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HOUSE OF COMMONS SESSION 1993–94

SCIENCE AND TECHNOLOGY COMMITTEE

Second Report

THE FORWARD LOOK OF GOVERNMENT-FUNDED SCIENCE, ENGINEERING AND TECHNOLOGY 1994

Report together with the
Proceedings of the Committee,
Minutes of Evidence and Appendices

Ordered by The House of Commons *to be printed*
Wednesday 20 July 1994

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The Science and Technology Committee is appointed under Standing Order No 130 to examine the expenditure, administration and policy of the Office of Science and Technology and associated public bodies.

The Committee consists of 11 Members. It has a quorum of three. Unless the House otherwise orders, all Members nominated to the Committee continue to be members of it for the remainder of the Parliament.

The Committee has power:

(a) to send for persons, papers and records, to sit notwithstanding any adjournment of the House, to adjourn from place to place, and to report from time to time;

(b) to appoint specialist advisers either to supply information which is not readily available or to elucidate matters of complexity within the Committee's order of reference;

(c) to communicate to any other such committee and to the Committee of Public Accounts its evidence and any other documents relating to matters of common interest; and

(d) to meet concurrently with any other such committee for the purposes of deliberating, taking evidence, or considering draft reports.

The following were nominated Members of the Committee on 13 July 1992:

Mr Spencer Batiste
Dr Jeremy Bray
Mr Malcolm Bruce
Mrs Anne Campbell
Cheryl Gillan
Mr William Powell
Sir Giles Shaw
Sir Trevor Skeet
Dr Gavin Strang
Sir Gerard Vaughan
Dr Alan W Williams

Sir Giles Shaw was elected Chairman on 15 July 1992.

On 9 November 1992 Mr Malcolm Bruce was discharged and Mr Andrew Miller added to the Committee.

On 16 November 1992 Dr Gavin Strang was discharged and Dr Lynne Jones added to the Committee.

The cost of preparing for publication the Shorthand Minutes of Evidence published with this Report was £2,053.74.
The cost of printing and publishing this Volume is estimated by HMSO at £5,460.

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SECOND REPORT

THE FORWARD LOOK OF GOVERNMENT-FUNDED SCIENCE, ENGINEERING AND TECHNOLOGY 1994

The Committee has agreed the following Report:

Introduction

1. On 27 April the Office of Science and Technology (OST) published the first edition of what is intended to be an annual publication, "The Forward Look of Government-funded Science, Engineering and Technology". The Science and Technology Committee decided on 23 February to examine the document once it was published. Accordingly, we held three evidence sessions, with the Department of Trade and Industry (DTI), the OST, and with Sir Robin Nicholson FRS FEng, Director of Pilkington plc and a member of the newly-created Council for Science and Technology (CST) and the Centre for Exploitation of Science and Technology (CEST). The evidence from these sessions is printed with this report. We also received a number of written memoranda which are also published in this volume. We are most grateful to our witnesses for their help, as well as to our specialist adviser, Professor Michael Gibbons, Director of the Science Policy Research Unit, University of Sussex.

I. THE OPERATIONAL PURPOSE OF THE DOCUMENT

Realising our Potential

2. The White Paper, "Realising our Potential", stated that:

> "the Government believes that this Review [Annual Review of Government funded R&D] needs to be extended in time and scope. It therefore proposes that from 1994 it will publish each April a Government-wide Forward Look giving a longer-term assessment of:
>
> The portfolio of publicly-funded work best suited to the broader scientific and technological needs of the country at a time of increasing economic competition, rapid scientific advance and accelerating technological change;
>
> the extent to which current individual Departmental science and technology programmes are matched to that portfolio, and the prospects of bringing about a closer alignment between the two."[1]

The White Paper also said that the Forward Look would "draw on the findings of the Technology Foresight Programme" and "seek the views of the new Council for Science and Technology." An explicitly stated purpose of the Forward Look was to "...set strategic objectives over a five to ten year perspective". In addition the White Paper stated that the Forward Look would consider gaps in education and training, compare the UK's efforts with its principal competitors, review the balance between civil and defence research and between domestic and international research, consider opportunities for achieving synergy across programmes, and consider the scope for greater concerted action within and between the public and private sectors. The Forward Look would "over time and reinforced by the results of the Technology Foresight Programme....form the basis for better-informed decisions between competing priorities, which can inform decisions taken during annual public expenditure surveys".[2]

3. The setting of strategic objectives over a five to ten year period would appear to be the most challenging of the objectives outlined in the White Paper. For the OST to be able to achieve this it will need to exert strong influence over the R&D priorities and policies of other Departments, notably the DTI and the MOD. This may prove a tall order.

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[1] *Realising our Potential*, CM 2250, para 2.36.

[2] *ibid*, para 2.37.

4. In the same way as the Technology Foresight Exercise is to create networks of, and between, a range of different players, many of which are in the private sector, the Forward Look exercise will attempt to achieve a similar effect within Government. As Mr Waldegrave explained to the Parliamentary and Scientific Committee recently,

> "It is important we understand that the Forward Look exercise is not just about producing a document once a year. It also provides a framework for a process in which the Government will continually review priorities and develop a more coherent, better co-ordinated and more far-sighted approach to S&T policy and to the deployment of funds for S&T."[3]

An Annual focus for debate?

5. Mr Waldegrave told us that:

> "...the whole purpose of having an annual Forward Look was to try to raise an annual rhythm of emphasis on the nation's publicly funded science strategy...an essential part of the thing was to try to get a proper annual debate within Parliament and more widely."[4]

6. We agree that the Forward Look should provide an annual focus for discussion on science and technology issues in general, both within and outside Parliament. **We therefore recommend that the Government provide Parliamentary time each year for a full day's debate on science and technology shortly after the Forward Look is published.**

The First Forward Look

7. The 1993 White Paper set out the Government's strategy for science, engineering and technology (SET) against a background of rapid technological change and competition to exploit this technology for economic advantage. This strategy is "to improve our competitiveness and quality of life by maintaining the excellence of science, engineering and technology in the UK and by encouraging closer partnerships between the science and engineering base and industry". The first Forward Look describes itself as "an important step in the development of this strategy".[5] It includes an overview of the current science and technology scene in the UK, sets out departmental and Research Council priorities over the years to come, and describes the measures taken so far to implement the White Paper. It also contains science and technology strategy statements by each government department and Research Council, covering aims, objectives, priorities, the international dimension to their work and partnerships with other organisations, particularly industry. All the Research Councils have in addition produced mission statements, but not all of the departments have produced science and technology mission statements.

8. The Forward Look admits that it is "just a first step towards the ambitious prospectus outlined in last year's SET White Paper. The Forward Look will evolve over the years to come..."[6] One important factor in its evolution will be the Technology Foresight Programme, the purpose of which is to ensure that resources are used to best effect in support of wealth creation and of the quality of life by bringing industrialists, engineers and scientists together in networks to help identify emerging opportunities in markets and technologies. The results of the programme "will inform decisions on spending, particularly by Government but also by industry".[7] The persons involved will be grouped into sector panels. By August 1994 these panels will prepare some preliminary views about the perceived market and technological opportunities in their sectors over the next 10-20 years. Following wide consultation, the panels will report their opinions on sector priorities to a steering group by

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[3] *Science in Parliament*, Vol 51 No. 3 June 1994.

[4] Q.84.

[5] *Forward Look of Government-funded Science, Engineering and Technology, 1994*, para 1.6.

[6] *Ibid*, para 2.5.

[7] *Ibid*, para 7.2.

December 1994. Early in 1995 the Chief Scientific Adviser (CSA) will present a report to the Chancellor of the Duchy of Lancaster which is likely to include:

> a summary of the key findings from each sector panel;
>
> specific instances where S&T opportunities accord with prospective markets;
>
> the initial priorities agreed, both sectorally and across sectors, taking account of the strengths and weaknesses of the UK industrial and science and engineering base;
>
> implications for wider Government policy; and
>
> lessons to be learnt for subsequent foresight work.[8]

The Foresight Programme will "influence subsequent Forward Looks, both through Departmental contributions and through the advice in the Forward Look offered by the Council for Science and Technology".[9]

9. Without the results of the Foresight Programme, Mr Waldegrave told us, the first Forward Look was "missing one part of its input". He also hoped to be able to consult the science community for their comments on the document.[10] Work will also take place over the next year on the investigation of the strategic issues mentioned in paragraph 2.37 of the White Paper.[11] In advance of all this information, the 1994 Forward Look described itself "necessarily embryonic."[12]

10. Some of our witnesses indeed commented that the Forward Look did not meet all the objectives in the White Paper, but agreed that it would change in future years as the results of the Foresight Programme emerged.[13] The Royal Society did not think that the document should be judged against the full set of objectives in the White Paper, since in addition to the absence of results from Foresight, it had been produced under considerable time pressure and during a period of extensive organisational change within the OST.[14] The Institute of Physics (IOP) thought that the Forward Look was "rather uncoordinated and unfocused," although this was probably inevitable for a first production. From 1995 onwards the document should "include cross-referencing of science and technology expenditure between different departments and agencies and, critically, evidence of co-operation and collaboration".[15]

11. CEST thought that more could be done in the Forward Look "to encourage the more visionary strategic debate which is believed to happen at CST and bring that more out into the public area". In addition, the Centre believed, there was more to be done in explaining how the results of Technology Foresight were going to be used by industry or by universities, where research to take advantage of the opportunities Foresight identified would be carried out.[16] The results of Foresight, though, would help the Forward Look to be more specific in indications of research priorities.[17] British Aerospace was "disappointed" with the Forward Look, even taking into account the absence of results from Foresight. It regretted that "mismatch" between the objectives set for the Forward Look in the White Paper and the document itself, which "did not set out a strategic framework of high level objectives expressed in terms of desired results", and "lacked a clear articulation of the connections

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[8] *Ibid*, paras 7.9-10.

[9] *Ibid*, para 7.12.

[10] Q. 84.

[11] A summary appears in para 2 above.

[12] *Forward Look*, para 2.5.

[13] Eg Ev. p. 41, 52 and 53.

[14] Ev. p. 42.

[15] Ev. p. 41.

[16] Q. 206.

[17] Q. 208.

between Government-funded R&D and any set of desirable outputs". Although wealth creation was mentioned several times, "no integrated system for achieving this is described".[18]

12. The Government was convinced that it was worth producing a Forward Look in 1994 in spite of the absence of some information which would be available in future years. The Chief Scientific Adviser, Professor Sir William Stewart, told us that "the 1994 Forward Look was the result of eight to nine months' work immediately following the White Paper. The Chancellor was keen to get a base line established for 1994. It would have been easy to leave it to 1995, but 1994 was the base line on which to build for the future".[19] Sir Robin Nicholson said that:

> "there were strong arguments for deferring it another year to get more input... On the other hand the OST would have been criticised if they had gone for two years after formation without producing a Forward Look. On balance they did the right thing but I feel and I am sure OST feels and the Chancellor feels that this is very much an interim document."[20]

II THE FORM OF THE DOCUMENT

The Old Annual Review of Government funded R&D

13. The Annual Review of Government funded R&D was first published in 1983 as a result of a recommendation by the House of Lords' Science and Technology Committee[21]. This gave an account of past, present and immediate future R&D activity. Departments gave details of their research activity including expenditure plans. The Forward Look was the result of the Government's aim to extend the time and scope of its examination of R&D expenditure. However, Sir Robin Nicholson said that the 1994 Forward Look was "somewhere half-way between or maybe not even half-way between the old annual review and what the new Forward Look will look like."[22]

14. Indeed in many ways this year's Forward Look is very similar to the Annual Review. As the Institution of Professionals, Managers and Specialists (IPMS) told us:

> "...the Forward Look differs little in substance or format from its predecessor... It does not adequately meet the challenge of looking forward over the next 5-10 years, although in the absence of the first report of the Technology Foresight exercise this is perhaps also understandable."[23]

15. The main difference between the two documents appears to be the inclusion in the Forward Look of essays on a range of issues, including details of trends in private sector investment, the international standing of UK science and analyses of research developments in several key industrial sectors. The statistical supplement to the Forward Look closely replicates information contained in the Annual Review.

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[18]Ev. p. 52.
[19]Q. 87.
[20]Q. 172.
[21]*Science and Government*, HL (1981-82) 20.
[22]Q.172
[23]Ev. p. 53.

The OST's control over the contents of the Forward Look

16. The White Paper said that the Forward Look would be an OST document, which would "seek contributions from the Government Departments through the official Committee on Science and Technology".[24] The Chancellor of the Duchy told us that Departments submitted their own contributions, which the OST then discussed with them. In many cases the departments' sections were altered through these discussions.[25] He also said, though, that he was "not... in the business... of writing a centralised plan for science".[26] On the other hand, the Royal Society thought that "... the principal challenge will be to produce a document that is more than the sum of its parts — to weld the information about the policies of individual Departments into a detailed, analytic statement about natural science and technology policy as a whole. This was not an explicit aim of the Annual Review, but it is an explicit aim of the Forward Look and it is inherent in the establishment of the OST".[27]

17. In addition to the consultations from Departments, advice from a wide range of organisations was received by the Chancellor during the consultation period before the Forward Look was published.[28] The new Council for Science and Technology (CST) seems already to have had an important role in the production of this year's Forward Look. Sir Robin Nicholson, a Member of the Council, told us that:

> "The composition of the Forward Look and the material in it changed substantially from its first draft and the Council for Science and Technology was instrumental in that. When we first saw it the two principal criticisms which we made were that it focused too much on the Government and not enough on the science and technology scene... and secondly that it was too inward looking, it did not have enough of an international approach. Both of those criticisms... were acted on in the final draft."[29]

We were pleased to learn that the Council for Science and Technology, which brings together senior representatives of the business and research worlds under the chairmanship of the Chancellor of the Duchy of Lancaster, has had such an influential role.

How the Forward Look might change

18. As noted above, the 1994 Forward Look is an embryonic document, and will develop next year as the Foresight Programme begins to produce results and the new Research Council structure matures. Sir Robin Nicholson also believed that the very structure of the Forward Look meant that it would change from year to year: "The format with the strategic articles and then what they call the essays and then the statistical backup is quite a good format because it gives a lot of flexibility. The first part will obviously go on year after year and I am sure the essays will change a lot in material content from time to time".[30] The Geological Society welcomed the essays on soil contamination and materials as "indicating the Government's acknowledgement that high scientific priority should be attached to these areas".[31] On the other hand, the Institute of Biology advised the OST to resist the temptation to say something new every year: "long-term priorities will lose their meaning if they are greatly changed on an annual basis".[32] We agree. **The main body of the Forward Look should be as similar as possible from year to year; this will be made easier if a strategic framework is developed. The Essays provide an adequate opportunity for the OST to address a variety of topical issues or to give each issue a common theme.**

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[24]Cm 2250, para 2.37.

[25]Q. 91.

[26]Q. 86.

[27]Ev. p. 42.

[28]Not published; deposited in the Record Office.

[29]Q. 170.

[30]Q. 173.

[31]Ev. p. 41.

[32]Contained in *Advice on the 1994 Forward Look of Government-funded Science and Technology received from outside bodies* (hereafter referred to as advice to the OST). Not published: deposited in RO.

19. One important matter that the OST will pursue by next year's issue is that of setting output targets to discover how far the Government is succeeding in meeting its objectives.[33] This matter is addressed in more detail below.[34]

20. Some of our witnesses suggested information that they believed should be included in subsequent Forward Looks. IPMS thought that more should be said about the SET labour market, and noted that while the strategy statements from Research Councils included comments on education, training and career development, those from Government Departments did not.[35] As far as the information in the statistical section of the Forward Look was concerned, the IPMS believed that:

> "the current statistics on STEs [Scientists, Technologists and Engineers] are inadequate to the task of monitoring the impact of policies or understanding what is happening in the STE labour market, especially below graduate level. Better statistics are not only required for core STE occupations, but also for STE staff in other occupations such as management, financial and consultancy functions both at different levels within a company/organisation and in separate organisations or sectors. Such statistics need to cover not only cross sectional and longitudinal aggregate statistics, but also the career paths of individual STEs going beyond first appointment after graduation. As in the case of statistics within Government, national and international statistics should include gender, non-graduate as well as graduate, and where possible, information on patterns of working."[36]

The Institution was also disappointed by the lack of a response from the Minister for Science to the OST Working Group report on Women in Science, Engineering and Technology:[37] "it is vital that the OST report is followed by action and that the situation on women in science is closely monitored in future Forward Looks".[38] Mr Waldegrave told us that there would be a response to the report "very shortly", and the response was subsequently published on 7 July. He said that there was "some carefully deployed seedcorn money which might be available there" to implement its recommendations.[39]

21. CEST was disappointed that the success of the Post-Graduate Training Partnership (PTP), introduced in 1992, was not given more prominence.[40] Under this scheme, five pilot partnerships between contract research organisations and universities have each contracted to accept five PTP research associates per year from 1992/3 to 1994/5.[41]

22. The Royal Society of Chemistry told us that the Forward Look provides "a good top level view of Science and Technology in the UK. Both provide a wealth of information that gives an insight into the activities and spending of Government Departments and the Research Councils. However, the Statistical Supplement is far less detailed (and hence less useful) in looking at the health and status of the University and Industry sectors". We were told that there were "a number of accessible sources of statistical data within the public domain (predominantly Government information) that do provide a much better picture than the Forward Look Statistical Supplement for these sectors".[42] The Society sent us some figures prepared by Dr Paul Whittingham as illustrations of the sorts of levels of detail that can be obtained from published sources. They show, for example, the level of research grants from industry to UK universities in the last five years, or the level of R&D spending in the four

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[33] Q. 85.

[34] See below, paras 44-48.

[35] Ev. p. 56.

[36] Ev. pp 58 and 59.

[37] *The Rising Tide*: A report on Women in Science, Engineering and Technology, HMSO 1994.

[38] Ev. p. 57.

[39] Q. 152-3.

[40] Q. 217.

[41] *Statistical Supplement to the Forward Look*, para 2.18.39.

[42] Ev. p. 43.

different parts of the chemicals industry sector since 1986.[43] The Forward Look does not generally contain such levels of detail for R&D outside the Research Councils and the Departments. Given that it is the Forward Look of *Government-funded* Science, Engineering and Technology, this is perhaps understandable, but since private sector R&D is 65% of the total, it might be helpful if a further layer of detail for industrial and university R&D were provided, enabling the users of the Forward Look to form a better judgment as to the health, funding and international competitiveness of UK industrial R&D, and the levels and sources of funding of different academic research disciplines in recent years. **We recommend that the OST consider increasing the level of detail on industrial and university research in next year's Forward Look, to help it become a comprehensive review of all UK science, engineering and technology, however funded.**

III. THE CONTENTS OF THE FORWARD LOOK

Gross Domestic Expenditure on R&D

23. In 1992, the most recent year for which figures are available, the UK's total investment in R&D, both in the private and public sectors, was £12.6 billion, equivalent to 2.12% of gross domestic product.[44] This is a lower percentage than at any time since 1985, when R&D investment was 2.27%. It is a lower percentage too than in Japan (2.3% in 1991), the USA (2.74%), Germany (2.58%) and France (2.36%), but higher than G7 members Canada (1.51%) and Italy (1.38%).[45] A substantial, but declining, part of this R&D spending is defence related: in 1985 this represented 0.5% of GDP; in 1992 0.38%.[46] Total civil R&D was £10.36 billion in 1992, equivalent to 1.74% of GDP. In terms of civil R&D as a proportion of GDP, the UK is fifth in the list of G7 countries, and its 'lead' over Canada and Italy, which spend very little on defence R&D, is much smaller than when all R&D is counted.[47] **The OST should examine the long-term consequences of the low level of civil research and development in the UK.**

Publicly funded R&D

24. Table 1.3.2 of the Statistical Supplement shows that in 1992-93 net Government expenditure on R&D was £5.449 billion. This can be compared with expenditure at 1992-93 prices of £6.274 billion in 1984-85 and planned expenditure, again at 1992-93 prices, of £4.815 billion in 1996-97.

25. Within this global figure are some significant shifts in the funding of Government R&D. Funding for the Research Councils and the Office of Public Service and Science (OPSS) rose in real terms from £790m in 1984-85 to £980.5m in 1992-93, and is planned to rise further to £1.040 billion in 1996-97. Higher Education Funding Councils (HEFCs) accounted for £982m in 1984-85, £963.3m in 1992-93, and spending of £879m is planned for 1996-97. The great bulk of this shift in resources is the result of the 'Dual Support Transfer' of funds from the HEFCs to the science budget; once this transfer is complete in 1994-95, the money allocated to the HEFCs is expected to increase slightly in real terms, while that for the OPSS and Research Councils will fall from its 1994-95 peak". The indicative UK contribution to the EC budget in respect of R&D rose in real terms from £96.5m in 1984-85 to £251m in 1992-93, and is projected to rise further to £313m by 1996-97. On the other hand, R&D spending by civil departments fell from £1.480 billion in 1984-85 to £1.034 billion in 1992-93, and will fall further to £750m in 1996-97, slightly more than half the level of 1984-85. Within this, spending on matters currently within the ambit of the DTI (which includes spending by the old Department of Energy) fell from £595.9m in 1984-85 to £350.8m in 1992-93, and will fall further to only £153.6m in 1996-97. The DTI R&D budget is

[43] Ev. pp 45&47.

[44] *Forward Look*, para 3.2.

[45] *Statistical Supplement to the Forward Look*, Table 1.6.1.

[46] *Forward Look*, para 3.3.

[47] *Ibid*, Table 2.

examined in more detail below.[48] R&D spending by the MOD fell from £2.926 billion in 1984-85 to £2.221 billion in 1992-93, and is projected to fall to £1.826 billion in 1996-97. On the other hand, the R&D budgets of the Department of the Environment, Northern Ireland Departments and the Overseas Development Administration show increases over the period. Figure 8 in The Royal Society of Chemistry's memorandum compares EC Member States' government-funded R&D budgets between 1980 and 1991, at current values and exchange rates. This shows that UK Government R&D funding has been fairly constant since 1984, but that, in contrast, the budgets of the German, French and Italian Governments grew strongly over the period.[49]

Private Sector Investment in R&D

26. In 1992 £7.930 billion was spent on R&D performed in UK business (BERD), a fall of 1.7% in real terms compared with 1991. Table 1.4.1 of the Statistical Supplement shows that real R&D spending reached its peak in 1989 and that the 1992 total was lower in real terms than in any year since 1985. In 1992 the figure for BERD was equivalent to 1.3% of GDP, lower than in any year from 1981 to 1991. Private R&D spending on defence fell 8% between 1991 and 1992, while spending in the chemicals and pharmaceuticals sector rose by 6%.[50]

27. Figure 1 on page 56 of the Forward Look shows that UK R&D investment is concentrated in the electronics, chemicals, pharmaceuticals and aerospace sectors. However, this figure shows changing R&D totals in business sectors since 1986 in cash terms; a more informative indication of the trends in R&D spending could be provided by displaying the totals in real terms as well,[51] and **we recommend that such a figure is provided in next year's issue of the Forward Look.** The UK lies fifth in the G7 in terms of BERD as a percentage of GDP, 0.1% behind France.[52] The UK's R&D intensity (BERD as a percentage of manufactured sales) is also lower than Japan, the USA, France and Germany, although there are variations between industrial sectors.[53]

28. Sir Robin Nicholson felt that:

> "the encouraging thing about industrial R&D over this recession has been that it has not gone down by as much as it has in past recessions... industrial R&D has certainly decreased a bit but some of that is caused by a reduction in defence spending and companies do seem, by and large, to have taken the view that they must preserve their R&D spend through the recession in order to emerge in better shape afterwards."[54]

Figure 22 in the Statistical Supplement shows that while industrial R&D has almost held up in cash terms in the years 1989-1992, there has been a marked fall in real terms.[55] When disaggregated by sector, one can see that while chemicals R&D spending has been maintained in real terms, there were noticeable falls in the real funds allocated to R&D in electronics, non-manufactured products, aerospace and other manufactured products.[56]

29. Sir Robin drew our attention to a possible problem with regard to the statistical basis of the figures for industrial R&D spending: "BERD, which is the Central Statistical Office measure... is inadequate in the sense that it only takes into account spending by UK companies in the UK". It excluded both R&D by UK companies overseas and the R&D

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[48] See paras 35-43.

