan Fund". This fund, of the order of £400-£500 million, would provide loans to universities to provide equipment and research facilities for groups carrying out research of excellence at the cutting edge of science and technology. Unlike a straight grant, the borrowing institution would be committed to repay the loan over a period of years – at a low rate of interest – from its grants and other income. The source of the money to fuel the fund is the problem. The most obvious source is government. However, the argument has been advanced that this is not possible owing to present Treasury accounting rules that make any amount contributed by government count towards the Public Sector Borrowing Requirement. To avoid this it was proposed that contributions to the fund should come from government sources – including RCs and HEFCs – and also from industry and the charities. However, this suggestion has not been received with any enthusiasm by these two private sector research funders. They regard the provision of infrastructure and major items of equipment for academic research as a government responsibility.

A point worth making – and is made in the Report – is that the same PSBR constraints would apply to the student loan fund that the Committee proposed. In that context, however, the Committee suggested that the Government "*looks urgently at alternative and internationally accepted approaches to national accounting which do not treat repayable parts of the loan in the same way as grants*". The same solution could be proposed in respect of the Infrastructure Loan Fund!

There are clear benefits to be gained from a Loan Fund Scheme for infrastructure. As the Scheme will require repayment of the borrowed capital, with some interest at a low rate, it would:

• require universities to manage their assets and resources in order to make the repayments;

• encourage universities to recover full costs of all funded research projects, including the costs of using the plant and equipment involved in the research;

• encourage university departments to rent out time on equipment and facilities to create revenue to repay the loan – that is foster the sharing of costly resources. This in turn would lead to less duplication and more effective use of expensive kit;

• ensure that costly equipment and infrastructure will be more effectively used; and,

• mean that the money in the fund is largely "recycled", and thus the fund will be largely self-sustaining in long term.

The funding of infrastructure, however, remains a problem and, again, unless it is resolved, the damage to the academic and industrial science bases will be significant.

Collaboration with industry and commerce

Now I turn to the role of university departments in supporting local and regional economies by engaging in more collaborations with industry and commerce. There is a need to bring the academic and business communities closer together to optimise the returns from the fruits of their research. Unfortunately, the RAE, as I have said, pays scant regard to research of a more applied nature, or to collaborative research with industry. A separate funding stream is therefore suggested to fund such joint efforts.

At present there are myriad government schemes available which are designed to encourage industry/academic collaborations – some of which are very effective. However, they make a confusing picture and create funding structures which are difficult to navigate successfully – particularly if you are a small company. Our solution is to amalgamate all of the existing, and future, initiatives under one heading to provide a "one stop" for company academics seeking collaborative funding. This is the "Industrial Partnership Development Fund". We proposed that present initiatives – such as LINK, ROPA, Teaching Company Scheme and others – are included in this Fund. Grants from it would then be available to academic groups carrying out industrially-relevant research – to which a company, or companies, would also contribute funding.

▲ *Sir Richard Skyes DSc FRS, Chairman of Glaxo Wellcome, talks with Tam Dalyell MP, a regular attender of the Foundation's events.*

Conclusion

And so, in conclusion, I believe that for our future prosperity we should be trying to achieve a virtuous circle involving government, industry and academia as partners to ensure that the UK is able to use its best talents and its research excellence in universities and industry to compete as a major player in the world-wide market place.

Clearly, government has a responsibility for ensuring the health of the Higher Education sector. It must address the increasingly serious funding and resourcing issues discussed above, and play its part in supporting Higher Education as an important element in ensuring the competitiveness of the UK. We need the funding bodies to develop better ways of assessing the quality, and value, of research undertaken in university departments, and to ensure that activities other than basic research – such as teaching and scholarship – are properly regarded and suitably supported to attain levels of excellence. The government must do all it can to encourage the collaborations between the academic and the industrial worlds because such collaborations have so much potential for wealth creation and the improvement of quality of life. However, in attempting this it is essential that the government be prepared to work with industry before launching new initiatives to ensure that they have a chance of success.

Companies should see their local, or regional, universities as important resources. They can be collaborators in basic strategic research helping companies to maintain a position at the cutting edge of science and technology; they may be able to provide R&D services for local bursaries; and they could be providers of training and reskilling for the company's workforce.

The universities must take steps to ensure that scarce funding is used to greatest effect; that they harness new tools and emerging technologies effectively for teaching, research and management; and that they strive for excellence and value in all of their activities. They must also see local, regional and national industries and businesses as partners to whom they can add value and so make real contributions to regional and local economies.

If we can achieve this virtuous circle than we will be in a position to secure economic success and quality of life for our people. If we fail? Well, the answer is obvious and the consequences dire. We must, therefore, sooner rather than later, move from discussing the contents of the Dearing report to putting into action the measures that are needed to ensure that we have the strong and effective Higher Education system we need to for our nation's future.

Research and Institutional Diversity

Professor David Watson*

Introduction

Your three speakers tonight have colluded each to bring a particular part of the picture called "The Dearing Report and the Research Base". Mine may well be the part that is least popularly received in this distinguished gathering. It is based upon the premise, as was the "research" chapter in our Report, that the research mission of UK higher education – and the public interest in that mission – goes much wider than meeting the needs of our top-ranking, international departments and groups.

While the Committee was working it was subject to a lot of single-issue advocacy from individuals or groups who felt that they held the key to the solution of the sector's problems. Here is a short list of the type of thing I mean:
- "research selectivity"
- "information and communication technology" (ICT)
- "credit and modularity" (CATs)
- "two year degrees"
- "employer needs"
- "institutional autonomy"
- "open enrolment"

Broadly, this set of "interests" relates to the groups who are now accusing the Report of "lacking vision". What, in fact, they mean is that it may lack their own, often narrow and sectional "vision", designed to exclude the visions of others. In contrast, the Committee set out explicitly to take a holistic view: to nourish and preserve the strengths of an already highly diverse sector.

Perhaps because of the heightened tension accompanying the 1996 Research Assessment Exercise (RAE), easily the strongest and most aggressive of these groups was that advancing the cause of greater selectivity and concentration of research funding. Here is the example which, just before Christmas, entered the public debate most dramatically.

[Mr Watson reproduced a slide depicting the Vice-Chancellors of Cambridge, Warwick and Edinburgh and the Provost of University College making their case for a super-league of top universities. It appeared in *The Observer* under the heading "We are the champions".]