[49] Ev. p. 51, Figure 8.

[50] *Forward Look*, p. 56.

[51] Ev. p. 46, Figure 3.

[52] *Forward Look*, p. 57.

[53] *Ibid*, Table 2.

[54] Q. 186.

[55] *Statistical Supplement to the Forward Look*, p. 30.

[56] Ev. p. 46, Figure 3.

performed in the UK by major subsidiaries of foreign companies, which meant that "the statistics really are well short of the importance of the subject".[57] **Indeed, we consider that the level of foreign R&D investment in the UK would be an important indicator of the strength of the science base. The OST and the Central Statistical Office (CSO) should address this matter so that, in addition to BERD, a measure of industrial R&D exists which accurately reflects all industrial R&D performed in the UK according to the ownership of the firms involved.**

30. Another measure of the relative strength of R&D in UK industry is the annual R&D Scoreboard, produced by Company Reporting Ltd on behalf of the DTI, which was published during the course of our inquiry on 17 June. This document ranks companies by their R&D expenditure, both within the UK, by industry, and globally. It claimed to show that overall UK industrial R&D spending increased by 9% to £7,100m, compared with a 3% rise in R&D spend by the world's top 200 R&D spending companies. However, of those top 200 R&D spending companies, 81 were US, 48 Japanese, 17 French, 13 UK and 11 German. Those top 13 UK companies still did not invest at the same rate (2.3% of sales) as the best foreign companies (4.9% of sales).[58]

31. Sir Robin Nicholson thought that the Scoreboard had improved in the four years of its existence but could still be improved. For example, Sir Robin was sceptical about the value of listing R&D spend in relation to dividend payout because it took no account of the different financial structures of companies in different countries; he believed that the R&D spending should be compared with total financing costs.[59] He also cast doubt on the significance of the claimed 9% increase in UK R&D, which was actually a composite of real increases and a 10% increase in the number of UK companies in the sample.[60] The Scoreboard further failed to include much R&D spending by unlisted UK companies, a fact pointed out in the Scoreboard itself.[61] Sir Robin undertook to make representations to the OST on improving the usefulness of the Scoreboard further.[62] **We trust that the OST and DTI will pay close heed to these representations.**

32. The Statistical Supplement shows that the number of business enterprise personnel engaged in R&D in the UK fell significantly from 188,000 in 1986 to 142,000 in 1992.[63] However, Dr Whelan of CEST was wary of drawing conclusions from these *prima facie* disappointing figures: there was "probably some evidence that there have been headcount reductions ... but ... the classification of what is an R&D person or is not can be quite tricky", particularly since many R&D engineers had been dispersed to production facilities and might not be captured in the statistics.[64] In any case, there was no simple correlation between a competitive level of R&D activity and the number of R&D personnel a company employed; the quality of the "total technical base" represented by its R&D personnel was the most important criterion.[65] Dr Whelan was more concerned about unemployment among Research Council funded PhD graduates, which was 15% in 1991.[66] He believed that if one added in "those who go into short term appointments or further training, then that figure starts to look like 30% or 40%. You might argue that one of the major problems we have is an extremely serious graduate and post-graduate unemployment problem".[67] A recent study of

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[57] Q. 189.

[58] *UK R&D Scoreboard 1994*, Company Reporting Ltd, Edinburgh.

[59] QQ. 183 and 187.

[60] Q. 186.

[61] *UK R&D Scoreboard 1994*, p. 1.

[62] Q. 188.

[63] *Statistical Supplement to the Forward Look*, p. 47, Table 1.7.1.

[64] Q. 229.

[65] QQ. 234-5.

[66] *Statistical Supplement to the Forward Look*, Table 1.7.9.

[67] Q. 235.

the annual total of 3,500 science PhD graduates, however, showed that only 3% had not found employment, although not all found jobs where their qualifications were essential.[68]

33. In paragraph 3.6 of the Forward Look, the figures for Publicly-funded S&T are presented, following sections on Gross domestic, Civil and Defence R&D, and before a section on international comparisons, again of R&D. The document explains that:

> "for the purpose of this analysis, S&T includes work described as R&D, together with work involved in the diffusion and exchange of advanced scientific and technical information (technology transfer), and other expenditure such as taught course awards, restructuring and redundancy costs where these are not part of the routine R&D management function."[69]

British Aerospace commented that "the Forward Look seems to use terms like S&T, Research, R&D as fairly interchangeable". It understood that "in nearly every case except Defence the R&D figures are S&T — ie work not directly related to the development of a specific product. It would be better to standardise the language and on a definition of S&T which excluded product development.[70]

34. The Science Policy Research Unit (SPRU) told us that there is more to technology and innovation than R&D, which although a good measure of technological activities in large firms and science-based sectors, such as chemicals and electronics, does not adequately represent activity in small firms and other industrial sectors. **The OST should reflect on whether the indicators in this year's Forward Look adequately reflect science, engineering and technology activity in the UK, and whether a standardised measure could be used in next year's issue.**

The Role of the DTI

35. The Government stated in the White Paper that it was committed to harnessing publicly-funded S&T more effectively to support wealth creation and to improve the quality of life. The Forward Look tells us that the DTI "has a key role to play" in taking forward the White Paper Strategy, since it has the particular responsibility within Government for championing the needs of UK business. In parallel with the preparation of the Science and Technology White Paper, the DTI "carried out a fundamental review of its innovation policy, to ensure that it contributed fully to enhancing industrial competitiveness. The conclusion of the review was that the Department needed to focus its efforts more on areas where it could make a real difference — in particular, in getting increased value for money from its own innovation budget and encouraging companies and research organisations to secure more investment from the market place".[71]

36. As a result of this review, "the DTI is shifting the balance of its innovation support away from generating new technology, on which industry and Government already spend billions, to concentrate more on influencing the broad environment which allows innovative firms to flourish. Over the period to 1996-97, R&D support for small firms will be maintained, support for collaborative research projects will reduce by around a half and support for technology transfer and best practice will more than double. By 1996-97, support for technology transfer, best practice and R&D for small firms, are together expected to account for over half of DTI's industrial innovation budget, compared with about a third currently. DTI innovation activities will in future concentrate on five main areas:

encouraging S&T input to all DTI/Government policies;

fostering the climate for innovation;

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[68] *Science PhDs and the Labour Market*, Institute of Manpower Studies 1994, quoted in *Laboratory News*, July 1994.

[69] *Forward Look*, para 3.6.

[70] Ev. p. 52.

[71] *Forward Look*, para 5.19.

establishing the infrastructure for innovation;

facilitating innovation and technology use; and

encouraging appropriate technology development.

DTI support for technology development is continuing, although at a reduced level, and will focus on assistance to small and medium sized firms, on collaborations between industry and the science and engineering base and on European collaborations".[72]

37. Table 1.2.3 of the Statistical Supplement shows that at 1992 prices, DTI spending on S&T reduced from £662.8m in 1986-87 (when, in addition, Department of Energy spending was £283.3m) to an estimated £410.1m in 1993-94, a figure which includes spending formerly undertaken by the Department of Energy. This is planned to fall further to £237.5m in 1992 prices by 1996-97. In cash terms this represents a fall from £423.5m in 1993-94 to £271.2m in 1996-97.[73] Much, but not all, of this fall is attributed to the closure of the Fast Reactor Programme and the end of the Consultancy Initiative.[74]

38. The DTI felt that responsibility within government for direct support for wealth creation through the generation of new technologies should properly be taken by the OST. Compared with R&D spending by UK industry of about £6-7 billion per year, the £60-70m spent by the DTI on direct technology support through Advanced Technology Programmes was not very significant.[75] On the other hand, the DTI could "add most value and ... make the most impact" by improving "the opportunities and the ability in the UK to transfer technology out of the science base into companies".[76] The DTI believed that some of British industry was world class in terms of innovation, but was concerned to see "a greater proportion of the generality, the average firm, achieving that excellence, that high standard of performance".[77] Somewhat to its surprise, industry had "not complained that vociferously about the cessation of the collaborative research programmes".[78]

39. The Chancellor of the Duchy told us that dissemination of existing technology even within companies was difficult, let alone within a whole economy.[79] £100m spent by the DTI on generating technology would be insignificant, but "if they are going to put that £100m into really good networks which will reach small and medium sized companies and it might actually be possible to make a really big difference then I think we are doing something extremely useful".[80]

40. Sir Robin Nicholson was unequivocal in his support for the DTI's new emphasis: "what the DTI is doing in promoting the importance of innovation and promoting awareness of technology transfer is the right policy." The money previously spent by the DTI on support for technology development had "often ended up supporting marginal projects in marginal companies. I am not sure that was a very good use of taxpayers' money". He believed that there was a very good "top layer" of UK companies which understood the value of R&D and were highly competitive, but not enough of them; it was the task of the DTI to increase the number of such firms by targeting its work at the layer of firms underneath that.[81] In addition, he thought that there was also a role for Government in "specific sectors which are heavily subsidised by foreign governments so that our companies can compete on a level

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[72] *Ibid*, Sections 8, 9 and 14, p. 143.

[73] *Statistical Supplement to the Forward Look*, Table 2.18.1.

[74] *Forward Look*, p. 142; Q. 61; Q 105.

[75] Q. 45.

[76] Q. 28.

[77] Q. 34.

[78] Q. 35.

[79] Q. 115.

[80] Q. 116.

[81] QQ. 192-3.

playing field. I also feel there is a very important role for small companies which the DTI is attending to"[82].

41. CEST believed that the problem identified by the DTI, that of the uptake of new technologies within industry, was a very important one. There was a danger, though, that the DTI might spread its efforts too thinly, and it recommended a regional focus for its work. Furthermore, the DTI had to focus firms' attention not on innovation generally but on specific topics, market opportunities or technologies. The success of the DTI's policy would also depend on the availability of "high calibre people who understand industry and how industry works and thinks and also can understand the technology actually to go out there and chivvy, harass, individual companies and bang heads together".[83]

42. Some witnesses disagreed with the DTI's policy. The Institute of Physics favoured direct funding of science and technology projects within industry by the DTI in order to encourage industry to invest in innovation.[84] The IPMS found it "disappointing" that "the recent White Paper on Competitiveness ... reiterates the approach put forward in the 'Forward Look' which is to concentrate on the 'marketing aspects' of technology transfer and 'business links'", and regretted that among the DTI's priorities "there is barely a mention of the need for strategic research — merely a grudging statement that DTI will continue to support S&T to underpin statutory obligations".[85]

43. The fall in government spending in real terms on civil research and development by £577m and on defence research and development by £1,100m in the twelve years from 1984-85 to 1996-97 is a major strategic shift which is likely to have an impact on the development of advanced technology in the UK.[86] The OST should examine its implications for competitiveness.

Measuring the outputs from R&D

44. The Statistical Supplement contains two important *caveats* as to the value of comparing R&D spending statistics in different countries: "First, as they concern inputs to R&D they cannot be used to indicate R&D outputs. Without a link between inputs and outputs it is not possible to assess R&D productivity. Second, although a link between R&D spending and improved economic performance can be demonstrated, other factors (eg growth in demand, improved efficiency, improved productivity, and innovation) may be just as, if not more, important contributors to successful economic performance".[87] An essay in the Forward Look attempts to give a "preliminary view" of the international standing of UK science and technology and discusses such output indicators as the number of scientific papers produced or cited, and the number of patents filed.[88] The question of how one measures the effectiveness of R&D spending is of special importance, since in the course of the next year, "the OST will agree with Departments a series of output measures and performance indicators against which the scientific achievements of Departments in respect of wealth creation and other quality of life objectives will be assessed".[89] The OST told us that it gave this work "high priority", and that examples of such output measures might be "the volume of collaborative research which Departments are undertaking with their users, particularly industrial users" and "measures of the extent to which Departmentally supported R&D is being turned into marketable products and processes".[90] The Chancellor of the Duchy

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[82] Q. 192.

[83] Q. 224.

[84] Ev. p. 41.

[85] Ev. p. 55.

[86] *Statistical Supplement to the Forward Look*, Table 1.3.2.

[87] *Statistical Supplement to the Forward Look*, para 1.6.5.

[88] *Forward Look*, pp 58-61.

[89] *Forward Look*, p 36.

[90] Q. 130.

described making some progress with this by the time of the next Forward Look as "an indicator for us".[90]

45. The Association of the British Pharmaceutical Industry (ABPI) told the OST that "historically, there has been too much emphasis on measuring R&D performance by input indicators... more emphasis must be given in the Forward Look to output indicators and, hence, R&D productivity. Previous attempts to assess S&T performance have been rudimentary".[91] British Aerospace believed that the Forward Look showed "Government-funded R&D to be managed by allocation to departments and to mechanisms rather than allocated to output strategies", and "lacked a clear articulation of the connections between Government-funded R&D and any set of desirable outputs".[92] The IPMS believed that output indicators should "measure quality as well as quantity and take account of the fact that some programmes may have neither any short-term commercial payback or immediate outcome".[93]

46. Sir Robin Nicholson suggested that for wealth creation, the output measures might be (i) the success of a market sector, either in terms of market share, exports or balance of payments and (ii) how far government programmes attracted matching funds from industry: "if you take the view... that it is fundamentally down to industry to know where the best future markets are to attack, then a good criterion of the relevance of Government spending on R&D is whether industry is prepared to put funds into the same programme".[94] In terms of quality of life measures, the health of the nation and how new health techniques are used might be possible indicators. The trends of such measures, rather than the absolute figures, would be the most significant.[95]

47. CEST also suggested economic output measures such as the number of new products introduced, the number of patents or the competitive position of companies,[96] but added that the link between R&D spending and such financial outputs had been revealed as "tenuous", since there were lots of reasons for a company's financial performance.[97] The Centre also suggested that the OST might use measures which focused on the human aspect of R&D, "particularly the flow of people from the science base into industry, recruitment and retention of science and technology graduates, involvement of companies in some of these people-based schemes, collaborative arrangements such as LINK, measures like that".[98] On the quality of life, measures could be derived from crime, participation in learning and training and, most obviously, environmental quality.[99]

48. The use of output measures is extremely important; the mere level of expenditure on R&D, whether by the private or public sector, is of much less importance than the effectiveness of the R&D that money pays for. This may be particularly difficult to measure in the case of departmental research which is "in support of Departmental Policy, statutory, operational, regulatory and procurement responsibilities".[100] **Nevertheless, we strongly support the development of output measures of the effectiveness of R&D in wealth creation, improving the quality of life and in underpinning departmental objectives. We intend to review next year the progress the OST has made in devising such measures. The evidence given in our First Report[101] on the effect of business research and**

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[90]Q. 132.

[91]Advice to the OST from the Association of the British Pharmaceutical Industry.

[92]Ev. p. 52.

[93]Ev. p. 57.

[94]Q. 179.

[95]Q. 180.

[96]QQ. 214-5.

[97]Ev. p. 40.

[98]Q. 214.

[99]Ev. p. 40.

[100]Cm 2250, p. 10.

[101]*The Routes through which the Science Base is translated into Innovative and Competitive Technology*, HC (1993-94) 74-I, paras 176-180.

development on total factor productivity is an example of output measurement of the kind that the OST should pursue.

The Co-ordinating Role of the OST

49. The White Paper explained that the OST "would play a central role in drawing together Government S&T initiatives, promoting collaboration between Departments, ensuring the effective handling of trans-departmental issues, and generally monitoring the efficiency and effectiveness of Departments' use of public funds". Among the examples of trans-departmental initiatives mentioned in the Forward Look are the Advisory Committee on Human Genome Research and a review of the UK national microbial culture collections. "During the next twelve months", the Forward Look continues, "in addition to working with Departments to enhance the contribution of their programmes to wealth creation and the quality of life, the OST will be pursuing a range of trans-departmental issues, for example, the co-ordination of cross-departmental policy on genetic modification technology and the presentation of that policy in international fora; and the co-ordination of UK interests in European Union research policy. The OST will also be examining with Departments the scope for improving collaboration between them, especially in areas that lie at the boundary of Departmental responsibilities, and between Government Departments and the Research Councils".[102]

50. British Aerospace was not convinced that the OST adequately co-ordinated the work of departments: "the Forward Look underlined one of the major deficiencies of Government-funding of technology — that it remains departmentally driven. The objective of wealth creation is mentioned several times but no integrated system for achieving this is described".[103]

51. The Chancellor of the Duchy of Lancaster told us that he did not want responsibility for Government science work to be taken away from Departments. The OST's task was "to use the inter-departmental machinery ... to make sure that though people are pursuing their own policy furrows in the individual departments, the whole field is actually being ploughed";[104] the OST was the guardian of the Government's science policy, but the whole Government had collectively signed up to the White Paper.[105] The OST had the right to question Departments which were not adequately implementing that science policy,[106] and to identify important trans-departmental matters, for example, environmental R&D and information technology, which needed to be co-ordinated centrally.[107] The Chancellor also said that the OST might consider taking over nationally important R&D programmes which were no longer required by their sponsoring Department.[108] **We hope in future to see evidence that the OST is using its powers to act as an effective guardian of the government's science policy.**

Direct OST support for research

52. Mr Waldegrave regarded doing "things that only Government can do — because they are more longer term than firms can plausibly persuade their shareholders to fund ... as our essential duty", provided that the UK was good enough in a particular area for the work to be worthwhile, and that UK industry was in a position to benefit from it,[109] a point also made to us by Sir Robin Nicholson.[110] In addition, the job of the OST was to "maintain

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[102] *Forward Look*, pp. 32-3.
[103] Ev. p. 52.
[104] Q. 90.
[105] Q. 91.
[106] Q. 92.
[107] QQ. 93-94.
[108] QQ. 102-4.
[109] Q. 143.
[110] Q. 177.

the science and engineering base". He did not believe that his department should be doing "industrial research that firms should be doing themselves",[111] although this did not mean that it would not fund any applied work, which had perhaps been the doctrine of the 1980s.[112]

53. Among the organisations which gave advice to the OST prior to the preparation of the Forward Look there was some support for the OST's approach. The Chemical Industries Association believed that "direct national expenditure on science, engineering and technology should be targeted mainly at basic research".[113] The Institution of Chemical Engineers said that "the UK... needs public funding of fundamental research as part of the process of ensuring a supply of technically trained engineers both for industry and to become the next generation of academics. This academic base must be funded by Government; although industry does supplement it, that is not the duty of commercial concerns".[114] The Institute of Physics advised that "while the Forward Look should pay particular attention to the needs of wealth creation and the environment, it should not neglect the importance of producing trained scientists".[115]

The Role of the Science Base

54. The White Paper declared that "the Government wishes to harness the intellectual resources of the science base to improve economic performance and the quality of life. It intends, in future, that decisions on priorities for support should be much more clearly related to meeting the country's needs and enhancing the wealth creating capacity of the country".[116] However, the Forward Look also said that:

> "This is not to say that the science and engineering base should be converted into short-term problem solvers for industrial customers. Industry does not want that; and nor does the Government intend to encourage or allow such a development. Rather, the Government intends to promote an effective partnership to the mutual benefit of all parties. This means that, far from being diverted into short-term problem-solving, the science and engineering base must concentrate on its proper role: the training of highly skilled men and women and the conduct of research at the frontiers of knowledge. However, in the setting of priorities and the allocation of resources, appropriate recognition should be given to the relevance as well as the scientific excellence and timeliness of research. Reward systems should take into account the value of research that is of general relevance to industry and other users. The Forward Look will help to set the research agenda. In any consideration of priorities, it will be important to maintain the overall long-term health of the science and engineering base. Basic research will be sustained by the universities, at their discretion, through the resources made available to them by the Higher Education Funding Councils; and the Research Councils, as stated in their new missions, will continue to support the basic research that falls within their fields of responsibility, as an explicit part of their policy for the fulfilment of their objectives."[117]

55. The Forward Look added that "the Research Councils will need to be aware of their customers' (industry, commerce, public sector bodies and other Government Departments) long-term, and even short-term needs, and use them to define strategic areas of research... At the same time, it will be essential to safeguard curiosity-driven research outside these sectors; there must always be a place for the unconventional, the bright idea, the novel approach of the individual scientist".[118] As far as higher education was concerned, the

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[111] Q. 113.

[112] Q. 148.

[113] Advice to the OST from the Chemical Industries Association.

[114] Advice to the OST from the Institution of Chemical Engineers.

[115] Advice to the OST from the Institute of Physics.

[116] Cm 2250, para 3.9.

[117] *Forward Look*, para 5.26.

[118] *Ibid*, para 5.29.

Government expected the Funding Councils "to continue to apply a selective approach that rewards excellence and gives due recognition to relevance in high quality research. In both the funding of HEIs [Higher Education Institutes] and personal career development, reward systems should take into account the value of research that is of general relevance to industry and other users".[119]

56. The IPMS welcomed the statement in the Forward Look that the science and engineering base should not be turned into short-term problem solvers for industrial customers, and believed that "an appropriate balance must be struck between long-term strategic research, which the public sector is uniquely placed to fill, and meeting the market needs of industry".[120] However, it was concerned that the increased proportion of commercial funding of university research in the pharmaceuticals, biotechnology and electronics left those disciplines vulnerable to the withdrawal of such external funding. It claimed that there was "evidence of commercial funders exerting pressure to narrow the researcher's approach", and warned that universities were under pressure to perform income-generating rather than knowledge-generating work.[121] The IOP believed that the UK's innovative, world class scientists would be much more effective if they were involved in areas which maximised the potential for wealth creation, but also that "fundamental science has a crucial part to play and support for science, particularly through the research councils, should not be exclusively directed at the creation of wealth".[122] The ABPI stressed that "mission orientated research should not be confused with applied research. Academia should not be forced to attempt to copy what industry is better at doing".[123]

57. On the other hand, the Institution of Chemical Engineers believed that scientific excellence had been allowed to be the dominant criterion in the allocation of research funding, when the relevance of that research was just as important. It believed that some public research spending, such as that on astronomy, did not obtain good value for money, since it produced little that could be commercially exploited.[124]

58. The Chancellor of the Duchy told us that in his experience universities did not believe that they were being asked to become short-term contract research organisations. The OST's desire was that, rather, universities should "build longer-term partnerships with industry", and he felt that universities had now settled down to a longer-term, productive relationship with industry, in contrast to the 1980s when academia had often supposed that it was being asked to enter short-term commercial partnerships and set up its own businesses.[125]

59. A way in which the OST is encouraging university departments to perform R&D for industry is through the Realising our Potential Award (ROPA) scheme, under which researchers receive funds from Research Councils to spend on whatever research they please to match the funding they receive through research contracts with industry. This scheme, under which £10m will be allocated this year, has so far been an experiment within three Research Councils, but it has been judged such a success that it is hoped to extend it to all the Councils. The Director General of Research Councils was particularly pleased that the scheme had been welcomed by the industrial partners concerned, who were keen to be involved with scientists who had funding to develop their own ideas.[126] The Chancellor of the Duchy also stressed the importance of the new system of rewarding, through the Higher Education Funding Councils, those who win industrial support.[127]

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[119] *Ibid*, para 5.29.

[120] Ev. p. 57.

[121] Ev. p. 54.

[122] Ev. p. 41.

[123] Advice to the OST from ABPI.

[124] Advice to the OST from the Institution of Chemical Engineers.

[125] QQ. 88-9.

[126] QQ. 144-7.

[127] Q. 137.

60. We endorse the approach of the OST in encouraging research into what is relevant to wealth creation and the quality of life while ensuring that this does not impede the principal role of the science base, which is to train scientists and conduct basic research. We would like to see some indication in the next issue of the Forward Look that these objectives are being achieved.