I'm aware that the authors of the article below this headline have protested (including at a previous Foundation for Science and Technology discussion) that they were mugged by *The Observer* sub-editor and that the headline distorted what they were really trying to say. Professor Broers certainly wrote to the editor saying (and I quote) that "none of us have [sic] called for a superleague of named universities". However, this sat a little uncomfortably alongside one of his co-author's speculation on the front page of the paper about exactly who besides UCL would be in the "premier league". In any case, the campaign they represented did have a palpable effect. It influenced the HEFCE to allocate additional funds to 5* departments, thereby causing huge safety-netting and adjustment problems further down the scale. It probably also affected the DfEE, whose annual letter of guidance stressed the need for further selectivity.

To get to the point, in making this case for pre-emptive premium funding, the authors of *The Observer* article fell into a number of traps, which I believe the Dearing Committee avoided.

Firstly, they confused the issue of the adequacy of the quantum of public money invested in the research (and especially the science) base with that of its distribution. The Dearing Committee faced the question of under-investment directly and positively, and, indeed, made a priority out of the restoration of this type of national capacity without any corresponding denigration of other valuable species of research & development (especially on a regional and local basis). The need to restore the research base led to the Committee's clearest, least ambiguous call for new public money.

Secondly, *The Observer* authors were attempting to freeze the distribution of available public funding, not just by institutional type, but also perforce by subject and professional focus. In particular, they were expressing a clear disdain for professional and vocational higher education, unless by historical accident (like law and medicine) it happened to be securely placed within the magic circle. They ignored, for example, the underfunding of art and design – one of the areas proportionately most affected by the Funding Councils' cap on high-scoring areas.

The Dearing five-strand model for research funding breaks this mould.

Supporting research and scholarship

We propose five research funding streams:
- project and programme provision – Research Councils
- to support institutional decisions about research priorities, assessed retrospectively through the Research Assessment Exercise – Funding Bodies

* Director, University of Brighton

• to support scholarship and research that underpins teaching – Funding Bodies
• an Industrial Partnership Development Fund, to support applied research assisting economic development – government matched by industry
• a revolving loan fund to maintain infrastructure in support of top quality research – government, industry and research charities.

I won't go into detail about how these strands are analysed or composed, since I am sure you are all familiar with the arguments in that section of the Report. However, here are some of the problems it is designed to overcome:

Research funding: the challenge of diversity

1. supporting "new entrants"
2. "developing capacity"
3. ensuring industrial and commercial impact, including "gearing"
4. motivating collaboration
5. confirming the distinctiveness of higher education.
   I would like to comment briefly on each of these in turn.

New entrants

This is the case where increased selectivity and concentration is at its weakest. How far does the process have to go before it simply incapacitates the competition? With something like 50% of Funding Council and 60% of Research Council funds going to just twelve institutions, it is at least arguable that we have reached that stage already.

Developing capacity

Just as total concentration will predicate simply more of the same, so it will preclude investment for new purposes. We must not give way to the argument that the best of what we currently have is all that we can ever have. For one thing it is by no means certain that everything we claim to be internationally excellent is in fact so; I don't believe I am alone in suspecting that in some areas the kind of international bench-marking which Dearing suggests is essential may turn out to be a cold bath. Similarly, the whole logic of "foresight" is that we must reserve some investment capacity.

There are several cases that would support this contention, of which perhaps the Bain Report on business and management research, commissioned by the ESRC in the early 1990s, is perhaps the clearest. Another is the shifting agenda in medical research: better to balance the interest in clinical intervention with that in user and community perspectives, where again we need to "grow" capacity.

Public/private "gearing"

Over the long haul, I suspect that one of the key contributions of the Dearing Report will be in the area of myth dissipation. There are several examples in the research arena. These include: the myth that some of our European partners operate a uncapped pool for matching any funds that academics bring in from the EU; the myth that there are respectable North American universities and colleges whose faculty members do no research; and the myth that other societies are more successful in garnering industrial support for pre-competitive research. In fact, on the latter point there seems to be an iron law that prevents direct commercial and industrial support from exceeding something in the range of 6-9% of all institutional spending on research.

On this basis the UK performance is entirely respectable. There is, however, yet another awkward question about the effect of further concentration of public funding. Greater selectivity seems to have the effect of reducing rather than increasing the "gearing" performance of institutions. I know that statistics can prove anything, but here is a table based on the proportion of support from UK industry achieved by four radically different institutions in 1995-96 (before the latest RAE – as a result of the 1996 settlement I predict a further widening of the gap).
Proportion of Research Funding from UK Industry, 1995-96:
• All universities 6.75 %
• Brighton 6.08%
• Cambridge 5.16%
• Oxford 4 03%
• Sussex 3.01%
There are several pathologies related to this condition, including, I suspect, a propensity for the institutions with more public funding to subsidise industrial projects (rather as they do, with greater justification, in the case of the medical charities). I also suspect that something similar explains the break-down of the latest attempt to fix the dual support boundary. Relatively well-funded institutions have in effect colluded with the Research Councils to cut the corners on overhead recovery: the institutions do so to capture the contracts even if at marginal cost; the Research Councils use this device to get further down their list of "unfunded alphas".

Turning to commercially and industrially relevant research, the Dearing Committee drew two morals from the story. The first concerns the lack of co-ordination of the public funding that is already going into this field, along with an anxiety that bidding for short-term initiatives (for example the serial versions of "competitiveness") may well have been developed beyond a point where it is efficient. The second is the proven leverage and positive effect of matched funding. A good case is the Teaching Company Scheme, and its impact on SMEs in particular. Both of these underpin the arguments for the proposed Industrial Partnership Development Fund.

Collaboration

Especially since the return of a new government, "collaboration" has become almost as much of a mantra in the discourse of UK higher education as "competition" was in the mid-1980s. So far a lot of this is literally lip service. When challenged by the Committee to explain how collaboration could be better supported, the only solid answer from the representative bodies (CVCP and SCOP) was the suggestion of top-slicing of funds for particular projects (as has already happened in Scotland). This, of course, sits uneasily with their general hostility to top-slicing for selective purposes.

Concrete action will be needed to ensure support of individuals and groups whose activities require access to facilities and assets held by institutions other than their own. This will not be aided by either formal or informal hierarchy of institutions, and will need intellectual as well as financial generosity to make it happen. It can work – and I would evidence the Complex Product Systems Innovation (or CoPS) Research Centre awarded by the ESRC jointly to the Universities of Brighton and Sussex, which has just completed a very successful first year. CoPS builds on distinctive and complementary strengths of the Science Policy Research Unit (SPRU) at Sussex and the Centre for Research into Innovation Management (CENTRIM) at Brighton. It was incidentally CENTRIM, with its long track record of industrial partnerships, which developed the research framework for the latest DTI project on *Competitiveness through partnerships with people* (DTI, 1997).

Higher education and scholarship

A key commitment of the Dearing Report is to the distinctive nature of something called higher education, and the centrality of scholarship to its effective maintenance. It is no accident that our chapter is entitled "supporting research and scholarship". This has got us into a fair amount of trouble with various of the special interest groups I listed earlier, including those who believe that life-long learning is best served by an entirely undifferentiated "tertiary" sector. Our ideas for explicit funding of this element of institutional support for higher education in those departments and institutions which rationally should opt out of an RAE exercise with a higher quality related threshold of access to support for basic research have brought about a reaction along the continuum from mystification to derision. For many such support should already be wrapped up in "T" (teaching) funding; for others it will simply mean that "bad research" will be funded (as presumably was at least occasionally the case before the first RAE!).

It might be unpopular, but my final throw is going to be to defend the Dearing proposal, or something like it, as both logical

and (at least temporarily) necessary. (I can also call on the support of the NAPAG report of April 1996 on the "research capability of the university system", which came up with a very similar idea.) If we are serious about the distinctiveness of higher education, including professional higher education, then we must keep both the funders and the institutions applying their funding honest about the implications. These include the provision of an appropriately scholarly *ethos* for all teaching and learning at the undergraduate and postgraduate level. To give up on this commitment will demean UK higher education as a whole, and universities and colleges (following the stresses and strains of underfunded expansion) need explicitly to acknowledge this. In other words, it is an inescapable corollary of the RAE opt-out.

In passing, it is probably worth mentioning that this pair of proposals also links with an important Dearing sub-theme: about reducing the amount of "transactional noise" with which we are encumbered across the sector (sadly not a cue picked up by the government in their otherwise courageous decision about graduate contributions).

Conclusions

The bottom line of my overall analysis is that research funding and research support, like so many other parts of the Dearing Report, cannot be cherry-picked and separated from other key priorities. The link I have tried to establish is between research and Dearing's notion of a disciplined diversity of institutions.

I am not arguing for a universal research entitlement or a single institutional research funding formula, such as was enjoyed by the institutions formerly funded by the UGC and the UFC. I am asking for respect and opportunity for a number of institutional "types" besides the international research-led university, including what might be termed the "modern professional formation university" operating effectively in the polytechnic tradition (with a strong regional and SME-orientation). My case is also relevant to the smaller HEI which might have one or more actual or potential individuals, groups or centres of international class.

The key to all of this is, I believe, being rigorous about funding research according to its various intended outcomes. If we get this right, a disciplined diversity of institutional missions will contribute constructively and effectively to the national research base.

Postgraduate themes

Professor Martin Harris*

Introduction

I have been asked to talk this evening about postgraduate themes in the Dearing Report, and these will indeed be my principal topics. I shall, however, add a brief word about two other matters: namely, the proposed Arts and Humanities Research Council and the question of the ownership of and responsibility for the Dearing Report now that it is in the public domain. I won't be talking, in the time available, about many other issues relating to the research base to which Dearing alludes, although I hope to join fully in discussion of these matters later in the evening.

It is a relief not to be speaking today primarily about funding, whether of institutions or of students. The CVCP line has been, as you know, to support the government in general terms in respect of the difficult decision which they have made to require a student contribution to the cost of their higher education tuition, although not without some anxieties and uncertainties. On the all-important question of the future funding of institutions and *a fortiori* of the research base, little will be clear until the conclusion of the comprehensive spending review, in the late summer or autumn of next year. In the meantime, we continue to press for the implementation of Sir Ron's funding recommendations and will sustain maximum pressure to this end.

Within the context of general support for government's decisions in respect of student funding, there is one obvious potential problem relevant to tonight's topic. Postgraduate students, both taught and research, have been increasing steadily over recent years, for a whole variety of reasons. Full-time and part-time, taught and research, numbers have gone up inexorably. For reasons of 'rebadging' or of continuing professional development, for intellectual challenge or as preparation for a research career, more and more students have continued beyond Bachelor's level. The issue is, will there continue to be an adequate supply of excellent potential research students, essential to the future health of the research base, once students graduating at Bachelor's level already have a significant debt to repay? No-one can of course yet know the answer to this question – but it does inevitably give rise to concern as our system of student support is being radically restructured.

Areas needing attention in the HE sector

But to my main topic. Colleagues will recall that I recently chaired

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a HEFCE/CVCP/SCOP review of postgraduate provision in the UK, which, while speaking broadly of a buoyant and successful segment of the higher education sector, of rapidly growing size and importance, nevertheless identified a number of areas which needed attention. Three main issues arose in respect of which changes were felt to be necessary, and I shall return to each of these shortly. I would like to thank QAA staff for up-dating me on recent progress in this field.

The recent NCIHE report explicitly endorsed the line taken by the Harris Review and in the follow-up work currently under way under the aegis initially of HEQC, now QAA. It made a number of specific recommendations with particular relevance to postgraduate education: for example, that as well as fostering the understanding of a range of research methods and supplying training in appropriate technical skills, institutions should make explicit the 'professional skills' such as communication, self-management and planning, that they sought to develop in their postgraduate research students. It proposed a code of practice 'for postgraduate education' and the development of a national qualifications framework, incorporating a number of explicit postgraduate levels – all very much in line with the earlier recommendations.

In the light of this, QAA's work on the quality and standards of postgraduate education has been adjusted to reflect the Dearing Report. There are, as I said, three main strands on which the work focuses, with the joint aim of clarifying the nature of postgraduate provision and the reinforcement of good practice. With something like consensus at work here, we really should be able to achieve something.

In this light, QAA have now designed a two-year project, which began in June. Work to date has attempted to identify a national approach to achieving greater clarity about postgraduate provision. A steering committee, chaired by Dr David Fussey, Vice-Chancellor of Greenwich, includes representatives of a wide range of interested parties. A project institutional group consists of representative of nine institutions, selected to represent the diversity and geographical range of the sector, who have agreed to supply policy advice and trial options.