The Research Councils

61. The Forward Look says that "the DGRC [Director General of Research Councils] is embarking on a fundamental review of the Science Budget Portfolio. The emphasis will be on ensuring that the maximum resource is expended efficiently and effectively in direct support of research, and that the costs and complexities of administering the systems are minimised. The number of staff at Research Council headquarters, together with the boards and committees set up to cover each Research Council's portfolio, represent a heavy administrative burden."[128]

62. The DGRC told us that this would be a "zero-based review of the Research Councils' activities", undertaken with their "full co-operation and enthusiasm" and would include looking at "efficiencies, cross-Council savings, size of headquarters, systems, mechanisms for deciding". The results of this review are expected to have fed through by the time of the 1995 PES round.[129] The Chancellor of the Duchy made clear to us that he wanted "to spend more on science and less on structures and administration".[130] Evidence from CEST suggests that there is some scope for such economies: it was surprised that an estimated 3,430 persons out of the 9,692 employed by the Research Councils were engaged in administration, compared with the proportion among contract research and development groups, which it believed was about 20%.[131] **If CEST is correct, there may be scope within the administration of the Research Councils for economies which would allow more money to be spent on science and technology. We look forward to receiving the results of the DGRC's zero-based review of the Research Councils' activities in time for the results to be contained in the 1995 Forward Look.**

International Collaboration

European Community Programmes

63. As pointed out above,[132] the UK contribution to the EC budget in respect of Research and Technology Development (RTD) has risen steadily in recent years, from £136.7m in 1986-87 to an estimated £257.6m in 1993-94 (at constant 1992 prices),[133] equivalent to 7.5% of UK Government civil expenditure on science and technology. Most programmes are industrially based, but the amount of basic research in areas relevant to future economic growth, such as biotechnology, has increased.[134] The OST told us that although it had "some continuing complaints about the way in which Brussels has handled some of the administration", it generally supported the current Framework Programme, which did "work of a really valuable kind often in bringing together networks of Europeanwide companies in a way which gives good hope that one might be able to challenge some of the mechanisms in Japan and the United States in due course". It was generally satisfied with the overall balance of the Programme, although it would prefer more money to be spent on social sciences, and was pleased that the UK received more from the Programme than it put in. The OST also told us, however, that it was "constantly on the watch to see that the programme is not

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[128] *Forward Look*, para 5.30.

[129] Q. 151. Further details of the review are to be found in the OPSS Management Plan 1994-95 to 1996-97.

[130] Q. 133.

[131] *Statistical Supplement to the Forward Look*, Table 1.7.3; Q. 232.

[132] See para 25.

[133] *Statistical Supplement to the Forward Look*, Table 1.2.3.

[134] *Forward Look*, para 6.2.

diverted towards a cohesion theory of spending things for social ends — it must be an R&D programme, an S&T programme".[135]

64. The DTI told us that although the UK did well out of the Framework Programme, it was concerned that much of the money allocated to the UK was directed to universities rather than business; it was making efforts to increase the takeup of European funds among industry, with some success.[136] CEST believed that, although obviously not tailored to UK needs alone, the European RTD programme was "reasonably attractive", to UK firms, which appeared to be willing to make the investment necessary to take part in it.[137]

65. A Fourth Framework Programme is due to begin in 1994 and will continue until 1998, with an expenditure ceiling of 12.3 billion ecu (about £9.5b), a real increase of 6.6 billion ecu on the Third Framework Programme. The UK, the Forward Look says, "played a significant part in shaping the structure and priorities" of the Programme. In view of the Chancellor of the Duchy's comments above, it is interesting to note that the Fourth Framework Programme includes a programme in the field of targeted socio-economic research.[138] The OST is now working with other departments and EC countries to shape the details of the individual programmes. In undertaking this:

> "a guiding aim will be to secure objectives and delivery methods that both reflect European strengths and are complementary to UK national priorities. A particular goal will be to ensure that value for money is secured from this substantial expenditure, judged on the basis of effective and timely independent evaluation against focused objectives."

In addition:

> "Plans are now under development for a major campaign to promote information and advice on the opportunities afforded by the new Framework Programme within all sections of the UK's S&T community. This campaign will bring together the promotional efforts of the OST with those of a wide range of other Government Departments and agencies, targeting the full range of potential audiences."[139]

66. The DTI told us that there were opportunities for getting better value for money from European programmes, but that there was inevitably a degree of compromise associated with any international programme, since the partners would have different needs.[140] CEST thought that as far as industry was concerned, the value for money of European programmes should be judged in the same way as any other industrial collaboration, namely by whether the companies involved introduced new products or undertook new activity as a result. It believed that the companies who had taken part in programmes in the past had found "reasonably good benefits".[141]

67. We are satisfied with the Government's approach to European science collaboration, and welcome the fact that the country receives more from the programmes than it contributes. **The Government should continue to press for good housekeeping in Brussels, ensure that the Fourth Framework Programme is as relevant as possible to the UK, and encourage the maximum participation in the Programme by UK industry.**

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[135] Q. 154.
[136] Q. 74.
[137] Q. 236.
[138] Proposal for a Council Decision 94/0091(CNS)
[139] *Forward Look*, paras 6.5-6.6.
[140] Q. 72.
[141] Q. 238.

Wider international collaboration

68. The Forward Look says that:

> "The UK will also continue to develop close and mutually beneficial links with major scientific partners in Europe and across the world, on both a bilateral and multilateral basis, where it is sensible and cost effective to do so."

Countries identified as likely partners include the USA, Japan, (with which a Science and Technology Agreement was signed on 13 June)[142] and south-east Asia, as well as European countries outside the structure of the EU.[143] The Forward Look also tells us that:

> "The UK will continue to play its part in the global S&T community through support for major international programmes where these contribute to UK objectives and represent value for money. Besides such major investments as CERN in Geneva (annual subscription £55m per annum), the ESA science programme (£30m per annum) and major environmental programmes, the UK also plays its part in nuclear fusion research at JET and other international projects supported by a range of institutions and Government Departments. As well as participating in these existing research programmes and facilities, the UK will remain closely involved, at both scientific and governmental levels, in the planning of major new international scientific collaborations, including the International Thermonuclear Experimental Reactor."[144]

69. Particular attention is being given at the moment to the proposed Large Hadron Collider (LHC) at Geneva, which it is estimated would cost £5.7 billion over ten years. It would, if agreed, be the largest particle collider in the world now that the USA has cancelled its Superconducting Super Collider (SSC). The objectives of the LHC would be to help understand the origin of mass, how gravity operates, and reveal new forms of matter.[145] The OST is in favour of the project, to which the UK would contribute about £700m over ten years, which is "basic pure science of the most exciting kind",[146] but the Chancellor of the Duchy wanted to be sure that there would be "really ruthless cost control ... because it is so big that not just us but the whole of Europe's science base can be overbalanced unless the cost control is rigorous". The Chancellor also wanted "wider international participation in it, of which there is some hope now from the US and Japan and perhaps Canada".[147]

70. If the OST decides finally to support the LHC project, we would certainly encourage the OST in its efforts to widen it into a global collaboration; the cancellation of the US SSC has meant that the LHC would, if built, be a global not just a European asset. **However, the expenditure of such a large amount of money on a single project must be very carefully, and publicly, justified by the OST.**

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

71. We recommend that the Government provide Parliamentary time each year for a full day's debate on science and technology shortly after the Forward Look is published. (Para 6)

The main body of the Forward Look should be as similar as possible from year to year; this will be made easier if a strategic framework is developed. The Essays provide an adequate opportunity for the OST to address a variety of topical issues or to give each issue a common theme. (Para 18)

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[142] *Official Report*, 4 July 1994, Col. 79-80.

[143] *Forward Look*, paras 6.7-6.9.

[144] *Ibid*, para 6.11.

[145] *Ibid*, para 6.12; *The Nature of Matter*, Parliamentary Office of Science and Technology (POST), June 1994.

[146] Q. 161; POST, *op cit*.

[147] Q. 160.

We recommend that the OST consider increasing the level of detail on industrial and university research in next year's Forward Look, to help it become a comprehensive review of all UK science, engineering and technology, however funded. (Para 22)

The OST should examine the consequences of the low level of civil research and development in the UK. (Para 23)

We recommend that the historic figures for BERD by industrial sector also be expressed in real terms in next year's issue of the Forward Look. (Para 27)

We consider that the level of foreign R&D investment in the UK would be an important indicator of the strength of the science base. The OST and the Central Statistical Office (CSO) should address this matter so that, in addition to BERD, a measure of industrial R&D exists which accurately reflects all industrial R&D performed in the UK irrespective of the ownership of the firms involved.(Para 29)

We trust that the OST and DTI will pay close heed to representations on improving the usefulness of the statistics in the R&D Scoreboard. (Para 31)

The OST should reflect on whether the indicators in this year's Forward Look adequately reflect science, engineering and technology activity in the UK, and whether a standardised measure could be used in next year's issue. (Para 34)

The fall in government spending in real terms on civil research and development by £577m and on defence research and development by £1,100m in the twelve years from 1984-85 to 1996-97 is a major strategic shift which is likely to have an impact on the development of advanced technology in the UK. The OST should examine its implications for competitiveness. (Para 43)

We strongly support the development of output measures of the effectiveness of R&D. We intend to review next year the progress the OST has made in devising such measures. The evidence given in our First Report on the effect of business research and development on total factor productivity is an example of output measurement of the kind that the OST should pursue. (Para 48)

We hope in future to see evidence that the OST is using its powers to act as an effective guardian of the government's science policy. (Para 51)

We endorse the approach of the OST in encouraging research into what is relevant to wealth creation and the quality of life while ensuring that this does not impede the principal role of the science base, which is to train scientists and conduct basic research. We would like to see some indication in the next issue of the Forward Look that these objectives are being achieved. (Para 60)

There may be scope within the administration of the Research Councils for economies which would allow more money to be spent on science and technology. We look forward to receiving the results of the DGRC's zero-based review of the Research Councils' activities in time for the results to be contained in the 1995 Forward Look. (Para 62)

The Government should continue to press for good housekeeping in Brussels, ensure that the Fourth Framework Programme is as relevant as possible to the UK, and encourage the maximum participation in the Programme by UK industry. (Para 67)

The expenditure of such a large amount of money [£700m over ten years] on a single project [the Large Hadron Collider] must be very carefully, and publicly, justified by the OST. (Para 70)

LIST OF ABBREVIATIONS

ABPI	—	Association of the British Pharmaceutical Industry
CEST	—	Centre for Exploitation of Science and Technology
CSA	—	Chief Scientific Adviser
CSO	—	Central Statistical Office
CST	—	Council for Science and Technology
DTI	—	Department of Trade and Industry
IOP	—	Institute of Physics
IPMS	—	Institution of Professionals, Managers and Specialists
LHC	—	Large Hadron Collider
OPSS	—	Office of Public Service and Science
OST	—	Office of Science and Technology
POST	—	Parliamentary Office of Science and Technology
PTP	—	Post-Graduate Training Partnership
ROPA	—	Realising our Potential Award
RTD	—	Research and Technology Development
SET	—	Science, Engineering and Technology
SPRU	—	Science Policy Research Unit
SSC	—	Super-conducting Super Collider

PROCEEDINGS OF THE COMMITTEE RELATING TO THE REPORT

WEDNESDAY, 20 JULY 1994

Members present:

Sir Giles Shaw, in the Chair

Mr Spencer Batiste	Cheryl Gillan
Dr Jeremy Bray	Mr William Powell
Mrs Anne Campbell	Dr Alan W Williams

The Committee deliberated.

Draft Report (The Forward Look of Government-Funded Science, Engineering and Technology 1994) proposed by the Chairman, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraph 1 read, amended, and agreed to.
Paragraphs 2 to 22 read and agreed to.
Paragraph 23 read, amended, and agreed to.
Paragraph 24 read and agreed to.
Paragraph 25 read, amended, and agreed to.
Paragraphs 26 to 28 read and agreed to.
Paragraph 29 read, amended, and agreed to.
Paragraph 30 read and agreed to.
Paragraph 31 read, amended, and agreed to.
Paragraphs 32 to 42 read and agreed to.
A paragraph — *(Dr Jeremy Bray)* — brought up, and read, as follows:

"The fall in government spending in real terms on civil research and development by £577m and on defence research and development by £1,100 million in the twelve years from 1984-85 to 1996-97 is a major strategic shift which is likely to have an impact on the development of advanced technology in the UK. The OST should examine its implications for competitiveness".

Ordered, That the paragraph be read a second time.

Amendment proposed to the proposed paragraph, in line 3, to leave out from the word "which" to the word "have" and insert the word "could" — *(Cheryl Gillan.)*

Question put, That the Amendment to the proposed paragraph be made.

The Committee divided.

Ayes, 2	Noes, 3
Mr Spencer Batiste	Dr Jeremy Bray
Cheryl Gillan	Mrs Anne Campbell
	Dr Alan W Williams

Paragraph inserted.

Paragraphs 43 to 46 (now 44 to 47) read and agreed to.
Paragaph 47 (now paragraph 48) read, amended, and agreed to.
Paragraphs 48 and 49 (now paragraphs 49 and 50) read and agreed to.
Paragraph 50 (now paragraph 51) read, amended, and agreed to.
Paragraphs 51-65 (now paragraphs 52 to 66) read and agreed to.
Paragraph 66 (now paragraph 67) read, amended, and agreed to.
Paragraphs 67 to 69 (now paragraphs 68 to 70) read and agreed to.
Paragraph 70 (now paragraph 71) read, amended, and agreed to.

Ordered, That a list of abbreviations be annexed to the Report. — *(The Chairman.)*

Resolved, That the Report, as amended, be the Second Report of the Committee to the House.

Ordered, That the Chairman do make the Report to the House.

Several papers were ordered to be appended to the Minutes of Evidence.

Ordered, That the Appendices to the Minutes of Evidence taken before the Committee be reported to the House. — *(The Chairman.)*

[Adjourned till Wednesday 19th October at Four o'clock.

LIST OF WITNESSES

LIST OF MEMORANDA INCLUDED IN THE MINUTES OF EVIDENCE

LIST OF APPENDICES TO THE MINUTES OF EVIDENCE

MINUTES OF EVIDENCE

TAKEN BEFORE THE SCIENCE AND TECHNOLOGY COMMITTEE

WEDNESDAY 18 MAY 1994

Members present:

Shaw, Sir Giles (Chairman)

Batiste, Mr Spencer
Bray, Dr Jeremy
Gillan, Cheryl
Miller, Mr Andrew
Skeet, Sir Trevor
Vaughan, Sir Gerard
Williams, Dr Alan W

DR DAVID EVANS, Head of the Technology and Innovation Policy Division, MR RICHARD KING, Head of National Science, Technology and Innovation Policy Co-ordination and DR ALISTAIR KEDDIE, Head of the Innovation Unit, Department of Trade and Industry, examined.

Chairman

1. Gentlemen, we apologise for the delay before we commence the evidence session with you. You will realise that we had a previous session and therefore I regret that we are running a quarter of an hour late, but I hope that, in no way, diminishes your interest in helping us to answer our questions. We are, as you know, running a fairly quick inquiry into the Forward Look and we have a date for the Chancellor of the Duchy of Lancaster in due course. We are most grateful to have the three of you here to answer questions in respect of your own activities, the Innovation Unit, of which you are the head, I believe. Is that right, Dr Evans?

(*Dr Evans*) I am not the head. Perhaps I might introduce my colleagues. I am David Evans. I am the head of Technology and Innovation Policy Division in DTI which was newly created at the beginning of March, so I have been in my post since then. That division was created following Dr Robinson 's departure. I have with me Alistair Keddie, who is the head of the Innovation Unit and Richard King who is the head of the Branch within my Division which looks after our general technology and innovation policy questions.

2. As far as fielding questions is concerned, it is a matter of the three of you pitching in, is it?

(*Dr Evans*) We will all do our best to help you with whatever direction you are coming from.

3. What is the Department's view—and I suppose this goes to yourself as the policy side of it—of the main future developments and policy challenges which will affect the Department's efforts to achieve the mission which you now have over the next five to ten years? What do you think are the main developments and policy challenges?

(*Dr Evans*) I have been thinking about what the right long term goal ought to be for DTI in this area. I have come to the conclusion that we need to think about the different activities and the different players in this game. It seems to me very important for us to have companies in the UK which are ready, keen and willing to innovate. When I say "innovate", I use the definition which the Innovation Unit has brought before us, which is successfully to make money out of new ideas, that is successfully exploiting new ideas. That runs somewhat wider than simply carrying out R&D or simply investing in technology. It goes through the whole process of bringing ideas into successful products or processes in the market place. We have to create a situation where companies within the UK are ready, keen and willing to innovate. We also need a healthy science base capable of producing the knowledge, information and the personnel in order to do that. Much of the content of the Forward Look and many of the changes we have put in place since the Science, Engineering and Technology White Paper have been moving in that direction. There is also a third point in this area which is that we need an effective infrastructure which ensures that companies are put in contact with the science base where they can get the technology they need and the information that is necessary for them to innovate successfully. The role of DTI focuses around the area of providing an environment, a broad framework, within which companies can be encouraged to innovate. The activities of the Innovation Unit, which I am sure Alastair Keddie can go into, are part of that creation of the right kind of climate and framework. Also we need to look at questions of infrastructure, questions of connection, how we can best bring firms together with the science and technology that will allow them to compete and to succeed.

4. Dr Keddie, do you want to add anything to that?

(*Dr Keddie*) I do not think so at this point, Chairman. Dr Evans has put it very well, as far as the overall whole is concerned as well.

Dr Bray

5. Quite a lot of work has been done to measure the output of innovation at company, industry and national levels, but very little of this work is reflected in the Forward Look. Would you like to see more of it?

(*Dr Evans*) Indeed I would, and I have to say that it seems to me that we are setting off on this road in preparing the next Forward Look. The Forward Look itself makes that clear, that this first example builds on the position we have now reached. It had substantially to be written before even the new Research Councils had come into existence. For example, the chapter on the Economic and Social Research Council talks about the priority which it is giving to the topic of innovation and a better understanding of the process of innovation within companies. That is an area where the Innovation Unit has done a great deal of work and is continuing to work with companies on the best way companies can innovate. That is the kind of area which we will

[**Dr Bray** *Cont*]
be looking more at in terms of our own activities and I hope the Forward Look will be able to cover that.

6. Have you read paragraphs 176 to 187 in our first report?
(*Dr Evans*) I have not brought it with me and I do not know that I have.

7. They deal with the measures of total productivity and the influence of research and development upon that and the incentives available to stimulate research and development at company, industry and national levels.
(*Dr Evans*) I have to own up that I have not read those paragraphs. I do not know if either of my colleagues is in a better position.
(*Dr Keddie*) I have read them, but I do not have them in front of me. I am not *au fait* with what they say.

8. Have you realised the order of magnitude of the effects that we talk about in that section, that by an appropriately designed fiscal policy one could add 0.8 per cent per annum growth to GDP within five years?
(Dr Keddie) The question of fiscal incentives for R&D is a matter for the Treasury, as you will better know than I. I think it is easy to assume that the tax system has a greater influence than in fact it does.

9. This is a matter for investigation, is it not? If you look at the US study it is based on a degree of analysis that simply is not made with the available data in this country. Who commissions the company reporting on the R&D scoreboard?
(*Dr Keddie*) We do.

10. And who analyses it?
(*Dr Keddie*) Company Reporting—

11. No, analyses it, that is to say, draws its implications and integrates that with respect to other measures of performance?
(*Dr Evans*) It is the responsibility of my Division to try to bring together the different areas of technology and innovation policy within DTI to promote the kind of vision that I have described for you.

12. Having generated that level of information, which is extremely interesting, can you refer us to any use of that analysis and the effect of research and development on the profitability, output, performance or anything else of the firms and industries covered?
(Dr Evans) That is something which we take very seriously in our department. It is a subject which, for example, we discuss with the Treasury, but in my own view—

13. Have you written any papers that you can give to this Committee?
(*Dr Evans*) I personally have not written any papers—

14. Has the DTI commissioned any papers?
(Dr Evans) I can say that to the best of my knowledge since I have had the responsibility I have had—which I have to repeat to you is since the beginning of March—we have not commissioned any papers on the subject.

15. Why not?
(*Dr Evans*) This is a subject which I think has been looked at by a number of other people. I think your question to me, if I have understood it correctly, is about the use of the R&D Scoreboard and the influence which it has. One of the things that we felt about the publication of the R&D Scoreboard was that it would generate a public debate about the way in which—

16. You have been doing that for three years now and where is the analysis?
(*Dr Evans*) That public debate, if I might continue—

17. Not debate, analysis. There is none. No analysis has been made of the implications of that for the performance of the firms and industries covered.
(*Dr Evans*) But can I make the point that I was attempting to make, and that was that one of the benefits which we sought from bringing that information into the public domain was to get the City analysts—the analysts of company profitability—to look more closely at the influence of investment in R&D. I would have to say again that investment in R&D only reflects part of the total investment in innovation in that there are other things which also have to be brought to the table in order to successfully innovate. But the point I am trying to make is that we are encouraging those in the City who are influential in terms of brokers and investment analysts to take more account of that information.

18. Can you give us the name of any single analyst who has used those data for doing a total factor productivity analysis comparable with that which we quote in our report? Would you like to take that away and give us their names?
(*Dr Keddie*) Can I just add to what Dr Evans has said? I could not give you the name of an analyst or a pension fund that has done precisely what you have suggested, Dr Bray, but there are a number which we know are increasingly referencing that kind of material in the decisions and the relationships they are developing with companies. That is not precisely the same thing as carrying out yet another study, but it is beginning to change the thinking and the behaviour of individual companies and individual analysts and pension funds.

Sir Gerard Vaughan

19. Are you proposing to commission any of the kinds of analysis that Dr Bray has been asking about?
(*Dr Keddie*) Not the precise analysis that Dr Bray has mentioned, if I have understood his point correctly. We have commissioned other analysis with Warwick University and Imperial College on other ways of building on the R&D Scoreboard and other measures of company performance to demonstrate whether some companies are more innovative than others.

Chairman

20. You have heard Dr Bray's observations. You have the report available to the Department. Will you please look at this matter and you might care to write to the Committee with your views as to how best you can take this forward? It is an issue for which

[**Chairman** *Cont*]
it is reasonable to say the DTI, particularly its Innovation Unit, should take as a serious opportunity to reassess the problem. We welcome your views about it.

(*Dr Evans*) Of course we will in due course be responding to the whole of your report, but I am very happy to take your request and respond to it[1].

Mr Batiste: We obviously welcome anything that you can do to influence the opinion of City analysts. We are also looking at something additional to that which is what lies behind the passages in that report, namely: that investment in R&D produces a very much wider benefit and that benefit is felt beyond the companies that make the benefit. That appears to be the outcome of US analysis of their figures. Part of the process of producing the information which you are doing must be to set a climate of debate within Government, particularly in relation to the Treasury and its assessment of fiscal measures, and that climate can only be set if the information you are getting is analysed to see what conclusions can be drawn from it. That is really what we are looking for.

Sir Gerard Vaughan

21. It may not surprise you to know that we are very interested in the effect of the Foresight process on departmental thinking and progress. If you look forward to the report next year, do you think that we are likely to see in that a number of detailed changes in attitudes, requirements and policy? You are described in Forward Look as having a key role to play in all of this. How do you see the future developing?

(*Dr Evans*) I very much hope that we will see a number of changes that have emerged from the process and the report of the Foresight process when we come to the next Forward Look. But it does seem to me that we in DTI and government generally are in the learning mode when we are doing the Foresight activity as to precisely how we will be in a position to respond. I am a member of the Engineering and Physical Sciences Research Council. What is clear to me from the meetings that I have been to of that new Council already, is that there is an enormous will to take the information, the knowledge, the output from the Foresight process and to use it in order to steer the activity that will be undertaken in the future. The difficulty that I have is that we do not yet know what the output is going to be and in what precise way it will be influential. What I am hopeful of is that the Foresight process will give us a better understanding of the way in which different technologies shall feed into different markets, different products and processes which can find success in the long-term future, 10-20 years or more, and hence allow us better to allocate priorities than at the moment.