Principal areas of work

Let us now look at the three principal areas of work. The first strand involves the construction of a national Directory of Postgraduate Provision, taking the form of an electronic database

based on a structured set of typographical categories for the collection of information about postgraduate courses together with a mechanism for the verification of information supplied. Categories of information identified to date include programme aims, entry requirements, the nature, mode and location of the study programme, its duration, structure and credit-rating, level of study, its method of assessment, and relevant quality assurance indicators. Information supplied by institutions in accordance with these categories will provide the basis of the Directory. Data collection and dissemination is being undertaken by the Careers Services Unit of CVCP, the publishers of the *Postgraduate Prospects* Directory. The first edition of CSU's Directory, which will begin to reflect the new categories, is expected to be introduced in 1998.

The second strand is designed in part to make the first possible. Consistent descriptions imply a clear typology and reasonably consistent nomenclature. To help to achieve this, the development of a typology of postgraduate awards is being taken forward through the Agency's work on a national qualifications framework. Although, at least in the short term, separate frameworks may be necessary for Scotland and the rest of the UK at undergraduate level in view of the different traditional structures, at the postgraduate level a UK-wide approach is both possible and desirable. The framework will involve a structure of clearly defined levels and credit ratings, enabling individual awards to be located and understood relative to one another. The harmonisation of postgraduate award nomenclature will be achieved as far as possible through the adoption of criteria for the use of any given award title.

Work on postgraduate levels and awards is still in progress. But some clear lines are already emerging, such as the proposal to credit-rate postgraduate provision with 180 credits for the equivalent of a calendar year, and to restrict the use of the Master's title in ways that I will describe in a moment. A limited range of options for taking forward a postgraduate qualifications framework has been identified, and arguments collected and weighed. One favoured option, subject to refinement and development, has a number of aspects: it broadly endorses the Dearing scheme, identifying three levels at which genuinely postgraduate awards may be made and one hybrid undergraduate/postgraduate level. Let me now describe these very briefly to you.

Levels above Bachelors

There would be, if emerging proposals can be developed into an acceptable form, four levels above Bachelors, each permitting both an academic and a professional route, this to be specified in the Directory. Equally, the academic route would allow for both taught and research degrees, the balance again being specified in the Directory. The fourth and highest of these levels would be the doctorate, whether a PhD or a professional doctorate, and I will say no more about this tonight.

The other three emerging levels might be as follows. It is suggested that above the Bachelor level there should be three levels below that of the doctorate. The first of these would be a hybrid 'undergraduate' level, covering such provision as the fourth year of MEng and comparable courses, 'conversion masters' and the like. In the aftermath of Dearing, such courses might lead to 'higher honours' rather than to a postgraduate qualification as such. In any event, the Masters designation should be ruled out.

The second level might be entitled Master's level, and would be based on 180 credits (perhaps one calendar year full-time, but time would not be a defining characteristic), to be offered in respect of taught, research or professional courses. The third level, perhaps known as 'Higher Masters', would also be based on 180 credits per year (perhaps taking two years when offered in full-time mode) and would again be potentially available in taught, research (eg MPhil) or professional (eg MClinPsych) form. The level of provision would be specified institutionally, would be stated in the Directory (as part of the information alluded to earlier), and would be susceptible to verification by peer group judgement, external examiners and the like. I should stress that this represents one possible line of development of work that is still at an early stage. The

final scheme will depend upon further development, consultation with institutions and, of course, to final adoption by the Board of the Agency.

Code of Practice

Finally, a word on the Code of Practice for Postgraduate Training and Research which both my committee and the NCIHE strongly supported. This code will relate to the support and supervision of all postgraduate student research, whether or not undertaken as part of an exclusively research programme. Work has taken as its starting point the *Guidelines on Postgraduate Research Degrees* published by HEQC in 1996, and the various Research Councils are participating in its development. This postgraduate code will hopefully become part of the overall code of practice envisaged by the Dearing Report, and indeed is the first of the codes to be developed. A first draft is now in preparation and is expected to be circulated for comment early in 1998. The existence of, and general adherence to, such a code of practice is seen as crucial in reassuring research students, in particular perhaps those from overseas, of the nature and standard of supervision and other support which they can expect to receive while at a UK university.

Arts & Humanities Research Council

So much for my principal theme. Now, as I promised, two brief postscripts. Firstly, can I ask for your support for the proposal that government should establish an Arts and Humanities Research Council. Of the two main reasons for this, one is essentially structural. Sir Ron's group reiterated its support for the dual support arrangements which have served our research base so well, and the creation of an AHRC would fill the one lacuna in that pattern of support.

The additional £25m p.a. requested in the Dearing Report would, when taken with the £25m currently distributed via the Humanities Research Board, ensure that the ratio of HEFCE QR money to Research Council funds would be roughly equivalent to that in other disciplines. That is important both in itself and symbolically to the relevant research community.

But the more significant reason relates to the inherent importance of arts and humanities research, both in itself and where it overlaps with the social sciences. Some key challenges for science arise, after all, at the interface between science and technology and our social structures and sets of beliefs. To underpin and support the advancement of science and technology, there is a strong case for understanding from the outset the society in which we live and public attitudes to scientific and technological change. Humanities research, for example, can aid in the understanding of the historical and cultural context that will help to decide whether a new scientific or technological advance will be accepted. Philosophy and theology provide an insight into the ethical implications of pharmaceutical breakthroughs or genetic engineering, as into appropriate business practice. Linguistics is central to the development of intelligent information systems that are crucial to supporting our information society. Art and design is situated at the very point where aesthetics, IT and engineering meet. The creative and performing arts are crucial to the multi-million pound entertainment industry – and of course universities' contributions in these fields often greatly enrich the lives of those in the communities which they serve. For these and many other reasons, CVCP strongly endorses the Dearing suggestion that an additional £25m p.a. should be provided for a newly established UK-wide AHRC, preferably within the OST framework.

"Ownership" of the Dearing Report

Finally, a brief word on the 'ownership' of the Dearing Report. As anyone who has ever chaired a national review knows, once the report has been submitted it needs champions, in addition to the (former) chairman, to take the work forward and to ensure that its recommendations are not, for whatever reason, overlooked. Sir Ron needs help from all the key stakeholders who are party to his compact, to ensure that the momentum achieved last summer is sustained.

For its part, CVCP is committed to supporting and taking forward many of Dearing's core proposals. We shall set up an Institute for Learning and Teaching, in part to accredit accomplishment on the part of university teachers. We shall work with the Quality Assurance Agency to seek to develop lighter but effective quality assurance arrangements, and to contribute to their developing ideas on standards. We shall support within available resources the government's agenda on access and on life-long learning and look forward with enthusiasm to the forthcoming White Paper.