22. We are talking about only a year ahead. I appreciate it is early days, particularly for you, but surely could you not be a bit more specific about how you think you are going to proceed on this? You are being very general at the moment, are you not?

(*Dr Evans*) I am being very general and I fear I will have to continue being quite general because we are not in a situation where I yet know what the nature of the output work from the Foresight process will be. I was previously working in the Department of Energy and we did an analogous kind of foresight activity on energy technologies, which has been published. That is something that was done on more than one occasion.

Sir Gerard Vaughan: Would it be unreasonable to ask you, perhaps in three months' time, to give us a much more detailed account of how you are going to proceed, what changes are likely to take place, or is that unreasonable?

Chairman

23. You will have a time scale yourself within which you almost have to proceed, if there are to be changes the next time round.

(*Dr Evans*) My understanding is that the timetable for the Foresight process itself has been arranged so as to deliver its report—or whatever the output will be—around the end of this calendar year or the beginning of the next calendar year. That will then feed into both Departmental and Research Council thinking from that point on. Although the process of Foresight—which as you know is running with panels—is something which is being done to a substantial degree within the public domain, and therefore the discussions in the public domain over the Autumn probably can start forming a climate of opinion which will be influential in changing things after that point.

24. Does that mean information you can put to us at the end of the year? You should do, should you not? You will have information available for the Committee on your views on the process later in the year, you must have?

(*Dr Evans*) Information from the Foresight panels?

25. No, the question is about the changes to be made.

(*Dr Evans*) Yes.

26. Presumably you will be arriving at views about how there should be changes.

(*Dr Evans*) I think what I was trying to say is that I believe that as the Foresight process carries on through the Autumn, we will be aware—you are correct—of the way in which the ideas are developing and the way in which the information is being gathered and we will concurrently be able to think more about what we in DTI should be doing and what other Departments should be doing. I have to say that it is important to recognise that the Foresight process is being run by the Office of Science and Technology with the aim of directing and helping the Director General for Science and Technology for the Research Councils to have control over the spending of the Research Councils.

Sir Gerard Vaughan

27. I must be frank with you. I had hoped that that you would have been able to be much more specific already and quite quickly tell us what effect the Forward Look and the Foresight programme will have on your own Department?

(*Dr Evans*) On my own Department?

[1]See p. 10

[**Sir Gerard Vaughan** *Cont*]

28. On the DTI.

(*Dr Evans*) My own Department, perhaps I should then come back to what I see as the priorities for our own Departmental spending. I said at the outset that we are more interested in talking about questions of infrastructure and questions of connection between companies and the science base because we think that is the area where DTI can add most value and the area where it can make the most impact. In those circumstances, we will be giving less priority in the next 12 months to spending on new areas of technology development, precisely because the Research Councils, who are spending £1.2 billion of public money, will be giving much more priority to that. Our priorities for the changes in forthcoming expenditure for DTI are to improve the opportunities and the ability in the UK to transfer technology out of the science base into companies, so we will be investing more in technology transfer mechanisms on the basis and understanding that the science base itself will be generating more technology, which is of relevance to industry. That seems to me a perfectly logical consequence of the changes started with the Science, Engineering and Technology White Paper last year.

Mr Batiste

29. What assessment have you made of how your new policy—as you describe it, this switching of emphasis towards the broad environment of allowing innovative firms to flourish—compares with the policies employed by the industry departments in Germany and Japan?

(*Dr Evans*) Since taking up my new role I am afraid I have not had the opportunity to visit Germany. I was in Paris yesterday and it had been my intention to carry out some discussions with the Industry Ministry today, until such time as you in the Committee asked me to appear here. For that reason I am afraid I have not discussed extensively with my foreign counterparts their approach to technology. I have, however, met one or two officials responsible for technology policy—I would have to say not comprehensively but in isolation—from equivalent industry departments in France and Germany. I have been surprised to find a degree of common thinking about the nature of the problems and challenges facing us in the future, but I could not and I cannot say that I have done an exhaustive comparison of the policies. It is in my work programme for the next few months to do so.

30. We understood that the White Paper on Competitiveness was going to be published early this week but, of course for obvious reasons, it has been put off for a little while. Surely that whole area is one that will draw upon the very wide ranging exercise of comparisons being drawn between the UK and other countries. Therefore, in having had this new shift on policy, you must have in your mind in your Department, certainly in the policy areas of your Department, for which you are responsible, how other countries handle these kinds of issues.

(*Dr Evans*) Yes.

31. Will we find this in the White Paper when it is published?

(*Dr Evans*) One of the areas on which work has been done in the Department in the past few months is in trying to understand the relative innovative performance of industry. Not only in relation to the question of what DTI should be doing, or what other Industry or Economics Ministries in other countries are doing, but it is important to ask what are the strengths and weaknesses of British industry compared with the strengths and weaknesses of other industries, because the prime case for intervention lies in the area where there are problems to be overcome in your own national industry. Without wishing to give too much away from Mr Heseltine and the White Paper which will be announced at some time in the future, you can expect to see some comparative analyses of the innovation performance of different countries with the intention of illuminating the different areas where it would be appropriate for us to—

32. You then go from that to making judgments about how the environment in those countries might be more conducive to innovation than it is here.

(*Dr Evans*) The work we have been doing has been looking at exactly that kind of question. What is it that differentiates the success, so far as we can identify it, of other countries where we can see it from the success in the UK and what is it that we in DTI for our part, accepting our role within our area of work, can do to overcome the deficiencies that we see in the UK.

33. We shall have to wait for the White Paper.

(*Dr Evans*) If you want it in a line by line statement you will have to wait.

Dr Alan W Williams

34. Is this not a shift of emphasis away from generating new technology to the broader environment and away from the sharp end, the more expensive end, to the more diffuse and, frankly, the cheaper end? It is something of a hands-off approach, when really our impression as a Committee from our visit to Germany and to Japan was one of the governments and departments such as your own being very much involved in promoting transfer of technology?

(*Dr Evans*) You could see possible options for the development of our policy in the way that you have said, but I do not know that it is a logical necessity. If we are trying to influence the behaviour of the many hundreds of thousands of firms in the UK, that is a more difficult and a more resource intensive task than trying, for example, to influence the behaviour of six Research Councils and seventy-odd universities in the UK, where it is perfectly reasonable to get the seventy vice-chancellors and the six heads of the Research Councils in one room to talk to them. That is the point that we have to think harder about, how we can provide an infrastructure which will help the broad generality of our firms. When we in DTI look to the performance of British industry in the area of innovation, we certainly see some examples of world class performance. There is no doubt about the fact that there are many companies within Britain which are absolutely world class and which can demonstrate and stand up to comparison with any other in the world. What we as an Industry Ministry

[Dr Alan W Williams *Cont]*
are concerned to achieve is a greater proportion of the generality, the average firm, achieving that excellence, that high standard of performance. That is the area, the area of spreading best practice, the area of communicating what needs to be done and how to do it, rather than the simple promotion of technology and the simple generation of new technologies which seems to me much more the task of the Office of Science and Technology.

35. I can understand the gain, for the large numbers out there, from the new contact that has been made and the better environment, but what about the companies, the private industry, that you are now pulling away from? What has been their reaction to the change in policy?

(*Dr Evans*) My impression, somewhat to my surprise, is that industry itself has not complained that vociferously about the cessation of the collaborative research programmes which we announced last Autumn. It is only fair to say, however, that some of the Research and Technology Organisations have complained. So it is not so much a question of companies themselves saying we have done a terrible thing by stopping this kind of funding, but it is the intermediaries. Even at that point we have to listen to what the Research and Technology Organisations are saying because they play an important role as intermediaries within the economy and we cannot afford to let them disappear without thinking about what further to do. Equally, we would make a mistake if we simply subsidised them for the sake of subsidising. We have to think further about how we can develop our policies in a way which will help them to help companies.

Chairman

36. Does OST have a direct role in this with trying to fashion government policies in your Department and in others?

(*Dr Evans*) The important area for us to work with OST is in the area of academic/industry collaboration. You may have read in the Forward Look that OST announces that there is to be a Departmental Whitehall-wide review of the LINK scheme. LINK certainly has had some very significant successes in the past. It also has had some problems, not least problems of the bureaucracy and the slowness of procedure and all that kind of thing. I am very keen to work with OST to try to get the best out of the advantages that we have seen from the past LINK programmes and to push that forward in a positive way in the future.

Mr Miller

37. Did I hear you correctly earlier, Dr Evans, when I thought you said the prime area for intervention is in areas where our industry is in difficulties? Is that what you said?

(*Dr Evans*) The point that I was trying to make was that in making international comparisons it is important for us to understand the strengths and weaknesses of British industry and to think about—there is a good question about where you put most of your resources—

38. I was going to ask—

(*Dr Evans*) Let me finish my introduction and then you can ask the difficult questions—about whether or not you put more resources in overcoming the weaknesses or you put more resources into reinforcing the strengths. I think you need to carry the analysis a step further and think about what the nature of the intervention you can do and what the output of that intervention is, what you can deliver and what realistically we as government can deliver in trying to decide where you can get best value for the taxpayers' money.

39. It seems to me that the prime area for intervention is in areas where we shall succeed and that seems to be what paragraph 1.4 of the introduction says in that inevitably our research effort is a small part of the world's scientific research, and that to compete internationally it is vital for the UK not only to use its own scarce resources to the best effect, but also to take full advantage of advances in science and technology wherever they might arise. It seems to me that the areas where that kind of partnership has existed—like in aerospace, in telecommunications and in pharmaceuticals—historically we have been successful, although on a sliding scale going rapidly down the hill now when that partnership is not perhaps working. How does the DTI concentrate funding activities which will lead to wealth creation without undertaking tasks which it perceives should be performed by the private sector?

(*Dr Evans*) If I knew the answer to that and could answer in one sentence I probably would earn my salary for the whole year having done it. It seems to me that that is a continuing task. The examples you gave us are quite interesting. The UK certainly has been very successful in areas like pharmaceuticals and aerospace. In the pharmaceutical area it is undoubtedly clear that the spending of the Research Councils, the old MRC and the other Research Councils, plays an important part in building that strength in the UK, both in the science base and—

40. I understand that is now with the NHS.

(*Dr Evans*) And there are other infrastructure questions like the spending power of the NHS, the arrangements under which drugs are paid for, the research element and all of those complicated effects. I certainly do not want to tell you that we want to do away with any of those things. It is the same thing in my Department. We have a research and development support budget for the aerospace industry, which is a relatively small budget. It is less than £20 million a year and shrinking, but it gives good value for money for a relatively modest expenditure. However, going back to the point that I was trying to make, we have very many excellent companies in the UK and we must make sure that we maintain that excellence, but also we have to work hard at seeing how we can improve the standards of the generality of those firms which are not excellent and bring them up to a higher level and in particular the generality of small firms where there are opportunities to help them to improve. That is a prime area for DTI to think about: what DTI rather than the science base—I have to say that I want to distinguish between the kind of activity that we might undertake and the activity of the science base—might do to improve the performance of industry.

[**Mr Miller** *Cont*]

41. Are you not concerned, though, that the R&D of those three examples that I gave is drifting out of the UK at a fairly rapid rate?

(*Dr Evans*) I am very concerned, if the performance of those three sectors are going down in terms of their contribution to wealth creation. I am not aware of any statistics that say that their R&D activities are moving away, or that their relative performance is going down.

Dr Bray

42. The general pattern in DTI has been to cut down expenditure on things like the advanced technology programmes and build it up in research and development. How does that look in the international context?

(*Dr Evans*) I cannot give you a synoptic view of all the things, but I am very well aware of concern on the part of several other Governments to work harder at the area of technology transfer—which is the area we say we have to work harder at. For example I met earlier in the year a representative of the US NIST, National Institute for Standards Technology, who talked about new activities and trying to get information out of US Government laboratories. I know that exactly the same thing is being thought about in the large science laboratories in Germany where a great deal of effort has been put into trying to get the work done in those laboratories, to be closer to industry and to be more responsive to the needs of industry.

43. Yes, but what about the cuts in the advanced technology programmes? The DTI in the form of Dr Robinson told us on 8 December that the idea was to cut down actual practical development work and industries were best left to do their own. What evidence have you that that really was a sensible decision?

(*Dr Evans*) There are some interesting statistics in this report about the level of private sector investment in R&D—

44. Which has been falling.

(*Dr Evans*) Which has been rising on a 10-year view, if you look at the table on page 13. The evolution—

45. It was rising while the DTI supported it and it has been falling while the DTI support has been falling. Does that not make a connection in your mind?

(*Dr Evans*) The figures that we have before us here indicate spending in private industry of around £6 or £7 billion a year. The changes and the closure of the advanced technology programmes, where I am very hopeful that I will be able to divert that money into the technology transfer activity, the kind of activity that I have already described to you, are likely at most to influence perhaps £60 or £70 million a year of Government expenditure. I find it difficult to relate those two quantities. I think it is important to bear in mind the relationship of those two quantities, but I come back basically to my fundamental point that we now have a science, Engineering and Technology White Paper that says that it is the task of the Science and Technology Research Council budget, which is £1.2 billion a year, to support wealth creation in the UK. I am very encouraged by that. That seems to me an entirely proper thing and something which works very well with the mission of my Department, with the knowledge that that money is being directed in that positive way. I think it is incumbent on me to ask where can I get the best value added for the taxpayers' money which I am disbursing. I come to the conclusion that I will spend that money better by helping companies get hold of technology rather than generating new technology.

46. Does it not occur to you to say that if these clever guys are putting it all forward then perhaps we have to give some support to the practical process of development? I do not know whether you were at the Chancellor of the Duchy's exposition.

(*Dr Evans*) On Monday?

47. On Monday.

(*Dr Evans*) Unfortunately I was in France, as I told you. I had to go to a meeting there.

48. He pointed out that the overall effort on development from government as a whole was falling as a share of government activity, whether from OST or DTI. On the whole it was falling on development.

(*Dr Keddie*) You are saying that expenditure by companies was falling. I was not sure whether you were saying expenditure by companies or the amount of R&D carried out in companies, a lot of which is funded by the public sector.

49. Business expenditure, both the private sector as a source and the private sector as a spender?

(*Dr Keddie*) One can obviously bandy figures around for ever. We were talking about the R&D Scoreboard earlier. For example, since 1990, in those companies reporting R&D expenditure in their accounts—there are an increasing number doing so and it looks as if there will be an increasing number again this year—there has been sustained growth in the total R&D expenditure reported by companies in company accounts. That is, it is not running in the same direction, is what I am saying.

50. In terms of aggregates, which are we to believe, your own statistics or Company Reporting statistics?

(*Dr Evans*) One hopes one can believe both.

(*Dr Keddie*) They are collected to some extent on a different basis.

51. Exactly. In fact DTI has no responsibility in this area now, has it not, because it has no control over the Business Statistics Office or the Central Statistical Office which compiles these figures?

(*Dr Evans*) I think we have an interest in using them for their accuracy and their importance as a foundation.

Sir Trevor Skeet

52. Were you not rather dismayed when you heard about the closure of the fast reactor programme, Dr Evans? How much of that expenditure were you actually providing?

(*Dr Evans*) The closure of the fast reactor programme was, as I remember, originally announced in 1987, a long time ago. The reasons for that closure came more from the expectation of the time at which there would be a need for fast reactors to be deployed within the economy and the perception that that was moving away and therefore

[**Sir Trevor Skeet** *Cont*]
the need for very large expenditures on fast reactors no longer had the same priority. My perception is that that general judgment about the time when fast reactors might be used in the economy still remains as valid, indeed perhaps that time when fast reactors might be used is yet further away in the future now than it was in 1987. I find it difficult to—

53. How much were you actually spending on this and how much did you cut it by between 1994 and 1996-97?

(*Dr Evans*) I am quoting from a table on page 132 of the supplement. The expenditure in 1991 on R&D into the fast reactor was £60.3 million. The expenditure in 1994-95 is intended to £0.9 million, so that is a reduction of just under £60 million a year.

54. It is funny we have to justify it, because we find Japan and other countries are going ahead with a fast reactor programme, but you have said yourself that you are bringing the level of the average industry up to a higher standard. But should we not be developing the best?

(*Dr Evans*) I certainly think that it is important to develop the best, but I think we come back to questions of Foresight. One of the purposes of the Foresight study in general is to try to understand what technologies are going to be used within a 10 or 20 year time span, so that we can invest more in those technologies which are going to be used. I mentioned earlier that we did a Technology Foresight activity within the Department of Energy, which at that time I worked for. We have done similar activities since. On a 20 or 30 year time horizon we did not come to the conclusion that there would be very much need for the fast reactor. If you are thinking about disposing large sums of taxpayers' money on such activities, it seems to me that one has to direct them more towards the areas where they will end up being used in the economy, rather than on activities which are not useful.

55. If one takes another illustration in communications, that is of Texas Instruments, which is now moving across to Germany and Italy. Would it not have been better to have encouraged them much more to remain in the United Kingdom than to have gone? What did your Department do in order to ensure that they stayed?

(*Dr Evans*) I am afraid that you are now moving into an area which goes well beyond my knowledge or understanding. I am afraid I cannot answer that. I am aware of the case, but I cannot answer what my Department—

56. Let us just follow that one step further. We cannot afford to lose many companies of this calibre from the United Kingdom. Surely your Department must have some positive policy to retain them.

(*Dr Evans*) What I can say is that my Department is very concerned to make sure that the UK remains a very attractive country for inward investments and we put a great deal of effort in trying to attract inward investment. It seems to me that the inward investments that we have had, notably those in the automobile sector, have been one of the great success stories of "industry policy", if you wish to describe it as that, in the past 10 or 15 years viewed from all sorts of different directions, either from the investment and the jobs that have been created or the effect that they have had more widely on industry. It is certainly true that that is a priority for the future.

Chairman

57. Sir Trevor was keen to point out the huge importance of having a big R&D spend on locating here to assist in the growth of our own innovative technology.

(*Dr Evans*) It is important that wherever possible we can have R&D activity sited in the UK, but my own personal view about that is that the attractiveness of the UK as a place to site mobile R&D activities is more likely to be influenced by the strength of our science base, the quality of the people who emerge from our universities and come out from our research establishments than by the availability or not of subsidies from DTI.

Mr Miller

58. The Prime Minister has spoken on a number of occasions about the importance he gives to science. Last night the Chancellor—I am very much paraphrasing his remarks—talked about the important signals that need to be sent to businesses. Does the proposed reduction in DTI spending on science and technology by £150 million in 1996-97 really send the right signals to business?

(*Dr Evans*) I think we have to understand the nature of that change in expenditure. A large part of the reduction—about £60 million—is accounted for by the fast reactor, which seems to me to be a set of circumstances not generally applicable to the run of ordinary companies. There is another reduction of about £40 million which comes from the fact that the Consultancy Initiative—the programmes we have run in the past for subsidising consultancy activity with small firms—is coming to an end and then there are miscellaneous adjustments which make up the balance. At the same time as reductions in that kind of spending, perhaps you will not be surprised to note that Mr Heseltine has been encouraging us to create all sorts of new ideas for other activities which may not be categorised as science and technology, but which will also contribute to the health of the economy. Notably in that area I would refer to the Business Links, the new network of assistance for small firms which we are developing and to which a great deal of activity is being directed within the Department. Therefore, it is important to see the picture in a slightly wider context and look at the other activities that DTI is undertaking in order to promote the health of the economy and the competitiveness of firms in the UK.

Dr Bray

59. A low tech, no tech economy?

(*Dr Evans*) Certainly that is not my vision at all.

60. Not yours, you said it was the Secretary of State's?

(*Dr Evans*) No I do not think so. Mr Heseltine ought to speak for himself, but I do not believe that is his vision either.

(*Dr Keddie*) Nor is it the vision of a large number of companies in the UK who simply do not put

[**Dr Bray** *Cont*]
themselves in that category. They are very capable of competing worldwide.

61. Why did you say the President asked you to see what you could do by cutting down on science and technology and building up in other areas?

(*Dr Evans*) I do not think I actually said that. I think we have to ask ourselves the question where do we best contribute. It comes back to this area of promoting best practice and promoting best practice may not be solely in the area of innovation. There are other dimensions to promoting best practice. Another point which I have not mentioned until now is that the Government have also agreed to a substantial expansion in the EC Framework Programme for R&D for which I have not been able to track down the statistics in the Forward Look and perhaps that is an area which we ought to look harder at next year to see that we properly reflect the position. The net effect of that, if we sustain the good performance that we have in getting money from the Framework Programme, is to increase the amount of industrial R&D support that will be available in the UK by about £100 million a year, when the main flow of R&D occurs. That will increase the UK's "juste retour" from the Framework Programme to about £400 million a year.

Dr Williams

62. Perhaps I can follow on the same wavelength as my colleagues. When you look at the spend on science and technology by the DTI, my colleague, Mr Miller, was a little generous in saying the cuts were only £150 million because on our brief—I have since confirmed it from table 123 in Forward Look—the expenditure on science and technology by the DTI has dropped from £662 million in 1986-87 to £410 million this year and a projected £237 million in 1996-97. It is falling to one third of its value a decade ago. It is not so much hands off as pulling out altogether from science and technology.

(*Dr Evans*) The figure of £150 million is the figure which I deduced and perhaps it is the same as you deduced from—

63. The picture over 10 years. There is a terrific slide. There is £400 million less down to one third of its value in 1986-87.

(*Dr Evans*) I agree there are other statistics which have to be included. There is the question of Launch Aid, which is the support the Government gives to the airframe manufacturers for Airbus and for the aero engine manufacturers Rolls Royce, which is on a repayment basis against the success of future sales. We have swung from a situation where we have been providing money under Launch Aid to a situation where we expect to get very large sums of money coming in. That is part of the story which has to be added in to these figures. I am afraid I cannot give you a reconciliation at the moment of the figures you have given to me, but it is certainly true that we have reduced our direct support of R&D in firms over the last few years. That came from a recognition that it was not appropriate—I think one could consult the Parliamentary record at the time to find out how Ministers described the changes in the policy. In essence the feeling was that it was not appropriate for government money to be used to support research which probably would otherwise have been done in companies and that it was more important for us to work at improving the climate within which research should be carried out. Indeed the increase in private sector investment in R&D, which we talked about earlier, bears that out as a policy.

64. What is the effect of this on the Research Councils? I believe earlier you referred to part of the grand strategy of pulling out of certain areas where, in a sense, that work then will fall to the Research Councils.

(*Dr Evans*) It is as a consequence of the fact that the mission of the Research Councils has been stated more explicitly to be concerned with wealth creation that we look to the Research Councils to take over more of these areas in technology generation.

Mr Batiste

65. Would you say that traditionally UK companies have been poorer at bench marking their activities with their overseas competitors?

(*Dr Evans*) You have to differentiate the best from the rest. I do not think that would be true of the best, but I suspect it is a statement which might well be accurate for the rest. For that reason my Department has been encouraging and taking initiatives to promote more bench marking, notably via the trade associations.

66. What has been industry's reaction to the Overseas Technology Brokerage initiative?

(*Dr Evans*) As I understand it, a colleague of mine who is not represented here today is carrying out a number of consultations about how best we can use our network of science and technology councillors and the people who work for the British Council abroad to provide better information of that kind, a brokerage service. I do not think we have yet reached a conclusion about how that should work in practice, so we are still at a settling down, consultation phase of how we shall operate. It is too early to say what the reaction is.

67. Are you aware whether there is a substantial input from industry into this process?

(*Dr Evans*) I think the consultations are taking place with industry, but if you wish I could ask my colleague who is responsible for this to write[1].

Chairman: Perhaps you could drop a line to the Committee.