But in some areas, in particular around the sustenance of our research base, we can only play our full part with others – with the Research Councils, the Charities, the private sector. That debilitating gap, especially in respect of research equipment, *must* be closed. And most important of all, we need the whole-hearted commitment of government to ensure that students are taught by sufficiently well qualified and well motivated staff with an infrastructure that is appropriate to a world class higher education system; that is something which only government can make possible.

Many people have referred to Sir Ron's Report as a set of interlocking proposals, an overall compact from which 'cherry picking' is not possible. CVCP agrees, and so do I. If *any* key stakeholder fails in their responsibility, a great opportunity will have been lost. That cannot be allowed to happen.

SUCCESS IN TECHNOLOGY VENTURES

A lecture and dinner discussion on "Success in Technology Ventures through Science, Engineering and Technology" was held on 3 December 1997 at the Royal Society of Edinburgh. It was organised jointly by the Royal Society of Edinburgh, CBI Scotland and the Foundation, and The Rt Hon The Lord Jenkin of Roding was in the chair. The speakers were Mr Gerald R Wilson CB, Secretary & Head of Department, the Scottish Office, Mr Meirion Thomas, Department of City and Regional Policy, University of Wales, and Mr J F McClelland CBE FRSE, Vice-President, Digital Equipment Ltd.

Mr Gerald R Wilson CB*

Introduction

This is a unique occasion for me. I am here primarily not so much as head of The Scottish Office Education and Industry Department but as a member of the Technology Ventures Leadership Group who are mainly businessmen. Indeed, I am here in place of the Chairman of the Group, Euan Baird, of Schlumberges, who very much regrets that he could not be here. Nonetheless, the civil service responsibilities are difficult to shake off and so you have before you a schizophrenic: Sir Humphrey Appleby crossed with Richard Branson. I shall do my best.

I was pleased to see the word 'success' in the title of tonight's event. There was a time when events concerned with the industry/academic interface – and there have been many over the years in Scotland – were marked by allegations that higher education and research institutions produced excellent research but were remote and unapproachable and that the business and finance worlds did not find the kind of work going on in these institutions to be particularly relevant. That was never, of course, entirely true in that, for example, many big companies have always had an interest in academic research – even that kind of research sometimes described pejoratively as "blue skies". There were the endless arguments on the one hand that there were many good ideas in the institutions but no money to exploit them commercially and on the other hand that there was plenty of money available but a dearth of commercially exploitable ideas. Each side tended to blame someone else for lack of progress.

I think things have changed. They have changed for a number of reasons. The institutions for their part have, like others who receive funds from the Exchequer, found themselves looking for ways of increasing their income, and exploiting the intellectual property arising within the institution is one way of doing this. By

Summary: Mr Wilson discussed the Technology Ventures initiatives with particular reference to the first year of operations. Much had been achieved but there was more to do in the university, business and finance areas. In particular, the good communications that had been established needed to be built upon and widened.

devoting resources and effort to the task they have got better at it. In the business and finance worlds there is now a real awareness of the importance of science, engineering and technology in the manufacturing and services sector of the 21st Century.

In a country like Scotland, the future of the economy and of the society it supports depends increasingly on high-tech, high value-added innovative products and services, and the higher education and research institutions are increasingly being seen as a source of expertise. One might add that the recent turmoil in the financial markets of the Far East underlines what we all know: that while inward investment has made and is still making a major contribution to the modernisation of the Scottish economy, it is not a panacea. We also need to make the most of the talent – financial, commercial, scientific and technical – that we have here. The commercialisation of academic research is a key to future progress.

The Technology Ventures strategy

As most of you know, the Technology Ventures strategy resulted from an enquiry into commercialising Scotland's science and technology. The enquiry was initiated by Scottish Enterprise and The Royal Society of Edinburgh against the background of the perception that I have already referred to – that Scotland did well in undertaking high quality scientific research but did not perform well in commercialising that research to the benefit of Scotland. Scottish Enterprise commissioned various pieces of research to evaluate that perception and to find out more about attitudes and obstacles to commercialisation. It is fair to say that while a clear need for action was identified, the picture even then was not as

Secretary & Head of Department, Scottish Office

gloomy as some had painted it. Much was already happening in Scotland and this was particularly true of academics' interests in the commercial relevance of their work.

As many of you know, the strategy was not produced by a small team carrying out extensive desk research or new research or analysing results and writing a report. The enquiry was deliberately a participative process engaging key individuals in business, universities and research institutions, the financial sector and government. The enquiry process stimulated discussion and, even more, it stimulated action. Not action under the control or direction of one organisation, but action by a whole variety of individuals and organisations. And that collaborative theme has continued. Many have been encouraged to do something new or to pursue projects for which they might not have found much support in the past. Some initiatives such as CONNECT were getting going even before the Technology Ventures Strategy was finalised.

What has been achieved?

The first annual review of the Technology Ventures initiatives is published today. The picture is, as Richard Branson might say, "amazing", and as Sir Humphrey might say, "very encouraging". Let me pick out a few key points.

The level of communication has improved greatly: CONNECT – bringing together businessmen, academics and investors – established in 1996 as a pilot among the three Edinburgh universities goes Scotland-wide by Spring 1998. A Web site and database are being created to facilitate the exchange of information. A Technology Ventures Congress was held a few weeks ago, including the first CONNECT Conference. Details of CONNECT's activities appear in the excellent Technology Ventures newsletters.

The finance scene is changing: In July Scottish Enterprise in partnership with 3i plc launched the Scottish Technology Fund to help at the very early stages of commercial product development. The Quantum Fund was launched last month involving staff from Scottish universities and possible financial backers. A growing interest in technology is developing within the LINC business angels network.

There are many particular examples of developing commercialisation involving universities and research institutes, the Scottish Enterprise Network and the public sector, including the creation of incubator units, changes in institutional management structures to facilitate commercialisation and the emergence of a number of new commercial ventures. The Royal Society of Edinburgh's Enterprise Fellowships are also relevant in this context. These developments are all referred to in greater detail in the report and they make encouraging reading.

The broader background

All of this is happening against a broader background. The Government's own Foresight initiative is highly relevant in encouraging research effort in projects with a potential for wealth creation and improving the quality of life. This initiative has provided another important network for debate and the Royal Society of Edinburgh has played an important part in encouraging that debate.

The Government's various other schemes are also part of the broader background: the LINK scheme, the Teaching Company Scheme, the SMART scheme – a record number of companies successful in this year's competition – and the SPUR scheme.

In the higher education institutions there are important developments aimed at ensuring that the skills base is fully responsive to the needs of the economy – the Scottish Advanced Manufacturing Centre is a good example. Dearing and Garrick fully recognised the importance of developing business/academic links. As part of their response to the Foresight exercise the Higher Education Funding Council provided £7.5m of research funding to projects. And there is the interesting by-product of the Technology Ventures Initiative – Scottish Knowledge – which aims to market Scottish higher education internationally.

I think that the progress, especially over the last year, has been substantial. I also think, however, that this evening's discussion should reflect about how we can reinforce the progress that has been made. I would like to refer to three areas.

Universities and research centres

First, looking at universities and research institutes, many departments have shown interest in looking more consciously at their research strategies. And at the institutional level some universities have adapted their management structures to focus more clearly on commercialisation and adopted strategies for action. But I have to acknowledge that there is still concern at the incentives for universities and individual researchers to collaborate with industry through, for example, carrying out contract research. Despite changes to the Research Assessment Exercise there is still a feeling, not just outside universities but shared by some academics, that RAE cannot take into account some types of commercial work, however leading edge. In fact, the evidence suggests that Departments with good research ratings also have good records on industrial links. But if people perceive a problem it may be that we have to address that perception – at the minimum by improving understanding.

Finance

Secondly, although there have been big improvements in finance available to spin-outs and other high-tech companies, and indeed some of the clearing banks have been keen to spread a better understanding of how and when they can and cannot help, there is more to be done on the financial side. Technology is very fast

▲ *One of the speakers (left), Mr Meirion Thomas, Department of City and Regional Policy, University of Wales, with Mr Bob Downes, Director, Scottish Business, Scottish Enterprise.*
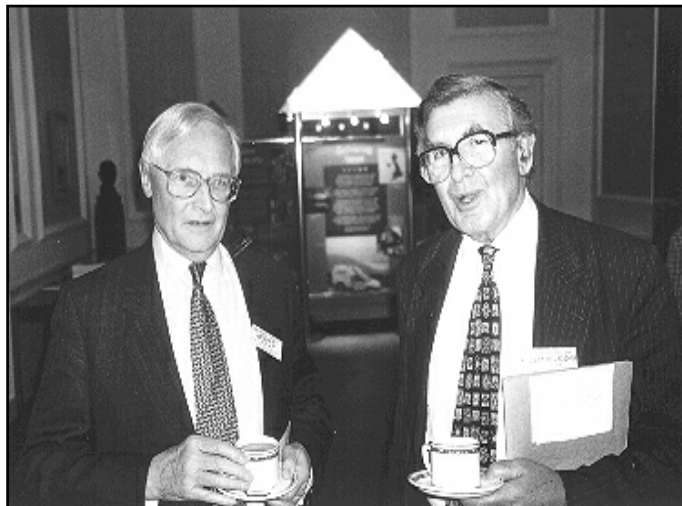
▲ *Professor Malcolm Jeeves CBE, President of The Royal Society of Edinburgh (left), with The Rt Hon The Lord Jenkin of Roding, Chairman of the Foundation, at the meeting.*

moving nowadays and if investors are to understand the potential of any development they require to develop more technical expertise. They have to acquire more in-depth understanding of the new and rapidly developing technologies that will shape the 21st Century. The astonishing growth of the multi-media industry is a good example. The rewards for those who make the right investments early are enormous.

Establishing links

Thirdly, the Technology Ventures strategy identifies the need to increase the number of links between universities and research institutions and existing companies – not just to focus on new companies. Perhaps this is the area where we have furthest to go. We still need a clearer message from industry as to what industry wants from universities and what are perceived as the obstacles to collaboration. Perhaps the message is clearer on the skills side but less so on collaboration in product development and business development more generally.

There are schemes which help: the Teaching Company scheme and the STEP scheme – the Shell Technology Enterprise Programme for instance. And a number of local enterprise companies are working hard with universities to build company links – and some of that work pre-dated the commercialisation enquiry. For example, support has been given to appoint commercial managers in institutions and their aim is partly to identify companies who could benefit from academic expertise. But we won't be able to have commercial managers for every department and companies do find it hard to know what is going on inside universities – to know of areas of expertise and current projects. SHEFC and Scottish Enterprise are working on that to produce a more user-friendly database. I suppose what I am saying is that there is more to be done on communication – particularly with those who have not yet got the message.

A focus for action

The final issue I want to touch on is not so much an obstacle as a focus for action. We have to make sure that we do not concentrate on technology and on finance and forget that much of what we want to achieve will be delivered by people with the right skills and attitudes. The Technology Ventures strategy identified the importance of bringing in *people with management skills to new technology-based companies*. A recent review undertaken by the DTI emphasised the importance of companies having suitably *qualified engineers and technologists* on their staff if they are to be able to engage in a dialogue with higher education and research institu-

▲ *Sir Graham Hills FRSE (left) and The Lord Taylor of Gryfe FRSE (centre) in discussion with Professor Malcolm Jeeves.*

tions.

This means looking at our skills base and SME recruitment practices – a rather wide-ranging task. But it is not a new task. It is an issue already on LEC and others' agendas. We also need the right *people in the institutions* able to advise on commercial exploitation of research – looking at issues of IPR and finance. There are some skilled people in universities already but their remit and their professional updating are key issues for universities and research institutions. Financial firms and institutions need more in-house technical expertise to evaluate projects.

Conclusion

Briefly, therefore, my message is that we have come a long way and have a lot of good stories to tell. There is, however, more to do: in universities, by giving fuller recognition to commercial research; in the finance sector, by improving skills; in businesses, by improving understanding of the potential contribution of academia to commercial success. And all the parties need to become better trained and yet more professional. Above all, the good communications – the networks, the databases, the exchanges of experience – which have been established need to be built upon and widened. Events like this have a major contribution to make and I welcome the initiative of the Foundation for Science and Technology in organising it.

FOUNDATION NEWS

▲ *Mr Gerald H David OBE, Chairman of Aerial Group Ltd (left), one of the sponsors of a recent Foundation event "How many public funded researchers should we have?", with The Butterworth (centre) and Sir Hermann Bondi KCB FRS, formerly Master of Churchill College, Cambridge.*

▲ *Pictured at the same evening were Dr M F Perutz OM CH CBE FRS, member of the Medical Research Council Laboratory of Molecular Biology, with Dr Ralph Kohn, Kohn Foundation, one of the sponsors, with his daughter on the right.*

PEOPLE AND WORLD-CLASS ENGINEERING

The Foundation paid a technology visit to Cranfield University on 16 June 1998 followed by a dinner discussion.