Sir Gerard Vaughan

68. You have already referred to the Research Councils. In your document you say that you are working very closely indeed with them to encourage them to develop within their programmes wealth creation and relevance to industry and things of that kind. Absolutely excellent, a great opportunity you say. Can you tell us the results of this?

(*Dr Evans*) I can tell you what we are doing with the new Research Councils.

69. It is the results we are interested in.

(*Dr Evans*) My observation from participating in the Research Council meetings that I have attended

[1]See p. 11

[**Sir Gerard Vaughan** *Cont*]
so far, is that the new Research Councils, which have also been in existence for only a month and a half, are still very much finding their own feet about how they should change their procedures and what new things they should do. What we are trying to do is work with them to make sure that the knowledge and the information we have from our Sector Divisions, who are in close contact with different sectors such as the chemical sector, the vehicle sector, steel sector and so on, is fed into the Research Councils as we develop our activities. This report already notes that we are intent on reviewing LINK, which has been a major activity between my Department and the Research Councils. I would have to be perfectly frank with you and say that we have not yet reached much in the way of results and it is in the category of work in progress.

70. Which will be turned into results before Christmas?

(*Dr Evans*) If you invite me to come to give you further evidence, I will tell you how much further we have got by Christmas. My colleague reminds me of an example. We have been doing an activity with the aerospace sector to set out a Foresight study for aerospace technology. We have created a report called the National Strategic Acquisition Plan for aerospace research, which is a published document. The DTI has worked with the aerospace industry and that document we will be taking to the new EPSRC to discuss how it can work alongside the priorities. Indeed a great deal of very good aerospace research is done in universities.

71. It will involve the OST in this activity?

(*Dr Evans*) Yes.

Chairman

72. I should like to ask a question now on European funds. Are the European Union programmes sufficiently focused on increasing competitiveness in industry?

(*Dr Evans*) That has been one of our objectives. It continues to be one of our objectives in the process of settling the detailed programmes under Framework Programme IV, the general fourth programme which was agreed at the end of the year. None of those programmes has yet finally been agreed. I was at a meeting with my colleagues on Friday in the Department where we were talking about our general approach to Framework Programmes. It is quite clear that the advisory groups which advise the Commission on the content of these programmes have been working very hard for the past three or four months to do that. It is certainly a DTI objective and a UK objective to make those programmes relevant to industry.

73. We have had some experience now of various frameworks producing activities in the UK. Do you think we are getting good value for money or comparable value for money as we would get from the UK's own Government spending?

(*Dr Evans*) There are opportunities for getting better value for money in European Community programmes, but there is inevitably a degree of compromise associated with any international programme where different countries coming from different traditions have different technological needs or different ways of deploying the technology.

Mr Batiste

74. It is said that British companies, because they are not as well plugged into the Brussels grapevine, do not get bids in or organised quickly enough in order to take full advantage of the Framework programme. Have your studies of this suggested that that is true?

(*Dr Evans*) As I said at the outset, the UK as a whole does very well out of the Framework Programme, but the area of concern to me in DTI is that quite a lot of that return to the UK comes to UK universities and not to UK companies. Previously I was the head of Environment Division in DTI and that was particularly true of the European Community environment programme which was a much smaller programme in the past, but is going to be a big one in the future. About a year ago we decided that we should do a bit of stirring up of industry in the environment area to see whether or not we could get more companies to put good proposals into the Commission. That was successful. We now have managed to get half a dozen extra company projects through the system more than would have been the case had we not done that degree of stirring up. That is a general area where we are trying to work now on a strategy as to how we should promote the Framework Programme, the detailed programmes as they are agreed, with British industry to increase the uptake. There are opportunities to do that.

Sir Trevor Skeet

75. A moment ago you said that you are still settling your programme with the Research Councils and therefore you are short of results. When it comes to the LINK programme, do you have their rules and procedures finalised now? Do they know where they stand?

(*Dr Evans*) We have a full set of procedures for LINK as it stands at the moment, but the Forward Look announced that we are in the process of reviewing LINK with the aim of trying to improve its contribution to this industry/academic partnership and, in particular, look at how it fits with the other activities in Government aimed at industry/academic partnership. I could name the Teaching Company Scheme as one. There are other activities of my own Department, for example the Senior Academics in Industry Scheme, and the CASE awards which Research Councils give. We are going to look at how they work together. We have had one discussion with OST and my Department will be having many more discussions with OST about that.

76. I just want to understand this. OST has taken over the Link programme, but you get a report as well as they do. Where basically does responsibility lie? Will it fall between two stools? Or will it be actively developed?

(*Dr Evans*) No, I believe it will be actively developed. I am intent on actively developing it and I see very significant advantages for industry in improving the linkages with academic research. That is something towards which LINK can make a contribution and I am intent on it making a better contribution in future than it has in the past.

[**Sir Trevor Skeet** *Cont*]

77. Will you compare the figures over the years in the number of schemes that you have been operating, let us say in the past two years, with the number you have operating today?

(*Dr Evans*) Of LINK programmes?

78. Yes, have they not gone down?

(*Dr Evans*) Our commitment of money and our spend has steadily risen.

Mr Miller

79. DTI spend or total Government spend?

(*Dr Evans*) DTI spend. I fear I will have to write to you with the figures[1].

Sir Trevor Skeet: If you write to me, I will be happy. Thank you very much.

Dr Williams

80. In this financial year you are investing £11 million in research into new environmental technologies. It is a rapidly growing area with lots of potential for the turn of the century and beyond, yet that programme is now being wound up and replaced by an environmental best practice programme which, I presume, is information or exhortation and thereby much cheaper. I am left with this impression from the session. I am sorry there is not a Minister here to answer for government policies. Perhaps you would comment on the environmental example. In broader terms the DTI seems to be moving away from a hands on interventionist, getting involved kind of approach, to something on the touchlines saying, "Come on boys, we have got to do this" and just exhortation which is very cheap. At the end of the day we are concerned with energy efficiency. "Saving the earth starts at home" is the slogan and you shuffle responsibility on to the home owners to insulate their houses. They do not, so they carry on producing carbon dioxide and it is not the Government's fault, because we told you what was happening. The same goes for the whole of precision industry here where, as a kind of act of policy, you are going away from intervention and involvement and encouraging industry directly to develop the industries that we need and the environment in this big growth area, just to one of exhortation which is very cheap but at the end of the day is completely ineffective.

(*Dr Evans*) In the area of environmental technology it is not our intention to reduce DTI's overall commitment of resources to that activity, but to direct our activities at making sure that companies take up the wealth of technology that already exists. For example, we have been supporting some club projects. We supported a project on Merseyside where a dozen different companies came together and looked at their waste arisings. Conclusions from that programme were that without any investment at all, just by improving the management of their operations, they could reduce their waste arisings by 10 per cent. with significant decreases in their costs—because if you are a company you are charged by waste arising, upon wastes that you have to carry away—and with significant reductions in their input costs in terms of less raw materials. If you throw away less waste then you are using your input materials more effectively. It was our experience that there was a wealth of technology, experience and expertise already in existence that companies were not using which they could, with benefit to themselves, use that led us to the conclusion that we in DTI and DoE (because it is a joint DTI/DoE programme which the President announced in December) could best spend those activities on trying to persuade companies to use that technology and get benefits in the here and now, this next financial year, rather than simply to spend money on R&D grants—which I agree is a deserving and worthwhile thing—that inevitably will probably take longer to come through to the bottom line. That was the direction that I have to say in microcosm that thought has underlined many of the changes which we in DTI have been thinking of making.

Chairman: Thank you, Dr Evans, you have handled all the questions virtually on your own. Thank you for being here to do so. Thank you, Dr Keddie and Mr King, for supporting Dr Evans. We are grateful to you. Thank you very much indeed.

[1]See p. 11

SUPPLEMENTARY EVIDENCE FROM DTI (13.6.94)

Q1. *How the DTI proposes to use the innovation scoreboard to analyse the effect of research and development on the profitability and output of industry, with reference to paras 176 to 187 of the Committee's First Report of Session 1993-94 (QQ. 5–23).*

1.1 DTI has facilitated the annual publication of the UK R&D Scoreboard since 1991, as part of the Department's wider activities to encourage improved communications between company management and the financial community. The Scoreboard has had some success in this respect and is increasingly referred by companies, analysts and investors.

1.2 The R&D Scoreboard is primarily a statement of company spending on R&D, which is only one input to the overall innovation process contributing to industrial competitiveness. DTI is, however, very interested in identifying robust output measures which reflect the overall innovativeness of companies and their success in the market place. Towards this end, DTI's Innovation Unit has commissioned separate studies with Warwick Business School (partnered by Stoy Hayward Consulting) and Imperial College Management School, to examine the feasibility of deriving such measures (in particular an Innovation Index) from publicly available data, including R&D expenditure. A key criterion to be met is that any index is regarded as both meaningful and useful by company management, investors and other stakeholders.

1.3 The Warwick Business School/Stoy Hayward approach uses econometric modelling based on Bronwyn Hall's work. The Imperial College Management School approach is a less formal, linear model of innovation and initially has focused on the analysis of new product announcements as a means of measuring overall innovative performance.

1.4 The first phase of each study is nearing completion. Both have made initial promising progress and the respective related consultation exercises have confirmed the need for a new measure of innovation. However it would be premature to judge whether, even with further work, either approach, or some combination of the two, can meet the stated objectives. Depending on the outcome of this further work DTI will decide whether a method for generating an innovation index is worth pursuing, or whether a quite different analysis of company data might be more rewarding.

1.5 With reference to paragraphs 176 to 187 of the Committee's Report (April 1994), the Government's detailed response to the Committee's recommendations will be published in due course.

Q2. *The reaction and contribution of industry to the DTI's Overseas Technology Brokerage Initiative (QQ. 68-70).*

2.1 The term "Overseas Technology Brokerage" is used to describe a range of activities that have the general objectives of making UK firms more aware of scientific and technological developments overseas, encouraging inward transfer of technology, and promoting technological partnerships with overseas firms. At present, Overseas Technology Brokerage covers existing initiatives such as the Overseas Technical Information Service (OTIS), the Overseas Science and Technology Experts Mission Scheme (OSTEMS) and the Engineers to Japan Scheme (EJS).

2.2 DTI plans to expand technology brokerage to a more interactive service which would respond to individual requests, particularly from small companies, for information—about developments, contacts and technology opportunities—and for subsequent local help and assistance. One way these needs could be met is through "industry counsellors" or technology "scouts", located in key countries, which could be tasked by UK firms, thereby providing a one-to-one service, besides providing more general information that could be widely circulated to business, most sensibly through local Business Links (one-stop-shops). Some other countries, most notably Finland, operate an industry counsellor network to great effect.

2.3 To determine how best to proceed, and to seek views from industry about existing overseas technology schemes, DTI has embarked on a programme of twelve regional workshops. At each, between thirty to sixty senior industrialists, typically Managing Directors of small companies, work with professional facilitators and DTI staff to articulate and discuss specific needs. To date, 5 workshops have taken place, which have all been welcomed by firms attending. Early indications suggest that, whilst smaller firms are pleased with existing schemes, they would wish to see more interactive measures to assist with working overseas.

2.4 The reports from the workshops, together with the findings of the current review of the network of Science and Technology sections in Embassies overseas (to be completed before the summer break), will provide a major input to the thinking on technology brokerage. Japan, Germany and the US are the UK's key technology partner countries and it is the intention to pilot new brokerage services in each of these within the coming year.

Q3. *The recent trend in the spending by Government and DTI on link programmes and in the number of such programmes (QQ79–82)*

3.1 DTI annual spend on Link since its inception is:

1988–89	£0.05 million
1989–90	£1.86 million
1990–91	£3.80 million
1991–92	£9.87 million
1992–93	£15.80 million
1993–94	£15.35 million

In 1992-93 DTI spend on LINK reached "steady state". DTI expects to spend about £15-£16 million per year on LINK during the present Public Expenditure Survey (PES) settlement.

3.2 The 39th LINK Programme was approved by the Link Steering Group in February 1994. The number of new LINK Programmes per year since the start of the scheme is as follows:

	New Programmes	of which, DTI Funded
1988	10	9
1989	11	11
1990	6	5
1991	3	3
1992	0	0
1993	5	5
1994	4 (to date)	2 (to date)

28 Programmes are still active ("Live"), and of these, DTI is funding 24.

3.3 Since 1 January 1993, DTI has committed funds to seven new LINK Programmes, as shown below. These Programmes are also being supported by other Government Departments and/or Research Councils.

Date Announced	Title of Programme	DTI Commitment (£ Million)
01.04.93	Biological Treatment of Soil and Water	3.3
30.04.93	Cell Engineering	3.8
15.06.93	Personal Communications	2.4
19.07.93	High Performance Interfaces and Protocols	2.6
07.12.93	Surface Engineering	3.0
26.05.94	Photonics	6.0
To be launched Summer 94	Biochemical Engineering	1.5

Note: The figures represent the amount DTI allocates to a Programme when it is announced. Actual spend on any one LINK Programme (see paragraph 3.1. for DTI's total spend) can be spread over several years.

3.4 Of the 506 LINK projects to date, DTI is a co-sponsor of 435 (86 per cent). 356 projects are still underway ("Live"), and of these, DTI is a co-founder of 256 (71 per cent).

Department of Trade and Industry June 1994

WEDNESDAY 15 JUNE 1994

Members present:

Sir Giles Shaw, in the Chair

Mr Spencer Batiste
Mrs Anne Campbell
Mr Andrew Miller
Mr William Powell
Sir Trevor Skeet
Sir Gerard Vaughan

Examination of Witnesses

RT HON WILLIAM WALDEGRAVE, a Member of the House (Chancellor of the Duchy of Lancaster), SIR JOHN CADOGAN, Director General of Research Councils, SIR WILLIAM STEWART, Government Chief Scientific Adviser and MRS HELEN WILLIAMS, Head of Trans-Departmental Science and Technology Group, Office of Science and Technology, examined.

Chairman

84. Chancellor, you are most welcome again to visit us and to discuss some of our questions in connection with the Forward Look. Before starting the proceedings may I welcome not only yourself but Sir John and in particular, if I may, Sir William and congratulate you most warmly on behalf of the Committee for your excellent work and for the recognition that it has attracted. Many congratulations. May we welcome Helen Williams as well to these proceedings. Chancellor, obviously you would expect our Committee to be most interested in the publication of your Forward Look and to be able to take some soundings, not only of your good self but of others, in connection with it and how it is going to work through and how it sets the scene for development of new policies in the new Department which you head. But I am obviously aware, the Committee is aware, that this is the first and there will follow, as it is committed, others each year. Could you please give us some idea as to how far you think this document, with the coverage that it has and the content matter that it has, how far is it really an embryonic first time shot or how far does it really represent, as it were, a committed style and type of document which will stand the test of time?

(*Mr Waldegrave*) Well, thank you very much, Chairman. Before answering that could I just say that Helen Williams, who is not as familiar to you as the two knights on either side of me, runs our trans-Departmental group and was in charge of the production of the Forward Look. The first thing, if I can say this, is that I regard this session in itself as being a very welcome part of the process because the whole purpose of having an annual Forward Look was to try to raise an annual rhythm of emphasis on the nation's publicly funded science strategy. That, to some extent, depends on others joining in the process, so the fact that the Select Committee is doing so is extremely welcome to me. Although no doubt there will then be things that you will want to say that we are not getting right but an essential part of the thing was to try to get a proper annual debate within Parliament and more widely. Now, how far does the document as it presently exists fulfil the task? Well, not entirely as you rightly say, Chairman, for two reasons I think. The first reason is that we do not yet have results out of the Technology Foresight exercise which I very much hope will be a growing input into this in the years ahead. In that sense it is missing one part of its input. Secondly, as with the whole of the science policy reforms, I am extremely conscious that this is an area where you have to go with consensus to some extent. These are people who we, in the OST, want to try to operate a focus of the science and technology community on so that we will respond to demand to some extent. Bill has been very recently, since the publication, in touch with the network of the science community to try and gather in responses to this: is this the kind of thing that people are looking for and so on. We have had some very satisfying responses in some ways which give us some reason to believe that we are on the right track. The Royal Society said nice things about it, the *New Scientist* said nice things about it. We have had some complimentary letters from people like Richard Sykes and others and I should actually mention the role of the Council for Science and Technology. I do not want to say that this is a document that they take responsibility for, they do not. It is my document but they read it, they contributed ideas, they then read the drafts and they gave it, I think their phrase was, "a general endorsement". They gave us a view that they thought we were on the right lines but we are very much open to further ideas about how to develop it. I am sure the idea is right of trying to mimic the annual debates and concentration on defence that the annual Defence White Paper produces with rather high quality essays and input often and I wanted to try and do the same kind of thing. How we take it forward, I would like the advice of this Committee, I would like the advice of all those who should be the customers for it. We are quite encouraged by the actual sales, if one can mention such a mercantile matter. It sold in the first about the same amount as the old annual review sold in a year. So it is at least stimulating interest.

85. Good. Well as far as this Committee is concerned, Chancellor, we are not going to hold up little cards and say so much for technical merit and so much for artistic impression! We are obviously interested in seeing a workman-like document which progresses each year. Let us take next year: we are glad to hear your commitment that Foresight is

[**Chairman** *Cont*]
playing a part in fashioning the review next time round and obviously that is very welcome but how about taking the five or ten year look based perhaps upon results anticipated? Do you think we can move in that direction?

(*Mr Waldegrave*) I think that one of the methodological areas where we have got more work to do, though we have put down some markers in this in terms of some work,—and your Committee questioned me about this quite rightly I think in the first session we had—is the objective setting and the target setting. How do you know you are succeeding? I am keen on that in general. It is part of our general approach setting, I am keen on it just so long as it does not mean that we invent a lot more forms for people to fill in. We should have some reasonably clear ideas about what we judge as success. Now we laid down some fairly obvious ones in this. We can go into some of those, some of them have to be treated with a little bit of care. We have used the bibliometric tests, we have used various well known international comparison tests and we will want to see us going up in all those things though each one has its own footnote to be attached to it. There are those who are sceptical about bibliometric tests, not without reason in my view. On others, for example, the success of better Departmental/industry/ academic based transfers, I would want to see a steady growth of the kind of programmes involved, such as, the Department of Transport's telematics programme one which is in here. If at the end of three or four years there are not more programmes like that I would want to know the reason why but there is an important additional degree of work to be done by the Office on setting up more measurable performance indicators, if you like, for next year.

86. I think probably what the Committee is desirous of seeing is a sort of commitment to perhaps policy in relation to priorities, for example, so you can say in your Forward Look "This is where we expect to see greater growth, development or achievement". Possibly in Sir John's area of the Councils it may well be that they too could be more precisely focused.

(*Mr Waldegrave*) My own ambition is to be able to say, increasingly, certain areas of effort are ones which we are going to signal resource broadly towards because that does help people to take long term decisions themselves. I must go a little bit carefully because I am not in the business, I do not think the Committee would want me to be in the business, of writing a centralised plan for science, that is not the point. It is at least as much a matter of reporting the directions back and saying what industry feels is necessary, what the scientists are telling us is interesting, and reporting that and then saying how we are responding to the perceived need. It must not be too *dirigiste* or we will get into bad mistakes.

Mrs Campbell

87. That is a good point, I think, for my question which is to do with what you actually found when you were producing the document. We are living in a very rapidly changing economic and social environment with the activities of the research charities in the private sector and I wonder, looking at those, whether you actually found any gaps in the education and training and research activity?

(*Mr Waldegrave*) I think the ones we found were ones which would not be news to you. There is a weakness in our technician training, well recognised in the past, in this country. I am pleased to see the Competitiveness White Paper taking some steps in that area. I would like Bill and John to join in, if they may. As we get further down the road, next year and the year after, we will probably begin focusing rather more, as the information becomes tougher and better based, on things where more needs to be done. You will see the essay written on infrastructure. There are obvious issues there which then lead one into the decisions which had to be taken jointly with the Higher Education Funding Councils about the kind of areas where you do need to be specialised because the infrastructure is so expensive, and where there has to be some planning because otherwise you do not get the expensive kit at all if you just leave it to chance. Perhaps Bill Stewart would like to add something here.

(*Sir William Stewart*) Chairman, the Science and Engineering-Based Co-ordinating Committee is looking very closely now, and will be over the next nine months, at the question of infrastructure. To take some examples; how do you make sure that, looking to the future, you have the buildings which are needed for the next century; how do you ensure that you get adequare consumables for the scientist; to make sure that the students and their best work are adequately supported; how do you make sure that the facilities we have for the very good scientists are more generally available? These are some of the things that we need to look at now that the first stage—the 1994 Forward Look—is over and done with. The 1994 Forward Look was the result of eight to nine months' work immediately following the White Paper. The Chancellor was keen to get a base line established for 1994. It would have been easy to leave it to 1995, but 1994 was the base line on which to build for the future. Over the next nine months we shall be looking at some of these infrastructural areas which are so terribly important, as you were saying, Mrs Campbell.

88. Getting away from the infrastructure and coming back to the research effort for a moment, one of the real problems which universities are facing, I think, is that the squeeze on the funding is making them think much more in terms of income generation possibly rather than knowledge generation. I wonder if you feel that that may cause some imbalance in the future, if it has not done so already?

(*Mr Waldegrave*) I think it is very important. The universities which I visit—the best ones—do not make the mistake that anybody thinks that they should become short-term contract research organisations. We are very keen that they should be doing joint work with industry on the longer-term strategic research, or whatever you call it. We are extremely keen that they should be closely in touch with industry about whether they are training people in the right way. There is a separate debate about the postgraduate training element, but there should also be serious and close contact with the Research Councils and the universities about the content of postgraduate training. I think there were at the

[**Mrs Campbell** *Cont*]
beginning of the 1980s, when the culture change was beginning, people who perhaps thought that what they were supposed to do, or that the best way forward, was to get into short-term things and set themselves up as businesses. One or two of them spun off jolly good businesses, do not misunderstand me. There is an excellent one which I saw the other day, in Edinburgh, which makes excellent miniature cameras and which is a jolly good business. However, that is not really the object of the exercise. The object of the exercise is to build longer-term partnerships with industry about the nature of the education, about the steerage of the strategic and longer-term research element.

Chairman

89. Then you are not worried that that is actually already happening?

(*Mr Waldegrave*) One has to keep an eye on it, but I think it has gone back the other way, on reflection. There was something of that in the early 1980s. I think that universities have settled down to a longer-term and more productive relationship in this area. Do not misunderstand me, I am all for having entrepreneurial university teachers as well who can spin off businesses, and the greatest of them—like Oxford Instruments, for instance,—are national glories, but that is not the only model.

Chairman: That is understood.

Mr Powell

90. There are many who think that the power of your Department really to be able to influence the way in which matters develop in the future is greatly diminished because the research and development budget which the Government has is far too much concentrated on the different individual Departments who will pursue *their* agendas, rather than the co-ordinated approach which we think you are trying to achieve and which we think you may not be able to achieve, simply because you do not have the spending power.

(*Mr Waldegrave*) It is always tempting for any Minister to be offered parts of other Departments! However, taking a deep breath, I am not actually in the empire-building frame of mind in that way. In the run-up to the White Paper we did look at the more centralised models of research and development Departments that there are in some other countries, principally perhaps (it is not actually what it is now) what used to be in Germany. We came to the conclusion that with the implicit undoing of the whole Rothschild doctrine of connection between policy setting and the science underpinning of policy, if we undid that we would be on the wrong track. I do not want to separate the policy Departments from the science which underpins them, by taking responsibility for it myself. The role of the central Department is a more subtle one, a do-able one, which is to use the inter-departmental machinery over which Bill Stewart and I and the Prime Minister preside, now strengthened by the annual round of the Forward Look and with the new institutional structure of the Technology Foresight exercise, to make sure that though people are pursuing their own policy furrows in the individual departments, the whole field is actually being ploughed and there are not bits which are being missed out or bits which are being ploughed twice.