The regular dinner/discussion meetings of the Foundation occasionally move from their home at the Royal Society and one such transfer took place on 16 June 1998 when a party of twenty-nine visited the University of Cranfield to hear presentations on, and to see something of, its work and to discuss its successes over a dinner.

Background

The Vice Chancellor, Professor Frank Hartley, explained that the University had been founded in 1946 as the College of Aeronautics to develop the advances in aviation made during the War. Its interests were now much wider than aeronautics, although that subject remained important and, indeed, the University still had its own aircraft and airfield. (It is noted that one guest, who appeared to have failed to catch the coach from London thereby causing the Director to fear that he would be stranded on the Embankment, took advantage of the facilities by flying his own light aeroplane to the University!) The College had been designated a university in 1969 and, on the Cranfield campus, was wholly postgraduate. This meant that research and teaching were wholly integrated, that excellence was the aim for all effort and that all the University's work had relevance to industry and wealth-creation – even to the extent of students designing real aircraft, tested by the University's test pilot and certified as airworthy by the University's staff. Much work was undertaken in equal partnership with industry.

The University's mission was to transform world-class science, technology and management expertise into viable, practical, environmentally desirable solutions to enhance economic development while its aim was to be the leading national, European and international institution for knowledge in engineering, applied science, manufacturing and management. Staff were constrained by both the disciplines of academe and industry. The Cranfield estate was concerned with aerospace, engineering, industrial and manufacturing science, bioscience and technology and management. There were two further University estates: one was at Shrivenham, the Royal Military College of Science, concerned with electronics, engineering, computing and information technology, applied mathematics and defence management; the other was at Silsoe and concentrated on agriculture, agricultural engineering, food production, land use and the environment; both had some undergraduates.

There was also considerable overseas co-operation: in Europe, the University worked with 13 institutions in 5 countries to provide double degree programmes (e.g. an MSc and a French degree after a 5 year course comprising 4 years in England or France and the fifth year in the other country); with the Pacific Rim there was a two-way flow of knowledge at the research level; in Africa, Asia and South America, there was an export-only of technological, agricultural and management support for developing countries.

From 1946 to 1992, the University had been funded only for teaching and so research funding had to be found from other sources but, since 1992, funding had come from the Higher Education Funding Council. In addition, research income continued to be earned from industry – until recently to more than twice the extent of its nearest competitor. The partnership in research with industry raised the problem of industry having to share its commercial secrets, but this was not a problem at Cranfield where staff understood and respected commercial confidentiality. Because of its defence work, many of the staff had signed the Official Secrets Act.

Around the site

The visitors were shown around the site: firstly, they went to the School of Industrial and Manufacturing Science; in the Water Science Department between sixty and seventy students conducted research for the water industries, including, in respect of sewage treatment, a project to solve the problem of chemicals in organic waste and the chemical treatment of phosphorus in waste water. They later saw the continuing research into underwater viewing, and in the Welding Department, the problem of laying and repairing pipelines in ever-deeper waters where the technique was to build an encasement and pump out the water but keep the pressure within similar to that without. There was much still to be understood before some operations could be automated.

The most participative part of the visit, other than dinner, was

▲ *Professor Helen Muir, Professor of Aerospace Psychology, briefs the visitors to Cranfield University in the body of the aircraft.*

▲ *EMERGENCY – ALL OUT!! One volunteer jumps to safety down the emergency chute from the aircraft.*

▲ *Meanwhile, Rod Muttram from Railtrack, looking cool, takes an easier exit from the aircraft.*

▲ *Most of the visitors below the aircraft wait for the last to exit.*

the visit to that School of the University entitled the College of Aeronautics. Here the visitors were shown a video of the (worrying) experiments undertaken in respect of aircraft cabin safety. Tests had shown that, in the absence of disaster, cabins could be evacuated in 90 seconds but, in many accidents, the time taken was much longer and often with fatal results. The reason for delay was human behaviour in emergency situations so there was a need to redesign seating and exits to cope with such behaviour. At every air accident, both the mechanical and behavioural causes were investigated. The visitors were then taken into the cabin research safety facility (part of a real aircraft cabin) where the more hardy (and younger!) were encouraged to slide down the escape chute.

The next port of call was the University's Institute of BioScience and Technology, whose concerns included medical diagnostics, environmental issues, food matters, imaging and contamination control. The Institute was interested in anything which can be sensed and the application of sensors to medicine, food, bioprocesses and the environment. It was anticipated that there would be a microanalytical revolution and that sensors would be able to acquire information about people's health, what they eat and even – perhaps in 40/50 years time – the ability to project their deaths. In the Engine Display area of the School of Mechanical Engineering there was a Whittle engine, an original which resided in what was now the leading university research and

teaching centre in the world for gas turbines. The School had been established as a department of Propulsion but had broadened its interests into fluid flow, image processing and other matters. Its teaching comprised MSc and PhD programmes and short courses: its research was both academic (for research councils and European funders) and industrial (providing consulting for commercial research houses); it was now one of the largest engineering schools with 130 staff engaged in teaching and research and from which 97% of its students found employment within six months of graduating. Its present interests included the study of the combustion process, computational engineering, turbomachinery (it had certain specialisms such as icing on the wings), engineering mechanics and optical sensors. There was a management content to all engineering courses: two months within each PhD, one whole year in a four year Eng D course, three-tenths of the Master's course, and each thesis required a section on management. The Vice Chancellor had explained that the University did not draw a distinction between research and development and much of what had been described in the visit as research could also be perceived as development.