Chairman

91. Forgive me, but does that allow me to ask you are the quotes about Departmental objectives and so on the result of influence from OST on the direction of individual Departments' objectives, or are they the Departments' view unsullied and printed in this document?

(*Mr Waldegrave*) There was quite a lot of interchange. I do not know if I can ask Helen Williams to reply here, because she was doing the work. The process was that they would put something forward, and there was then a dialogue which led to improvement in quite a lot of cases, I think. Would that be fair, Helen?

(*Mrs Williams*) Yes. It is, of course, general government policy that all Government Departments should seek to implement last year's Science and Technology White Paper, which for commissioning Departments has meant an increased effort to get closer to their users and do more to secure the exploitation of their R&D. This year's Forward Look quotes in the first section a number of ways in which Departments are trying to increase the wealth-creation focus of their work, and certainly OST encourages them in that. It is not just OST pushing; Departments, as I say, are pushing too.

(*Mr Waldegrave*) There is a collective policy. We regard ourselves as the guardians of it, but we have all, as a Government, signed up to the White Paper.

Sir Gerard Vaughan

92. Is it possible to ask you to go a little further on this? I understand exactly what you mean about the different Departments, but if you have an overall, national policy, who is in charge of that? Are you able to insist, "This is our agreed national policy" and ask the Departments to fit into it?

(*Mr Waldegrave*) There are two different things. One is the kind of approach to the objectives which Helen was talking about, in that each Department must have coherent plans about how it is going to get a spin-off from what it is doing. There we would have a very powerful position if we saw a Department simply not paying attention to this. I think we would say, "You're not carrying out the Government's policy" and "Excuse me, you've got to do something about it". If it was whether or not the Department of Health was doing enough research into coronary heart disease, that would be a different issue. We might cross-examine and say, "Why is there this much increase, this much decrease?" Ultimately they, with the professionals in the relevant Research Council, will be the proper people to take that decision, I think. We might cross-examine them but ultimately that is their policy.

93. You have chosen a very good example, I understand that. There is a fear though, there is a worry, that so much R&D will be fragmented across too many places and will not have a coherent central strategy.

(*Mr Waldegrave*) I think I should add a third point which is very important and you are right to re-direct

[Sir Gerard Vaughan *Cont]*
me to it which is that we have—and Bill has led this—effectively in some areas from time to time said: "Look there is a trans-Departmental area here where we have got to get together and have a more coherent policy". He has set up working groups to do that.

94. You have made a lot of progress on that.

(*Mr Waldegrave*) That worked well, I do not know whether he would like to talk about one or two? For example, on the whole range of post Rio environmental programmes, there is now a number of lateral groups to ensure that Whitehall more or less aims in the same direction and that there is a coherent policy coming out of that. We would regard ourselves as having a duty to set up such an operation if we thought that some coherence was being lost. Here I might mention another subject. Take a subject like, I do not know what to call it now because the experts always rebuke me when I say super highways because it is all three dimensional and so forth but you know what I mean, the IT and telecoms revolution which is already underway and international. Now Government has various roles in that: regulatory, which is the DTI, and then there is a role which we have picked up at the centre to look at which is to say that, well, the Government is the biggest owner of information in society. There is a whole range of issues to do with the deployment of that information in this new communication network in order to encourage its development. There are lots of things we own that people would like access to but there are issues of data protection and privacy and so on that somebody has got to look at. We have been commissioning work from CCTA, which is just by chance an agency which happens to be responsible to me anyway but it might not be. It was an OST piece of analysis which showed that there was work to do here and we have taken a role in that which does not mean that we are taking away from the DTI their proper regulatory role but there is a central function to do as well.

Sir Trevor Skeet

95. Chancellor, British Aerospace, which is a very significant industry in the United Kingdom, says this in one of their papers: "Government funded R&D is managed by allocation to Departments rather than to output strategies"[1]. Departments are continuing to cut back and so far as the MoD is concerned, which spent half of the total expenditure, they have their mission anyhow. You have not got very much control over them, have you?

(*Mr Waldegrave*) Some Departments—before we go on to MoD and DTI—are not cutting back. The figures show that some Departments have quite a sharp increase in R&D spend: Health does; DoE is quite flat in real terms I think; MAFF about flat and somebody else, Welsh suddenly I am happy to say—since Sir John's arrival—has suddenly started to take R&D seriously. So there are some going up as well. Now, I do not think it would be right for me, would it, it would be an option but it would be a very cumbersome option for the whole business of policy in aerospace to be taken away from DTI and MoD and centralised with us. I am not quite sure how that would work. The policy in buying war planes is bound to stay with MoD and traditionally DTI has been the sponsor Department for civil aerospace. I am not sure, I certainly could not take over the procurement role. Again, I think our role is a little bit more one of cross-examination to see whether the big operation that has gone on in DTI and MoD called "In Step" is done properly.

96. Yes, but, Chancellor, you have cut back, even in the DTI the nuclear energy part has gone. If you take MAFF, which you referred to just a moment ago, there has been a cut in expenditure there from £224 million to £154 million that comes out from an excellent paper provided by IPMS on 3 June[1].

(*Mr Waldegrave*) All the figures are in the Forward Look.

Chairman

97. Whilst you are looking through the papers, the Committee's concern I think is to believe that such a thing as the Forward Look should be able to take a cohesive view of the nation's scientific endeavour, at least that within the public sector, and lay it down in a way that shows that there are significant objectives to be achieved over a period of time through the agencies of various Departments that are handling it.

(*Mr Waldegrave*) That is correct.

98. But your own Department's initiation and catalytic role must surely be towards the consideration of objectives and the setting of priorities, must it not?

(*Mr Waldegrave*) If you take the two we have just discussed, the big cut back and closure of the commercial fast-breeder programme obviously has an impact on the research on that subject in DTI. That was a collective decision of Government to get out of that, it was actually taken I think before my Department was set up.

Sir Trevor Skeet

99. Yes.

(*Mr Waldegrave*) If a similar decision was taken now we would be involved in looking at the science of it but that was fundamentally a decision about energy policy and what was the right commercial strategy for energy policy which it would be. That is not for me to take. The cut back in the defence R&D is again policy led, although incidentally there are some very encouraging things to show about how the DRA believes it is going to get very great output increases, productivity increases, and it is going to be doing just about as many man and woman days of science at the end of these cutbacks as it was before which shows that there may be some organisational improvements to make. They are policy led. Now they may have implications for the science base of the country which impact on us, and that I think is the point you are making, Chairman, and that would be perfectly right for us to say: "Look, here is a rightful thing which is part of the science base which has civil

[1]See p. 52

[1]See p. 54

[Sir Trevor Skeet *Cont]*
applications and so on, we want to know how we are going to handle this".

100. Chancellor, have you got any influence over the MoD in its general expenditure? If the MoD says they must spend money on aircraft and other things, even though they have been very severely cutback, will your weight in that Department carry or will it be their own Ministers?

(*Mr Waldegrave*) What would be the decision? Their decision would be, the research involved decision would probably be, whether to buy one off the shelf or build it yourself and that would be a national policy defence strategic decision.

101. Exactly.

(*Mr Waldegrave*) We would be involved if somebody said: "What are the science implications of it?" but ultimately that is probably a Cabinet decision which we would be part of but it would be very wrong for us to tell them.

Chairman

102. I think we are talking at cross-purposes. Obviously procurement, the purchase of an aircraft or weapons' system or whatever, is understood, but the nation's science base and the technological developments which can flow from a given project which is subsequently cancelled on MoD grounds could well be a matter you would have a role in?

(*Mr Waldegrave*) We might well indeed have a role in saying that there was a particular defence project which was going to be very productive in civil spin-off which had therefore to be considered in a wider contest. That would be a legitimate thing. Bill wants to say something

(*Sir William Stewart*) If I could come in on this? Basically the White Paper set out the broad agenda which was wealth creation, quality of life and a strong science and technology base. The Forward Look will generate some of the output measures. What we are trying to do is to have a collective look at strategy for United Kingdom S&T. That will be decided eventually at Cabinet level. The sub-committee of Cabinet which will be responsible for that will be EDS which is the Ministerial Committee on Science and Technology. They will address the various issues. What we can do in the centre, via the Forward Look and elsewhere, is to determine whether the outputs, which the White Paper has asked the Government Departments to deliver, have actually been taken forward. In relation to the Ministry of Defence I can say that just about three hours ago I had quite an important meeting with the Ministry of Defence to consider issues relevant to how science and technology were developing in that sector. So there is close interaction. If EDS itself is not meeting every week it does not mean to say that there is not communication between Ministers and Officials of EDS Departments on a regular basis.

Mr Batiste

103. I wanted to follow up the Chairman's question as to how it would operate. For example, if MoD decided on procurement grounds it does not wish to proceed with a particular purchase but an area of research which you regard as being important for a civil spin-off would as a consequence be discontinued,then quite clearly there would not be much point in you arguing that the procurement programme should go ahead if there was not a need for it. Would your role in those circumstances be to hive off the proportion of the MoD budget perhaps to DTI or perhaps to your own Department so that what you would regard as a strategically important area for civil research should be continued now free from its MoD connotations?

(*Mr Waldegrave*) I think that would be the strategy one would try to follow. One could say that here is a crucial national asset which happened to be under the aegis of MoD, as it were, but we needed it for other reasons, and how were we going to sponsor it in the future if MoD says that it is a low priority to them?

Chairman

104. It would be perhaps too much, Chancellor, but could one look forward to seeing that kind of inference drawn from Forward Look?

(*Mr Waldegrave*) Yes, but I know what MoD's first reaction would be—"Then you pay for it"!

Mr Miller

105. I was very tempted, in view of your earlier comments, to ask you what energy policy you were referring to, because many of us would argue that the Government does not have an energy policy. However, I shall not follow up on that! I want to move on to the area of public support for engineering and science and some of the ramifications of that. I had a very interesting discussion 10 days ago, during an event celebrating World Environment Day, with Professor Marrs who I think is known to Sir William. One of the offshoots of this discussion which Sir William, I am sure, will agree with is that there does seem to be a much greater understanding amongst the public, of science and engineering, north of the border in Scotland than there is elsewhere in the country. There have been one or two interesting things which have emerged. It appears that since 1986-87 there is a greater understanding amongst the general public, but of course, cutting all the flowery bits aside, the fact is that the government spending on science and technology has fallen substantially since then. Does this really send the right signal to business about the priority which Government attaches to science and technology?

(*Mr Waldegrave*) You have to be quite careful of the figures, as usual. If you look at the DTI figure, which is the one which goes down most, putting aside defence for a moment—which was a big strategic decision that we needed less defence effort, and everybody since has been spending the defence dividend like anything—looking at the DTI figure, there is a fall in it. The two big bits of it come first from the ending of the commercial fast breeder reactor programme, and second from a bit of negative expenditure, namely the income, which is about £50 million a year, from the return on previous launch aid for aerospace. So the spend is actually £50 million higher than it looks, because they have got the income coming in and it is netted off. Plus, of course, there is the European Union. One should not forget that there is, over the period of the Framework Programme, an increase of about £100 million of net

[**Mr Miller** *Cont*]
attributable spend on plausible assumptions and on more plausible assumptions (though doubtless this would be a matter for argument), about another £50 million of that would probably be attributable to DTI. I am not arguing that there is not overall a fall in total government spend on R&D over the coming period. There is a fall. However, the big bits of it are commercial fast breeder programme, defence and the increase in EU Framework Programme.

106. But there is actually a cut?
(*Mr Waldegrave*) Yes.

107. Does this send the right signals to business?
(*Mr Waldegrave*) Yes. I think it could have been a much worse signal. This is controversial, and Sir Trevor and I used to argue about it. We used to be on the same side, because we were great proponents of the nuclear industry. At that point it would have looked odd to industry to go on with the commercial fast breeder. Anyway, a decision was taken, and I think it was the right one. I think it was also right to cut back defence spending overall. It would have been a much odder decision for the civil science community if we had gone on spending as if nothing had happened on the defence side. Meanwhile, the percentage of total spend in the country on non-defence spending is still going up, and that is the biggest matter of all.

Sir Trevor Skeet

108. Chancellor, you have admitted that we are spending less government spending on R&D. When one compares us with other countries, the United Kingdom gross expenditure in 1992 was 2.1 per cent of GDP, in France it was 2.4 per cent, in one of our leading competitors—Germany—it was 2.6 per cent, and in the United States it was 2.7 per cent. Are we doing what we should do as a governmental policy in priming the necessary pump to ensure that our industry is competitive?
(*Mr Waldegrave*) We are the fifth spender in absolute terms, and out of the G7 countries we are fifth too, I think, in percentage terms, in relation to R&D. Those are not too bad. If you look at the figures for the last couple of years there have been some dramatic drops in some of the other countries too. There is huge pressure going on in France now. In 1992 Japan had the first year ever, since their records began, when their business research and development actually fell. So that the fact that we have got our basic research line stable in real terms over the next few years is better than some countries. It is not too bad, I do not think.

109. Minister, are you speaking in cash terms or real terms?
(*Mr Waldegrave*) Real terms on the science budget. There is a fall-off, for the reasons we have been round on defence spend and commercial fast breeder, on total government growth, GOVERD.

110. Yes, but in real terms government spending on science and technology is expected to fall from £6.5 billion in 1986-87 to £5 billion in 1996-97. That looks to be the wrong signal that we are giving to industry. Are you expecting to recoup the loss from industry itself? Are you expecting to do what the Japanese have done?
(*Mr Waldegrave*) The Japanese have gone backwards in the last year. Taking account of the Framework Programme which is rising—that is, rather more being done in Europe, which is probably sensible—the Government's plans allowed for a rise in cash of £5.6 billion to £5.7 billion, which is a small increase of 1 per cent between 1992-93 and 1996-97. That is a real-terms reduction, of course, but it is a slight cash increase. However, for the reasons which I will not repeat again, though they are policy-led reasons, it is not that the whole thing is being cut, but we have got out of commercial fast breeder (sad, but right), we are cutting back defence spend, and there is net income from launch aid, which confuses the figure, plus there is more being done in Europe. So that is not too bad.

Mrs Campbell

111. Chancellor, can I pick you up on these points you have been making about the fast breeder reactor and also the income from launch aid. It was over the period 1986-87 to 1991-92 when the Department of Energy was separate from DTI and covered nuclear expenditure. DTI expenditure during that period actually declined from £462 million down to £330 million, did it not, before 1992, in cash terms?
(*Mr Waldegrave*) Yes.

112. That cannot be explained by the cancellation of the fast breeder reactor. There has been a massive fall in DTI spending in real terms on R&D, has there not?
(*Mr Waldegrave*) There is a fall. I am not arguing that there is not. The biggest bits of it, though—and I was concentrating on what was actually going to happen next—were for the reasons I have said. They have also quite explicitly said that they wish to shift their policy to some extent from the generation of technologies to the dissemination of technologies, and they have increased their spend on dissemination. I have heard the President use this argument, and it is not at all a bad argument. In terms of their contribution to the generation of civil/industrial technologies, it was really very small, but they could have an absolutely crucial role in terms of dissemination which is after all what everybody says, rightly, is the principal task, particularly in relation to small and medium-size enterprises.

Chairman

113. May I ask a supplementary on that? Chancellor, would not the DTI's role and its perception of its role being changed mean that you yourself and OST would end up funding most industrial research, and would that not be a good thing?
(*Mr Waldegrave*) No. It is arguable whether it is the Government's task at all to fund industrial research. They can be in partnership sometimes with it. Our job is not to do that; our job is to maintain the science and engineering base. I do believe that there is a proper role—and this is the theme of the White Paper—for bringing decision-taking about the science and engineering base and industrial decisions closer together, particularly in the strategic or generic area which I regard as a part of something to which

[**Chairman** *Cont*]
the science and engineering base makes a big contribution. I believe that we should be working much more closely with industry. I do not believe that my Department—and I am not sure I believe that any Government Department—should be doing industrial research that firms should be doing themselves. It is one of the encouraging things even about this last recession which is that British business has been rather more protective of its R&D as far as the figures show than in previous recessions which is good.

114. Understood. Just finally on that point: your role in protecting the science base is a little distant from the fact if industry itself is not prepared to support it.

(*Mr Waldegrave*) If you look at the beginning of the Forward Look you get some rather good figures. Although I am always urging industry to do more, our national civil effort stands up quite well. It is just about the same in percentage terms as France, I think there is 0.1 per cent between them. Again, British business has actually been doing rather well. The table I have is the one right at the beginning.

Mrs Campbell

115. Just to take this on a little further, Chancellor: when the DTI transfers money from its R&D budget to its dissemination budget, would you not say that that is actually sending a rather poor signal to industry? We are not advising industry to switch money from R&D to marketing so why is the Government?

(*Mr Waldegrave*) It is not marketing, it is dissemination of technology. I was talking to the research director of one of our biggest companies the other day who said exactly that, that even within his own great company—John might like to talk to this having run such a thing—that one of the main problems is to get the technology that exists used. That is a real task within big companies let alone transferring it from the science base through application. The figures I was looking at: BERD, international comparisons of BERD, we are 1.3 per cent of GDP, France is 1.4, Italy is 0.8, Japan is very high of course 2.1, Canada 0.8 and USA 1.9. We are in the game. I want British businesses to do even better but they are not doing as badly as you think.

Chairman

116. Would Sir John care to comment on that?

(*Sir John Cadogan*) It is certainly extremely difficult to convert knowledge and technology from the science base into making money, whether it be in the universities or in industry. I certainly found that from my experience, I used to think when I was in university research that the most difficult thing in the world was to do first class research. I discovered after being an industrialist that there was something which was even more difficult and that was to turn first class research, even in an industrial company, into something which would deliver in the market place. So the transfer of knowledge and skills with the people into the marketing end is really the major target for industry but they cannot do that unless they have a good strategic research base on which to draw.

(*Mr Waldegrave*) Putting it again in context, British Enterprise R&D is just under £8 billion a year, the DTI is going to spend plus or minus another £100 million maybe. It is not going to make it a transformation factor but if they are going to put that £100 million into really good networks which will reach small and medium sized companies and it might actually be possible to make a really big difference then I think we are doing something extremely useful.

Mr Batiste

117. When companies produce a business plan they very often produce success/failure criteria by which they can judge whether they are making progress against their policies and their objectives. Now earlier on in your evidence you dealt with this question of measurability of targets and you spoke of international comparisons and you spoke of the bibliometric test. Is that the limit—

(*Mr Waldegrave*) No.

118.—which you wish to make? In other words, in a year or two's time as the process develops are we going to find a series of more specific success/failure criteria built into a plan so that when we sit here we will actually be able to measure performance against stated objective?

(*Mr Waldegrave*) I put that alongside getting the technology foresight working and into our influencing of things, really I think as my second priority. I am very conscious there is much more work to do. It is a quite difficult subject. I am anxious not to have people spending even more time filling in forms.

119. Sure.

(*Mr Waldegrave*) I think there is a lot more we can do. We have been consulting, we have been talking to various academics who are expert in this area. There is a lot more to be done. I would be very interested in advice from the community on which one would actually carry weight because we want to have measurements that people own and accept and think are realistic. I am conscious that we are only at the beginning of this process. If I can just make one more footnote: there has to be room in it, when you are supporting really excellent basic science for just saying: "We are supporting brilliance, and maybe one day that will lead to Watson and Crick but we cannot measure that at the moment". So there is a back end of the spectrum, we just have to find very, very good people for that.

120. We will be able in the future to look at the various portions of the delivery of your policy and be able to match that against the expectations which you have from the outset?

(*Mr Waldegrave*) Yes, and I think it becomes most relevant in the areas where we are trying to do things jointly with industry and setting ourselves projects that relate to outputs which lead to wealth creation.

Mrs Campbell

121. Coming back again to private sector R&D spending, I would be very interested to know whether the Government actually has a target for the level that they would like to see for R&D spending? Can I

[**Mrs Campbell** *Cont*]
just feed in another question at the same time. Coming back again to the dissemination of information, which I accept I am not expecting you to be answerable to the Department of Trade and Industry but I think perhaps you could comment on certainly remarks which I have had from firms that in the cancellation of the advance technology programme, which was targeted help for specific well-thought of firms, what is happening is that there is an amount of money being very thinly spread. What firms have said to me is that the money is being so thinly spread that what it amounts to is one glossy leaflet per firm which is worse than useless.

(*Mr Waldegrave*) I think that is why the President—who is one politician who does not need anybody to speak for him—would say if you asked him would be: "Exactly" and that it is far better to put that money, which is not going to be significant in that kind of area, into something where you can really make a difference and that on top of that £8 billion that business is spending themselves on the acquisition of the technologies and the development of the technologies they need we in DTI should not be giving it as one of our objectives to do their work for them. But there is something else which is a weakness of British structure, that we are poor at dissemination, particularly we are poor at dissemination in the medium and small sized companies. I think I and the President can make a real difference there.

122. Do you have a target for R&D spending?

(*Mr Waldegrave*) For companies, no I do not think that would be meaningful. I think it is quite interesting to compare individual companies. You have to make sure that the profile of the company is the same and then look at their best international competitor and see what they have spent. Without causing any trouble I think the company that does best in this country if you really look at it like that is Rolls Royce and not many others do as well.

Mr Powell

123. A month ago we had officials from the DTI come to give evidence before us. Their evidence was that they saw the role of the DTI as focusing around the area of providing an environment that is a broad framework within which companies can be encouraged to innovate. Are you content that this should be the main role of the DTI or do you envisage that your Department can complement it by concentrating on providing a more direct support for United Kingdom science and technology?

(*Mr Waldegrave*) I think that is a sensible division of labour, that they should be the leaders and the expert in innovation policy because at the marketing end they are involved in trade promotions, they are involved in all the things towards that end of the spectrum. Our contribution is to keep the science base healthy and I believe it can be healthy and be more useful to industry by the much closer networking relationships I am trying to build. I think it is sensible that they should be the innovation Department and in so far as Government can help in this, which it can in dissemination and it can in creating sensible structures of one kind or another, the Department that is accountable for trying to turn ideas into products which I do not think is my Department. I think my Department is a step back from that and is responsible for ensuring that the work we are doing on the underpinning of science and technology is the right work.

(*Sir William Stewart*) In relation to the role of the science and engineering base, it seems to me that as one looks at the pace of technological change and as one looks at what industry is actually seeking from the system, they will say that they need bright innovative people with good ideas with whom they can interact. One of the things that we have to do in the United Kingdom is to sustain that strong science and engineering base. I thought it was helpful that the Prime Minister at the Parliamentary and Scientific Committee lunch actually emphasised that the science and engineering base would be a priority because looking to the future, that is where the interaction is going to be and where a lot of the new R&D—which will generate wealth—is going to come from. The question of exploiting that R&D in various areas is not a question for the science base. It is a question for industry.

Mr Batiste

124. Our research effort in the United Kingdom is only a very small proportion of what goes on in the world at large, and you draw attention to that yourself in your paper. Would you say that it was a fair reading of the DTI's White Paper on Competitiveness, read alongside your paper, that on the whole, though there are some very considerable areas of exception, United Kingdom companies are *less* successful than, say, Americans or Japanese in plugging themselves into and taking advantage of developments on the world science base?

(*Mr Waldegrave*) I think that the best of the Japanese companies and the best of the American companies are fantastically strong in this area, and the resilience of the American economy within the last few years, their repositioning themselves some years ahead of the Japanese in terms of some of the IT functions, is a phenomenal achievement. I was incredibly impressed with what I saw of the atmosphere inside the best Japanese companies who do a lot of basic research themselves, of course. It is some of their intimacy of relationship between original work and people who are involved in marketing and making products that I want to try to reproduce in our rather different structures.

125. How do you believe that can be achieved? There must be enormous scope for achieving it.

(*Mr Waldegrave*) That, in a way, is the drive of the whole White Paper; it is to try to say that although our institutional structures cannot, and should not, be dramatically overturned overnight, because you do great damage if you try to do that, if we can build the kind of intimacy of contact between the best original researchers and the marketing people in the way that we have seen inside the best Japanese firms, then maybe we will be able to match better what Bill has been talking about which means getting better product development than we have been getting. There are some quite dramatic figures about the speed of innovation and the pace of innovation.

126. Would you agree with the point which we made in our last report that the ability of a company

[Mr Batiste *Cont*]
to undertake its own research is important not only in the context of the research which it actually does but in its ability to interpret developments elsewhere in the world, and that it is one of the failings in the United Kingdom that we do not do enough research in-house in the companies themselves?

(*Mr Waldegrave*) Yes. I have said it in public before and I say it again now. I think we have some very good companies at the top, and if we had another 100 as good as the best 10 then we would be much better off. We particularly lack enough really good medium-sized high-tech companies which are often the quickest moving and most innovative. I wish we had another 100 Oxford Instruments.

Sir Trevor Skeet

127. You talk about the best and you compare them with the best abroad. What we are concerned with, of course, is the average.

(*Mr Waldegrave*) I agree.

128. If you take the United Kingdom, Business Enterprise R&D is £7.9 billion, is it not?

(*Mr Waldegrave*) Yes.

129. Is not this a rather urgent matter? We have to catch up with these people. Why concentrate on the best? You have to concentrate on the average right throughout the field, do you not?

(*Mr Waldegrave*) I think that one reason for concentrating on the best is that you can sometimes learn from that—which is what I tried to do in the White Paper—what kind of approach does the Glaxo, the Rolls-Royce and the ICI use in this area, and can we do things which make it easier for us to do the same. You have quoted the two phenomenally best ones. Japan is, of course, odd in its profile; it has a relatively rather low government spend, lower than ours, as a proportion of GDP. America is the other one. Incidentally, there is a defence element too in what happens in private R&D, not surprisingly. There is a falling off of some R&D in some of our defence-based firms, in exact parallel with the defence cutback. I do not think I am arguing with you, Sir Trevor, in the sense that you are absolutely right, it is the big number, the average, that you want to get better, and that is the thrust of the whole of the White Paper.

Chairman

130. Chancellor, in paragraph 5.15 in your Forward Look you refer to "during this year the OST will agree with Departments a series of output measures and performance indicators against which the scientific achievements of Departments in respect of wealth creation and other quality of life objectives will be assessed." How are you getting on with that, and what sort of indicators are you considering?

(*Mr Waldegrave*) Perhaps I could ask Helen to give an account of that. She has to do the work. All I would say is that, as I said to Mr Batiste, I think that is a very high priority for us. It is quite difficult work, but it is beginning.

(*Mrs Williams*) Chairman, I have to say that it is early days. We put an enormous amount of effort into producing this Forward Look, and we are now looking forward to the 1995 Forward Look. We have set up a group under the auspices of the official committee on S&T which is chaired by Sir William Stewart. One of the tasks of that group will be to work with other Departments to develop output measures—for example, the volume of collaborative research which Departments are undertaking with their users, particularly industrial users, measures of the extent to which Departmentally supported R&D is being turned into marketable products and processes. We hope to get some measures of that.

131. So you have some indicators being developed, have you?

(*Mrs Williams*) We have some indicators in mind.

132. The statement was made that you will do it within this year.

(*Mr Waldegrave*) We have to make some measurable progress. This is an indicator for us. We have to jolly well make it clear that by the time this document's successor comes out we have rather more to say on this subject.

Mrs Campbell

133. Chancellor, one of the areas which I am sure you will agree is important when you are devising performance indicators is the flow of scientists, technologists and engineers into the policy-making areas of Government. You are obviously very well aware of that at the present time. In view of the Government's intention perhaps to rearrange government research laboratories, are you confident that that flow of scientific expertise will continue up to the higher echelons of Government and be able to continue taking on that policy role?

(*Mr Waldegrave*) It is very important that it should, and any changes of an institutional kind which are to be made will need to have that as one criterion. The quality of policy advice to Ministers and to senior decision-takers in this area must not become worse; if possible, it has to get better. On the other hand, I do not want at all to minimise the fact that, if possible, I want to spend more on science and less on structures and administration. If we can save money on actual structures and administration, then the better for that.

Chairman: You have hit a chord with the Committee!

Sir Gerard Vaughan

134. In the same accurately-worded paragraph, paragraph 5, you talk about reward systems and say that "Reward systems should take into account the value of research". This is for industry. What are these reward systems? What do you have in mind?

(*Mr Waldegrave*) Money is one of them. We should be taking into account the fact that, for example, university departments which do well in winning serious industrial R&D should benefit out of the research assessment systems. Bill Stewart's Science and Engineering Base Co-ordinating Committee has done good work on that. You can hear passionate and admirable evangelism on that from Professor Bhattacharyya of Warwick University, for example.

Chairman

135. We have already heard it!

(*Mr Waldegrave*) That is one line. John Cadogan invented for me an admirable scheme which we call the ROPA scheme, which provides an actual piece of reward in terms of backing for their own science for those researchers who win good peer-group assessed, properly controlled contracts from industry. We now put some money alongside them to say, "You've been chosen, you've been judged by hard-headed industrial characters as good people for developing this. We'll give you some money alongside to do your own work which may or may not be related to that." That is a reward. Most scientists find, in my experience, that the best reward is to be allowed to do more science, so that is a good reward structure, along with things like that.

Sir Gerard Vaughan

136. You are going to channel extra money into directions which you think are valuable for general industrial development, is that right?

(*Mr Waldegrave*) In that case it is not what I think is of industrial value. We have contracts won by people whom the industrialists have valued, so it is their judgment. They know more about markets than I do, but if they are good scientists we are saying, "If somebody else outside—the research director of Glaxo—says you are a very good team, we will give you a bit of extra money to do alongside that some of the things that Glaxo may not want to pay to do".

137. Do you have a budget in mind?

(*Mr Waldegrave*) On that particular scheme—there is a whole range of schemes, I just mentioned that one because it is new—John invented it, it started experimentally and it has gone so well that we have already doubled the money for it to about £10 million. That started as an experimental scheme. Alongside that there is LINK and there are the Teaching Company Awards, there is a whole range of things there. Perhaps most important of all is the incentivisation of the whole system through the HEFCs in terms of rewarding those who do rather well in winning industrial support whereas they did not actually get much recognition for that under the old structure. That was not, I believe I am right in saying, taken specifically into account in their research assessment exercise which seemed to me very unfair.

Mr Miller

138. Sir Gerard just now praised the language in part of paragraph five, if I can take issue with you in terms of paragraph 5.11 and refer you to a sentence of Whitehall-speak in the middle which says: "They record..." referring to the table "... Department by Department, the proportion of Departments' statutory, regulatory, policy making and procurement S&T that is being commissioned through robust contractual mechanisms and the extent to which that work is being exposed to market forces through competitive tendering". I think it will be helpful, Chancellor, if you are able to describe what these robust contractual mechanisms are and if you can would it be helpful if next year's Forward Look sets the targets for the amounts of Departmental science and technology work commissioned through these mechanisms in addition to the performance indicators included this year?

(*Mr Waldegrave*) The robust mechanisms, this is where the whole customer-contractor mechanism started in Government with the Rothschild doctrine in the 1971 White Paper and has spread beneficially from there into all sorts of, at that time, unexpected directions. I firmly believe that putting aside the basic research area, which Rothschild said was not relevant to this doctrine at all, that private customer-contractor relationship is extremely beneficial for Departments. I want to see that there is a level playing field between universities where there are some private sector research institutes, and Government's own research laboratories when those decisions are made. Those are the mechanisms and we will, I am sure, be reporting in the same way next year on the percentage of things that are treated in that way.

(*Mrs Williams*) Yes.

(*Mr Waldegrave*) Does Bill want to say anything?

(*Sir William Stewart*) It is fair to say that more and more of the contracts—the work needed by Departments—is being commissioned on a customer-contractor principle. Even more recent data than those in the Forward Look show that to be the case. However, I am not very sure about targets, because a target depends on the science, and on the resource that is available etc. and I do not think we should be setting artificial targets if the quality of those who can carry out the research is not there. In some areas the target might be high and in other areas it might be low. It depends on the quality of the scientists and the service that they can provide.

Mr Batiste

139. You must have some ideas, for example, in OST how much you would expect to be able to save by robust contractual mechanisms?

(*Mr Waldegrave*) How much we will be able to save? Well I do not know whether Sir John, as the first Director-General of Research Councils, would like to have a word about this. I do not think he has set himself any targets but he will be pretty robust, I hope, about looking at the structures of the research councils to see whether any more money can be found for the science. There are various models, are there not? You can privatise something if that is sensible with a long term contract maybe to launch it, you can contractorise the management which the Ministry of Defence has done for example at Aldermaston and the Americans are doing at various big laboratories. You can set things up as not for profit companies which can be a good model so you get management freedom and so on. So there are various different models depending on the kind of work that is done, the objective being to save unnecessary administrative costs and to get better management.

140. One of the inevitable by-products of this, as you said, is the greater use of independent research organisations where they exist. One of the concerns expressed by such organisations is that those who are making the decisions are so orientated towards public sector organisations, particularly the universities, and the network of communication to

[Mr Batiste *Cont]*
what is being done is so much more effective as it flows towards universities that the research organisations find themselves at a disadvantage. Do you think that is fair?

(*Mr Waldegrave*) I think that it is very important that that sector—small but growing—and with some very high quality operations in it, should get a fair crack at the whip, I do. There are some very interesting things. Smith Systems Industries, for example, just to take the first one that comes to mind, have set up a little institute with the Mathematics Department in Cambridge.

141. Yes, we visited it.

(*Mr Waldegrave*) You have been there already. That kind of thing is extremely attractive and they may well do work which could attract the attention of a commissioning research council, why not?

Sir Gerard Vaughan

142. You talk about the wealth creation mission for research councils, you also talk about the need not to stifle poor research, basic research, which is not necessarily short term wealth creation. Can you explain to us how you are going to ensure that?

(*Mr Waldegrave*) Well it is a matter of balance, is it not? I firmly believe, we made it clear in the missions of all the research councils that they have a duty to the health of the underpinning science which means that all of them, for example, have to keep an eye on whether enough people are being trained in the basic disciplines and mathematics. There is no magic formula, particularly as Mr Batiste is quite right to say, we must always keep an eye on the fact that we are doing quite a small part of world research. Professor Stewart is right to say that there is no point at all, you cannot set a target for how much research you are going to do in astrophysics or whatever it is, it depends if you have got good people. If you have not you are completely wasting your time and it would be better not to do that. Happily that is a very poor example for me to use because we have some extremely good people in astrophysics. So I do not have any underlying proportion of those things that are pure real basic work and those things that are generic or strategic. I am increasingly dissatisfied with these categories. I am not sure that Mr Frascati did us a service with all these categories actually because they overlap so much and basic work can be done in a very mission-orientated way sometimes. You know you have to solve very basic problems sometimes to give an answer to an immediate pressing issue that you want solved and on other occasions your basic research may be much more long term and speculative. I am not sure that there is an answer to your question I think is what I am saying.

143. Unless you set out a priority to safeguard what you call curiosity-driven research it is going to get swamped, is it not, by all the more immediate pressures of other kinds of research?

(*Mr Waldegrave*) No, I can give you that guarantee. We regard the doing of things that only Government can do—because they are more longer term than firms can plausibly persuade their shareholders to fund in our context anyway, the Japanese do some of it—as our essential duty. There are two rooms for manoeuvre: one is are we good enough in that particular area for it to be worthwhile doing it and, secondly, in the generic or strategic areas where you have already got an eye to applications of developments and spin-offs and so on, are we doing the right ones that our own industry can actually appropriate?

Chairman

144. Can we ask Sir John to lead on from that: research councils have their missions, they are all set up and really to some extent Sir John's role I assume seems to include they stick to the fact they have their curiosity-driven overlay as well as their direct research and development.

(*Sir John Cadogan*) I take my brief from paragraph 5.26 which very clearly sets out the position, Government's position, which I intend to carry out as best I can. It begins by saying: "This is not to say the science and engineering base should be converted into short term problem solvers for industrial customers ..." and so on. We have a lot of users on research councils but we also have a lot of people from the science base and they will be constantly bearing this in mind. I and my colleagues will also have to constantly bear this in mind. The ROPA scheme to which the Chancellor referred, of course, is a classic. We are countering the danger of industrialists and academics, going shortterm, by getting so close that the academics work with the industrialists. We are countering that and balancing it by actually giving the academics cash, providing it is good science, to do exactly what they please. So for every pound which goes in from industry, which we might argue is short term, we are giving them cash. We are excluding from that anything which smacks of a short-term contract. If industry says to Dr X, "Make me a widget", those people would not qualify for support for this kind of focussed research. So the very fact that the Chancellor is prepared to put cash into this which is going into people's blue-sky ideas is the very best evidence you can have that we are going to safeguard this kind of capability.

145. Has industry welcomed this approach?

(*Sir John Cadogan*) We have not got a complete survey yet, because one of the advantages is that we pushed the scheme through very quickly—it has been five weeks from beginning to end. Many of the industrialists we have consulted have reported that they like it very much, they think it is very, very good. Some of them have said to their colleagues who have been successful, "If you get a ROPA we'll give you more money so that you can get a ROPA next time, because we want to get alongside you people who've now got freedom to carry out these great ideas." That was a bonus.

Sir Gerard Vaughan

146. Next year you will set these out and specify these amounts, will you not?

(*Sir John Cadogan*) The programme this year was £10 million. It started at £5 million. Indeed, the Research Council has put more money in to make it a bigger sum. The Chancellor has agreed in principle that next year we should extend this scheme to all Councils right across the piece.

Chairman

147. It is restricted to certain Councils at the moment, is it?

(*Sir John Cadogan*) It is a pilot within three Councils, just to see what happens. Next year we would hope to go further. Of course, that is going to depend on the outcome of the PES bid and how much money is going to be available, but we would like to see it increased.

Sir Trevor Skeet

148. Minister, you have indicated earlier that industry should finance work for their own benefit, and I think that that makes very good sense, but how does that fit in with the missions of the Research Councils? Will they not be doing a lot of work which is for the profit of the companies involved, which should be borne by industry?

(*Mr Waldegrave*) It is very difficult, I think, to make hard-and-fast rules about where it stops exactly, and it may vary from different kind of activity to different kind of activity, but we should not be spending money on things which firms should be doing themselves. That is the principle. I rather deliberately tried to get away from the doctrine which was about in the mid-1980s which said that nobody in the science base should do anything which was at all applied, because there may be in some areas very interesting intellectual applied work which is good stuff for the science base to be doing, so it is rather hard to make an absolute and clear decision. That produced a very odd reaction in universities of saying, "Oh well, if ever we do anything useful we're in trouble", which is a very bad signal to produce. Of course, one way of finding out where the balance lies will be who owns what share of the intellectual property and so on, is it publishable and all that sort of thing.

149. Surely you must take into account that the figures which I read out to you in terms of Business Enterprise R&D show that the United States and Japan are well ahead of us? Would you not do some pump-priming there to ensure that we catch up with them?

(*Mr Waldegrave*) I would love to catch up with the very best, but there are not that many areas in the world where Britain can very firmly say we are the fifth best out of the whole world. I would like to be *the* best, I quite agree, but we are still a very big player in this area. The direction slowly, slowly through the 1980s has been going in the right way. Perhaps even when we come to get the full figures of the dip which has happened in the recession, it will show that the tendency is in the right direction. If we can encourage it further by making more partnerships with these people, making our own science base more successful, helping to change the culture on both sides of the divide, I hope we may reinforce that upward line. I am with you, though. Of course we would like to be first.

Chairman

150. Can I ask a question of a rather nit-picking kind but useful to the Select Committee with its eye on expenditure? We would like to hear what scope there is for reducing the administrative cost of this new and splendid range of Research Councils, in order that more money should go on scientific research endeavour and less on administration. Perhaps you can give us some figures?

(*Mr Waldegrave*) I would like to hear it too! That is what Sir John is there for.

(*Sir John Cadogan*) Not yet!

151. They are not available yet?

(*Sir John Cadogan*) I am conducting what we call a zero-based review of the Research Councils' activities. That is with, I must say, full co-operation and enthusiasm from Research Councils. The object is to see how we can spend our money more effectively in frontline science, technology and scholarship. That, of course, includes the whole issue of efficiencies, cross-Council savings, size of headquarters, systems, mechanisms for deciding. All the Councils are looking at this now. I think I would say watch this space for the PES review next year.

Chairman: Very good. You can guarantee that we shall keep a close watch on this matter.

Mrs Campbell

152. Sir John, when you have made these huge cuts in administrative costs, will you consider spending some of it on recommendations made in Rising Tide which were to bring about the promotion of women to science and technology? Or is that a question for the Chancellor?

(*Mr Waldegrave*) It is a question for me. The answer is that we will be responding very quickly, in very short order, to that report. Without setting out new administrative structures to spend any administrative savings we have made in the old administrative structures, which would be rather paradoxical, I think there is some carefully deployed seedcorn money which might be available there. However, we have not actually issued our response to that yet. I do not want to set up new bureaucracies which may be of limited effect, just in order to save a set amount. I want to change things, and some of that is outside my control.

153. I think there is disappointment, though, that there has been no response to that.

(*Mr Waldegrave*) There will be a response very shortly on that, I can assure you.

Mr Batiste

154. European Union programmes are taking an increasing share of the science and technology budget. I would like to ask you two questions in relation to that European end. The first is to what extent do you consider they give as good value for money as your own domestic programmes? The second is to what extent do you consider that they are complementary to your own strategic objectives and to what extent irrelevant to them?

(*Mr Waldegrave*) On the first, it varies a bit from programme to programme. We have had some continuing complaints about the way in which Brussels has handled some of the administration, but on the whole we are supporters of this programme, we think it is a good programme and does work of a really valuable kind often in bringing together networks of Europeanwide companies in a way which gives good hope that one might be able to

[**Mr Batiste** *Cont*]
challenge some of the mechanisms in Japan and the United States in due course. Though not everything in it is perfect and we are constantly on the watch to see that the programme is not diverted towards a cohesion theory of spending things for social ends—it must be an R&D programme, an S&T programme—we are reasonably satisfied with it. We are also very proud of the fact that Britain gets back more than it puts in, we estimate. This is not a programme run on a *juste retour* basis. What we have been doing is better than a *juste retour*. I am also proud of the fact that somebody did a survey of who was the preferred scientist to work with. They asked each partner. Britain was the only country which scored the number one slot in both France and Germany, and I think we were the only country where most people liked working with our scientists. That certainly does complement what we are doing at home. The test of that is how much we got our own priorities into the structure of the thing, and we did. We did really rather well getting, for example, into the biotechnology and industrial technology fields and so forth, getting money into the material sciences area and IT. So we are pretty satisfied with the shape of that programme now. We argued, paradoxically perhaps, it might surprise people, for a little bit more money to go on social sciences. We actually think that there is a real issue of technology change, if you like, which is a social science subject which is worth spending some monies on and the ESRC is spending money on. But, apart from that, it is a very small part of the programme and we are rather satisfied with the overall balance.

155. You would say then your policy in this area, your achievements in this area, are an indication of the approach that we benefit more from European programmes if we get in there and help to structure and shape them from the beginning rather than coming in too late because if we get in early it comes out in our priorities and not unnaturally it is our own scientists and their own companies which will be focused on with that?

(*Mr Waldegrave*) I think if you wanted a classic argument for the Union of R&D, the Framework Programme is a good one. They are still quite small. As Commissioner Ruberti is fond of reminding us it is only four per cent of European science but they do a very valuable job in networking together and if you take them together with various other things which are not Union programmes but are European, like some of the basic science programmes such as CERN and like EUREKA at the other end, there is a whole collection of things which are valuable here and a good argument for European co-operation.

Mrs Campbell

156. Is it not the case though, Chancellor, that in the United Kingdom we have gone a good deal further than other Member States in separating, privatising and contracting out public research activities? What I am concerned about is the EC Directive 92/50 which is the one which deals with contracts worth at least 200,000 ecus which means those contracts have to be advertised in the EC official journal. Is there not a serious danger that United Kingdom public research establishments will be exposed to much greater competition without reciprocal opportunities that would occur if other Member States had gone as far as we had? Do you not see a great danger there in endangering our public research infrastructure as a result?

(*Mr Waldegrave*) I am aware of this issue, it is a real issue. There are, however, some things which can be done legally in the way contracts are structured, particularly if they are in basic research, which mitigate it. There is an issue here. It is a classic issue. It is an issue in other procurement areas too where we have liberalised and others may not have done so, outside science. Ultimately, of course, we believe that we will be getting the best value for society as a whole, for the taxpayers, but we do not want to put our own people at a disadvantage in winning a fair share. We have various ways of mitigating the damage. Others are now catching up with us in some of these areas I am happy to say so there will be a greater opening up all round, I think. If I can add one thing: in the Fourth Framework Programme, we have pressed very hard successfully with powerful help from the French and from the Germans, to open up JRC to far more competitive activity and that will be very good for it in the long term.

157. Does mitigating the damage mean ignoring the Directive?

(*Mr Waldegrave*) No, no, you cannot break the law but there are ways of proceeding sensibly.

Mr Miller

158. Chancellor, you said you do not want to put our own people at a disadvantage in the context of this area. I am constantly reminded, because I can see it from my back garden at home, of the research laboratory at Daresbury and they would be a group of people who say they have been put at a disadvantage.

(*Mr Waldegrave*) That is a different issue. That was a strategic decision to close something.

159. Okay. That was a strategic decision based upon directing the funds elsewhere.

(*Mr Waldegrave*) Yes.

160. Is there a danger that too much may be spent on international collaborative programmes, the very big expensive areas, a tremendous challenge to determine whether an international project on particle physics or astronomy should go ahead? Is there a danger that that will damage our own base?

(*Mr Waldegrave*) I think, without giving any secrets, I can say the meeting that we just came from, John Cadogan and I, was about the future of the LHC and it was aimed at the following objective: we would like the LHC to go ahead. I think on scientific grounds it is a good project but I am going to be extremely adamantine and so are other partners, above all the Germans, in seeing that there is really ruthless cost control in that programme because it is so big that not just us but the whole of Europe's science base can be overbalanced unless the cost control is rigorous. We also want to see wider international participation in it, of which there is some hope now from the US and Japan and perhaps Canada. We also want to see the Spanish pay their bills.

[**Mr Miller** *Cont*]

161. Is it your approach not to put our own people at a disadvantage or is it the exploitation of science, what comes first?

(*Mr Waldegrave*) This is a classic piece of the real true science base. If we find the Higgs Boson that this is not a quantifiable industrial spin-off, although there are some good contracts to win for people who supply equipment, this is real basic pure science of the most exciting kind. But it cannot be regarded as having to keep Europe in check. The British particle physics community wants it but even they will say: "Rigorous cost control" because otherwise there will not be enough money left in anybody's system actually to use the experiments apart from anything else. Sir John, who is closely in touch with this, might like to add a word. I would re-emphasise I think the experiment should go ahead but cost controls have got to be really tough.

(*Sir John Cadogan*) I have nothing to add to that.

Sir Trevor Skeet

162. Minister, a few years ago when we were contemplating pulling out of CERN no other country was wishing to take this course and we did not take it either. Now as the Americans are not going ahead with their major project they obviously should participate in Europe and carry some of the burden.

(*Mr Waldegrave*) I believe you are entirely right, Sir Trevor, their own particle physics community would like to and Dr Krebs, who is the relevant officer in the OSTP in the US said yesterday to the Congress that she would like to be given permission by the Congress to negotiate participation. So I hope there is good hope but since that last period there has been terrific stress on other people's budgets too, above all in Germany. The German Minister told me over the weekend that he has 39 scientists applying for every job in Germany at the moment because of the collapse of East German science and engineering. They have a serious crisis, they are not in the same mood that they were a few years back, and others too. The demands are very great.

Chairman: Chancellor, thank you for the time you have given us and for answering our questions. May I say thank you too to Sir William and Sir John and Helen Williams for kindly coming here and helping us with our inquiry. You are very welcome here. Thank you very much.