Acknowledgement

All photographs are reproduced by courtesy of Cranfield University, *Leith Lawrey.*

PROFILES OF COUNCIL MEMBERS

Sir Aaron Klug, OM, PRS

Sir Aaron Klug is a distinguished member of Council of the Foundation – ex-officio by reason of his Presidency of the Royal Society. He was educated at Durban High School and then at the Universities of Witwatersrand and Capetown where he graduated with a first class MSc in 1946. He had started university as a medical student but, disappointed at the lack of fundamental science in medicine, he transferred to science, and graduated in mathemtics, chemistry and physics. He once wrote to some Japanese school-children as follows:

"When I was at school I was interested in most subjects, and had no particular ambition to be a scientist. I read widely, both fiction and non-fiction, collected stamps, played sport, and spent time outdoors. Furthermore, when I began in science I had no preconceived plan for working in a particular field. I was curious about many things and phenomena in chemistry, physics and biology and had the good fortune to live in circumstances where I was able

to follow my instincts in choosing what I studied and worked on. I therefore found myself prepared, without knowing it at the time, for tasks yet to come and which only, as it were, gradually appeared out of my general interests. I had no grand plan to solve some great questions, but simply looked for interesting opportunities. My experience shows that it can be fruitful to study concrete problems or phenomena, even if they do not seem to be directly relevant to fundamental questions at the time. Studying a particular system can lead to quite unexpected results on techniques of major importance with wide applications, so one should not undervalue simple curiosity about the way strange phenomena happen and what unusual things are made of".

He came to the Cavendish Laboratory at Cambridge as an 1851 Exhibition Overseas Scholar in 1949 and he stayed there until he was awarded his PhD for a thesis on a theoretical problem concerned with phase transitions in solids – later Cambridge was to

award him an ScD. He then moved to Birkbeck College, London, as Nuffield Research Fellow, where he met Rosalind Franklin whose experimental skill combined with Dr Klug's theoretical insight proved fruitful, particularly in their collaboration on the structure of tobacco mosaic virus; for example, they discovered that the RNA followed a single helical path through the virus. Later, at Cambridge, he and his colleagues worked out the remarkable pathway of assembly of the virus particle, which uses an intermediate aggregate that provides a mechanism for initiating the growth and simultaneously fulfils the biological necessity for specific recognition of the RNA. He was Director of Virus Research Project from 1959 to 1962. In 1962, the MRC Laboratory of Molecular Biology opened and Dr Klug returned to Cambridge to join it. He has remained there ever since, becoming its Director from 1986 to 1996 and a Fellow of Peterhouse where he was also Director of Studies in natural science. His achievements at MRC have ranged widely from the architecture of viruses and chromosomes to the activation of transcription in enkaryotes.

Klug's most famous achievement is his application of the principles of X-ray crystallography and physical optics to the interpretation of electron micrographs. He developed a mathematical/computational method for reconstructing a three-dimensional map of a structure from a series of two-dimensional projections obtained by tilting the specimen at different angles. This later became the principle of the CAT scanner. Another of his interests has been in nucleic acids, the structure of chromatin and the control of gene expression, in which field he discovered the zinc finger family of transcription factors. He has advanced the knowledge of the nucleosome unit which packages DNA in the nucleus, and he has recently been concerned in research work into Alzheimer's disease.

It is said of him that his publications are written with such clarity that the essential points are easily understood by any of their scientific readers. Certainly, his scientific career has been recognised by many honours: he was knighted in 1988 for his services to science and awarded the Order of Merit in 1995, elected a fellow of the Royal Society in 1969 and received the Nobel Prize for Chemistry in 1982. In addition, he was awarded the Heineken Prize of the Netherlands Academy of Science in 1979, the Louise Gross Horowitz Prize of Columbia University in 1981 and the Copley Medal in 1985. He has been awarded honorary doctorates from the Universities of Chicago, Columbia and Strasbourg (1978), Stockholm (1980), Witwatersrand and Jerusalem (1984), Hull (1985), St Andrews (1987), Western Ontario (1991), Warwick (1994) and Cambridge (1998). He has also been awarded honorary fellowship of a number of learned societies.

On the occasion of his admission as an Honorary Fellow of the
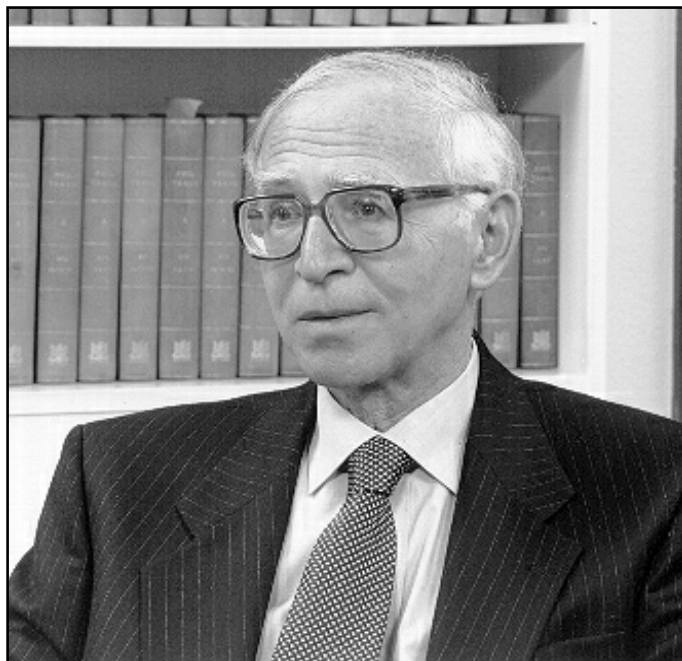
▲ *Sir Aaron Klug, OM, PRS.*

Royal College of Pathologists, Professor Ingrid Allen, in presenting the citation, said of Sir Aaron "He is culturally catholic, reading widely, enjoying the pages not only of Nature, but of the Times Literary Supplement and reportedly of Vogue, and spotted reading the Confessions of St Augustine on a transatlantic flight. He is rigorous, tough, loyal, honourable and kind – virtues all displayed in his defence of Rosalind Franklin and of her contributions to the discovery of the structure of DNA.

To conclude, I would like to use a description of the philosopher Kant who is described as 'the archetypal academic who stands for the exploration and defence of aspects and qualities of human life which cannot be measured or counted and cannot easily be perceived or promoted in the market place. He illustrates the simultaneous detachment from the world and involvement in the world which is the ultimate point of what the academic does'.

Sir Aaron is unquestionably the archetypal scientist. He too stands for the exploration of qualities of life which cannot be easily perceived or promoted in the market place. His work typifies the great scientist's necessary detachment from the world, yet involvement in the world, the process whereby scientific problems are posed and solved". Indeed, his own research and his Directorship of a major institution has involved him directly in technology transfer from laboratory to industry.

FOUNDATION NEWS

▲ *Pictured at the Foundation's AGM in May were (above) Sir Richard Morris, the retiring Vice-Chairman, with Chairman The Rt Hon The Lord Jenkin of Roding.*

▲ *Members of the audience at the AGM.*

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