WEDNESDAY 22 JUNE 1994

Members present:

Sir Giles Shaw, in the Chair

Mr Spencer Batiste
Dr Jeremy Bray
Mrs Anne Campbell
Cheryl Gillan
Mr Andrew Miller
Mr William Powell
Sir Trevor Skeet
Sir Gerard Vaughan
Mr Alan W Williams

Examination of Witness

SIR ROBIN NICHOLSON, FRS, FEng, Director of Pilkington PLC and a member of the Council for Science and Technology, examined

Chairman

163. You are very welcome in both your capacities: as a director of the great Pilkingtons and also as member of the Council for Science and Technology as which you have appeared before this Committee on previous occasions. As you know, we are taking a look at the Forward Look and we feel it is right to take some evidence from those who are likely to have fairly strong views about it. You yourself are one such. If you were able to state it quite simply what do you think are the main benefits that you see in the new proposal, the Forward Look, compared with the old annual reviews of Government funded research?

(*Sir Robin Nicholson*) The principal benefit is that it does look forward. The annual review inevitably looks backwards.

164. That is a very fine answer: I asked an idiotic question. I will rephrase it. The Forward Look is designed to look forward. In order to achieve that it has to be able to place a different emphasis on science and technology than was placed previously in the annual reviews. Obviously the extent to which the Forward Look is a new dimension of the problem or merely a whole series of objectives which may not indeed be reached, we have to wait and see. As an instrument by which we seek to examine the Government's scientific and development policies do you see this as being an improvement?

(*Sir Robin Nicholson*) Yes; certainly.

165. If so in what dimension.

(*Sir Robin Nicholson*) Yes, I do, in a number of dimensions. The Forward Look clearly has to be assessed against the background of last year's White Paper which in my view provided a strategic framework for the future of British science and technology, against which the Government's policies as a whole will be judged and against which the Forward Look will be judged. One aspect of the Forward Look is a progress report on that White Paper. The second point is that I place great emphasis on the Technology Foresight exercise and the role that that will have in guiding the priorities for Government R&D. We do not really see that in this year's Forward Look for the very good reason that it began to be assembled in the autumn of last year before the Foresight study had really started and indeed before the new research councils had come into being. One cannot really judge whether the Forward Look is going to be a success or a failure in that respect but I obviously have great expectations that in future Forward Looks Government spend and Government policy towards science and technology can be assessed in the light of the outcome of the Technology Foresight study.

Sir Trevor Skeet

166. Yes, but you prefer to look forward: I prefer to look back. The Council for Science and Technology had a predecessor known as ACOST; prior to that it had another one which was known as ACARD, Advisory Council for Applied Research and Development. Over the course of years, three bodies have risen, two have disappeared from sight, what did they achieve and do you think you can achieve any more by what you have in mind.

(*Sir Robin Nicholson*) Yes, they have disappeared from sight; it has been an evolutionary process and in some respect the CST goes back to ACARD in having a ministerial chairman. As I am sure you will remember, Mr Peart was the chairman of ACARD when it was first set up and it then went to a lay chairman in the late 1970s. I think that when we moved from ACARD to ACOST it was a deliberate effort to bring in a science base in addition to the application of science in research and development in the country. That was a movement forward, bringing the two sides of science and technology together. Speaking as a former chairman of ACOST, I think that we did some good work, if I may say so. We published some good reports.

167. Many.

(*Sir Robin Nicholson*) Yes, many reports and some good ones. The principal criticism of ACOST which this Committee amongst others has made is whether there was sufficient action following from those reports. In my position as chairman of ACOST I think it was difficult to get enough action from those reports because as the Chancellor of the Duchy of Lancaster put it, when he was introducing his White Paper last year, ACOST was neither within nor without the Government's system. CST is firmly within the system; there is a ministerial chairman and he of course is accountable to Parliament. You could

[Sir Trevor Skeet *Cont*]
say that I was accountable to no one. I welcome bringing back a ministerial chairman. It is the right time and the White Paper, which you will recall is the first Government White Paper on science and technology for 25 years, does produce a framework against which the CST and indeed Forward Look will be judged. It is an evolutionary process and CST is right for the times. It is not going to be right for ever and no doubt you will be questioning someone in the future as to why CST has died and another organisation has taken its place.

168. You are after action being taken and you have mentioned these demised organisations which have not been very successful in that. Do you understand that under the present structure you will have greater possibilities? Do you think you will have a coherent policy for science, engineering and technology?

(*Sir Robin Nicholson*) Those are two quite separate issues. On the question of whether there will be greater possibilities of action I think the answer is yes, because there is no longer the interface between the committee and Government. Government is chairing the committee and members of the committee may offer their advice and if they are not satisfied with the way that advice is dealt with they can resign from the committee. The Government is in a position where it is receiving this advice; there is a Minister receiving it and he is accountable to Parliament for what action is or is not taken. I believe there will be an improvement.

169. Will you have access to the Prime Minister or only to the Chancellor?

(*Sir Robin Nicholson*) We have had three meetings to date and we have been informed that the Prime Minister will attend future meetings, yes.

Mr Powell

170. Can you tell us what contribution the Council for Science and Technology made to Forward Look?

(*Sir Robin Nicholson*) We received it at our first two meetings in draft; we received the first draft and then obviously a second draft and my recollection is we also then saw a final copy between meetings to comment on. The composition of the Forward Look and the material in it changed substantially from its first draft and the Council for Science and Technology was instrumental in that. When we first saw it the two principal criticisms which we made were that it focused too much on the Government and not enough on the science and technology scene as a whole, particularly on the industrial scene and secondly that it was too inward looking, it did not have enough of an international approach. Both of those criticisms—and there were other smaller criticisms—were acted on in the final draft. I feel and I would guess my colleagues on the Council feel that we certainly had a good opportunity to comment in the preparative stages of this report.

171. Were there any recommendations of a substantial sort which you made which were not adopted in the final report?

(*Sir Robin Nicholson*) Not of a substantial sort. There were some things where we said it would be nice to do this, this and this, and the response was, "Well, that's something which we would hope to do next year but it is difficult to do it this year". For example, one thing which I know this Committee is interested in is the movement towards research output measures rather than just research input measures. The need to go in that direction was wholly accepted by the Chancellor and I would expect some work to be done by the OST and this to feature more prominently in future Forward Looks.

Mrs Campbell

172. Do you think that the Forward Look exercise was worth doing before the results of the Technology Foresight process are known?

(*Sir Robin Nicholson*) That is a very fair question. It is one of these things where you are damned if you do and you are damned if you do not, probably because there were strong arguments for deferring it another year to get more input, particularly as I mentioned in my answer to Sir Trevor Skeet that if you look at what the research councils have put forward it is very much yesterday's view, yesterday's research councils. On the other hand the OST would have been criticised if they had gone for two years after formation without producing a Forward Look. On balance they did the right thing but I feel and I am sure OST feels and the Chancellor feels that this is very much an interim document. It is somewhere half-way between or maybe not even half-way between the old annual review and what the new Forward Look will look like.

173. This is a practice for getting it right next time.

(*Sir Robin Nicholson*) Yes, to some extent. I know that the comments which are made by this Committee and others on the Forward Look will obviously have an important effect on how it is done next year. There is a mass of material one could put in. The format with the strategic articles and then what they call the essays and then the statistical backup is quite a good format because it gives a lot of flexibility. The first part will obviously go on year after year and I am sure the essays will change a lot in material content from time to time.

174. Can you tell us what in your view is the best way of indicating research priorities? Is that going to come as a result of the Foresight process or is that something that will be decided after the Foresight process has taken place?

(*Sir Robin Nicholson*) The Technology Foresight process will in effect make bids. The 15 different panels, who by human nature will obviously be populated by enthusiasts for either that market or that area of technology and rightly so, will attempt to put their priorities in the best possible way. The OST will then need to make some judgement between those priorities and certainly the commitment which I believe the Government has made is for the Council for Science and Technology to play an important part in that process. We will see a number of scenarios being painted which will be more or less believable and more or less supportable.

Sir Gerard Vaughan

175. Coming back from the various scenarios in the future, the Forward Look is pretty broad brush, is it not? A lot of people have criticised it for that; they are a bit disappointed. Do you think it would have been helpful at this stage to have had more

[Sir Gerard Vaughan *Cont]*
indications of specific research policies? Do you think this is something we have missed out of this Forward Look?

(*Sir Robin Nicholson*) That would have been putting the cart before the horse really. It is very broad brush, you are absolutely right of course and the detail will be sketched in initially by the Technology Foresight panels and then drawn together by the OST with help from the Council. Then we will see more detailed research policies but it is really a cascade process, is it not? There will be hopefully a more flesh-covered skeleton in this next time and then the individual research councils will look at the detail of this and produce their own policies. As members of the Committee will be aware from studies of POST and other organisations, the whole Technology Foresight process is iterative by its very nature. It should be iterative by its very nature if it is to be successful and that detail will be gradually sketched in. I also hope that other organisations will publicly make their views known on Technology Foresight. Already some of the more go-ahead industrial associations are doing that, for example in aerospace, in chemicals and so on.

176. Given the present situation are you saying it would have been largely impossible to give clear guidance on specific research, that the Forward Look will be collecting more information on this?

(*Sir Robin Nicholson*) Yes. It would have been very difficult to give guidance on specific research. There are some areas where Government have taken a view, for example on fast breeder reactors. However there are several quite major areas like that out there in the future and it would have been impossible to have given a considered view on those in this year's Forward Look.

Mr Miller

177. As the document starts to unfold year after year a pattern will be established of the various councils' own individual pet topics and they are bound to have their own pets. Surely there has to be a mechanism inside Forward Look to give some indication of the particular priorities that the Government of the day are thinking about. How would you envisage that working?

(*Sir Robin Nicholson*) Can I just correct either you or myself: either you have misquoted me or I said the wrong thing. The pet topics I have said were really coming from the Technology Foresight panels not from the CST. We are supposed to be above having pet topics; whether that is the case or not we will see. I think that the generation of priorities is going to have to depend on two things: the importance of the topic and the likelihood of success. I would refer you perhaps to the Australian Technology Foresight exercise which is reported in some detail in the POST study where they had four criteria against which they measured each of their equivalent of the panels. I am afraid I cannot off the top of my head remember the four but I remember two of them: one was the importance of the topic to the Australia, to Australian economy and Australian society and the second was the ability of the country to capture those benefits. I thought that was very interesting. Something can be enormously important but if you have absolutely no hope of making it then what is the point of spending money.

178. The establishment of criteria like that would help develop research priorities, particularly some of the long-term issues that need to be addressed rather than just snatching at the short-term priorities.

(*Sir Robin Nicholson*) Yes; absolutely right.

Mrs Campbell

179. Do you have any suggestions for sensible output and performance measures with which the Government can judge its success? Really in harnessing the spending on wealth creation and quality of life, both factors being mentioned in the White Paper, do you think that those two are actually the same? Does one use the same performance measures for both of those or are there rather different ones that could be used to measure one or the other?

(*Sir Robin Nicholson*) The measures are different and I feel less confident I know what the measures are for quality of life which has a very strong political input into it than I do about wealth creation which is more straightforward. I would suggest there are two measures which could be used for wealth creation: one is the success in balance of payment terms or market share terms or export terms, whatever one likes to use, of a particular industrial sector. Forward Look and the statistical backup gives data on various sectors and there is a wide, wide variation. If one measures that trend over a number of years in a research intensive industry—not including package holidays or something like that but in a research intensive industry—then the trend in that sort of economic data does give a measure. The second one, as far as the Government's own spend is concerned which I should actually have liked to have seen in the original White Paper, would have been a greater element of matching funds. If you take the view, which I do, that it is fundamentally down to industry to know where the best future markets are to attack, then a good criterion of the relevance of Government spending on R&D is whether industry is prepared to put funds into the same programme. I think that one of the relatively few opportunities that was missed in the White Paper was to bring the concept of matching funds more to the fore. There are several mechanisms by which this could be done and I still feel that is quite an acid test of performance of public spending on R&D.

180. Do you not feel able to delve into the rather more political questions of the quality of life?

(*Sir Robin Nicholson*) I am certainly not going to fall into the trap of trying to inform this Committee on politics because you have forgotten more than I know. I think there are measures which can be used; particularly in areas such as the Health Service there are clearly measures. The degree of success with which the Health Service tackles various illnesses, the degree of health of the people in this country, the extent to which new techniques are taken on board and disseminated are things which are susceptible to quantitative assessment. Most of these things, as you know, are very hard to do in absolute terms and this tends to put statisticians off. In fact the trend is a very real figure and that has been shown over the years. If

[**Mrs Campbell** *Cont*]
you keep your measures constant the actual trend in the measures subsumes the inaccuracy of the absolute figure.

Dr Bray

181. The Forward Look does contain a table comparing industry financed business enterprise research and development in different countries. There is quite a lot of material at an industry level in the R&D Scoreboard and the industry picture is interesting and important and relevant to the competitive strength of the businesses. Should that not be covered?

(*Sir Robin Nicholson*) Yes, there are some sections both in the Forward Look itself and in the statistical supplement which covers industrial R&D spend. I agree with you that the Scoreboard provides some additional data on that. The interpretation of some of this data is extremely difficult and I would hope that the OST and maybe the DTI will put a greater amount of work into this area for the future because I do not think we have really bottomed some of the differences which have shown up in the international comparisons. I find some of them very hard to understand.

182. The history of the R&D Scoreboard is that each year complaints have been made about particular companies being missed out or not able to explain the figures and so on which has resulted in a great improvement in the figures from year to year. It is only if your Council insists in asking the right questions that the improvement will continue.

(*Sir Robin Nicholson*) I agree with that completely.

183. Are you aware that the R&D Scoreboard is produced by a company called Company Reporting whose main business is in fact reporting on the accounting conventions of publicly quoted companies, so they have a very deadly line straight to finance directors and they are able to produce precisely the carefully accounted for output measures and all the rest of it in whatever form Government cares to ask the question? Has the Council had David Tompkin of Company Reporting along and asked him what he could do about output measures by industry?

(*Sir Robin Nicholson*) The answer to that question is no, it has not. As it happens, when we were asked by the Chancellor of the Duchy of Lancaster to suggest areas which the Council should study, I did suggest exactly the area you have just raised. I am afraid it did not make the short list. I hope it will in the future. I agree completely with you that this study has improved over the four years that it has been done but the list of health warnings at the back is still very full and I personally have views about ways in which it could be improved, particularly, and I know this is a subject close to your heart, I think that the comparison of R&D spend with dividend payout is the wrong criterion because it takes no account of the different financial structures of companies in different countries. It ignores the equity base structure in this country and the predominantly preference share and debt based structure in Germany and Japan. You get ludicrous things like Daimler-Benz being reported as having spent 2,424.4 per cent of their dividends on R&D. That is a ludicrous statement. It is technically accurate but it does not actually help at all. I think it would be very valuable for there to be an interaction between Government and Company Reporting Limited to make this document even more useful than it is already.

184. The raw material to ask the right questions does exist, it is actually in Company Reporting.

(*Sir Robin Nicholson*) The raw material exists: the quality of the raw material leaves a lot to be desired because, as you are well aware, the precise reporting standards in this country and the United States and France and Japan differ widely and one of the health warnings here is exactly that point. The extent to which engineering improvement is included in R&D for example varies from one country to another. The great strength of this is that it is a factual document, the material exists. The weakness is in the difficulty of interpreting it and some of the ratios which Mr Kenward and his associates have chosen to use, which I do not think are the most appropriate ratios.

185. Another relevant consideration in this is the fact that the R&D spending by particular industries is much influenced by Government industrial policies in relation to that sector. You have only to think of pharmaceuticals, telecoms, aircraft, aerospace and so on, to see some of the main explanatory reasons for international differences. It is simply an input to industrial policy, thinking about industrial policy. Should there not be closer links from the R&D side going out into raising the right questions of innovation in general, industrial investment?

(*Sir Robin Nicholson*) Yes, I agree completely. The research intensity in a particular industrial sector is partly a function of the degree of maturity of the industry and things like that, the basic nature of the industry and is partly a function of the interaction between Government and industry. Certain sectors—aerospace is an obvious example—have been greatly influenced in that way and one of the concerns which this sort of document raises is the extent to which our companies in the aerospace field are actually operating on a level playing field compared with companies abroad in connection with the amount of R&D which is supported by foreign governments in that sector of industry.

Mr Williams

186. In view of the qualifications you have made about the reliability and the nature of the material gathered in that Scoreboard, what do you make of the headline figure used by the President of the Board of Trade last week that investment in research and development had gone up by nine per cent over last year? What conclusions do you read into that nine per cent?

(*Sir Robin Nicholson*) That headline was, as I saw it, originally in the press release put out by Company Reporting Limited and I think probably the President of the Board of Trade was simply quoting from that. In the short few days which have elapsed since its publication I have not had a lot of time to study it but that nine per cent seems to be a pretty curious figure. It is composite of real increases and changes in the sample because it does say that the sample has gone up from 330 companies to 360. If my

[Mr Williams *Cont*]
maths is correct that is roughly 10 per cent. I know that the companies which have come into the sample do not necessarily spend the same amount as companies which are already in but that is an excellent example of the weakness of this. In my view there should be some method of normalising it so that you actually take those out of the year-by-year comparison. The encouraging thing about industrial R&D over this recession has been that it has not gone down by as much as it has in past recessions. If one looks at the figures, industrial R&D has certainly decreased a bit but some of that is caused by a reduction in defence spending and companies do seem to me by and large to have taken the view that they must preserve their R&D spend through the recession in order to emerge in better shape afterwards. Whether it is five per cent down or nine per cent up is a bit of a statistical quirk. The main thing is that there has not been a sharp fall away in R&D.

187. What about this other point you alluded to earlier, that is the comparison with dividends, the money brought out of profit. When we compare ourselves to other advanced countries we are quite out of line in terms of how much is reinvested in research and development from profits made and how much is paid out in dividends. We do seem to be a jam-today economy and not so concerned about five years and ten years' time.

(*Sir Robin Nicholson*) Two comments on that. In the present recession a lot of companies, including my own, Pilkington, have cut their dividends and maintained their R&D spend. One swallow does not make a summer but a lot of companies have done that. I feel that the behaviour of companies during this recession has been significantly different from the past and although the factor you allude to is still undoubtedly present, it has been less. Secondly, I really do feel that the international comparison here has a number of very serious faults and I do not actually believe that the figures in relating R&D spend to dividend in comparing UK companies with those abroad are right. They totally ignore the difference in the financial structure. What should be happening is that they should compare R&D spend with the total financing costs, dividends, preference dividends and interest payments. If you did that then Daimler-Benz would look a very different company in here because it is paying oceans of money to the Deutsche Bank.

Chairman

188. This is not the first time you have referred to this and it is a crucial point in relation to providing a database against which things like the Forward Look can be taken as soundly based or unsoundly based. Is your Council—which must have a remit in this matter—going to make strong representations to OST on this particular issue?

(*Sir Robin Nicholson*) I can only say that I am going to.

189. I am sure we shall be backing you up in what you say in our report.

(*Sir Robin Nicholson*) Thank you very much. The two measures we presently have of industrial R&D, namely the so-called BERD, which is the Central Statistical Office measure, and this, are both inadequate. BERD is inadequate in the sense that it only takes into account spending by UK companies in the UK and not UK companies abroad. The Scoreboard is inadequate for the reasons I have given also that it does not include unlisted companies. Major subsidiaries of foreign companies who do a lot of R&D in this country are not included in the basic statistics. Some of them are listed but only a few, so the statistics really are well short of the importance of the subject.

Mr Batiste

190. Could I carry this a little further because it does seem that to have some reasonably reliable and objective data has to be one of the most important building blocks on which any Forward Look can be based. At first sight, reading through the paper, in terms of the number of UK companies in the top 200, it did not look too bad as compared to Germany or France, though obviously Japan and the United States are way ahead. Then when you looked a little bit below the line that did not seem really to answer any serious questions. For example, if you took out the pharmaceutical industry, where we have a very successful world class sector, and you took out our companies in that top 20 which were pharmaceutical based, the number would fall quite substantially. If you bear in mind that we do not have a large-scale domestic motorcar manufacturer and motor manufacture dominates the R&D figures in the top 200, the comparisons become really quite meaningless, how many companies you have in that top 200. It is trying to explore what actually in terms of planning within the UK are the sensible things that seem to be most important. How important would you rate trying to get reliable figures on a sector by sector basis on how much UK industry spends on average as a proportion of sales on R&D compared to its equivalent abroad? Would that be the most useful yardstick we could get for planning purposes?

(*Sir Robin Nicholson*) Yes, I think it would. I must say immediately I agree with everything you say and it is very important to have better statistics sector by sector to make judgements of what is happening. As I said earlier in answer to Mrs Campbell, the trends in these are also as important as the actual figures themselves, therefore the sooner we do it the better. I think you will find—I am sure you know this—that for most industrial companies, when looking at how much money to spend on R&D, one of the factors is how much your competitors are spending. It is not the only factor obviously; there are many others. If you are spending half as much as your competitors, you are either going out of business or else you are a lot brighter than your competitors. The first you do not want and the second is seldom true unfortunately. If you are spending twice as much you then also have to ask yourself serious questions. I think comparison sector by sector with like companies here and abroad should be done. I must say it is difficult even within what is really quite a simple and small sector, the glass industry, for us to compare because most of our major competitors on a world scale are in businesses other than the glass business. When they publish their accounts, certainly in some of the countries which have less demanding

[Mr Batiste *Cont*]
financial standards than we do, the broad brush nature of the data is such that you cannot actually separate how much they are spending on glass compared with chemicals or bricks or whatever. There are difficulties and the American companies are the easiest to follow; because of all the SEC regulations a tremendous amount of data comes out. That is the fundamental input test. The fundamental output test is in terms of market share and profitability.

191. Equally it would arise from what you said that just lumping all UK industry together and comparing the average R&D spend here with the average spent in other countries is fairly meaningless because we will not have the same sectoral mix as other countries. If you take the point you are making about comparisons, to do that is a meaningless exercise.

(*Sir Robin Nicholson*) I hesitate to call it meaningless but it could be an awful lot better. The other factor which you have partly brought out in your comments is the extent to which industry in the UK is foreign owned and therefore comes effectively in the unlisted sector. In the motor vehicle sector which you referred to, obviously Ford and General Motors have for many years done substantial amounts of R&D in the UK but this will not appear in those statistics; also Hewlitt Packard and so on. It is a very imperfect document but I have bent over backwards to be fair to it because it is motivated by the best possible reasons and I agree with Dr Bray that it is something which is in existence from a very reputable company and it could be significantly improved.

Chairman

192. In the report it would appear that DTI is changing its emphasis from spending directly on new technology towards—and I quote from page 19 of Forward Look—"creating an environment which encourages firms to secure economic benefit from S&T through successful innovation". Do you support that change of emphasis if indeed it is a change of emphasis, which I think it is?

(*Sir Robin Nicholson*) Yes, I think it is a change of emphasis and on balance I do support it. If one is prioritising that is probably the most important thing that DTI can do. I take the view as an industrialist that the most important thing which Government can do for R&D is to have a stable growing economy and an excellent education system; those are the two things at the top of my list. After that I do think there is a role for Government in specific sectors which are heavily subsidised by foreign governments so that our companies can compete on a level playing field. I also feel there is a very important role for small companies which the DTI is attending to. I think the policy which DTI has on awareness and promoting technology transfer is key because it has really been implicit in many of the comments that members of the Committee have made that our problem is not that no companies are any good in this country. We have several companies, several sectors, in which we are world competitive, unfortunately there just are not enough of them. Therefore you have to ask how we are going to spread the good news from the companies who basically believe that R&D can lead to success and who have been successful in persuading their shareholders and financial analysts to this effect to those who for one reason or another do not believe that R&D is the key to success or have not been able to persuade their shareholders that way. What the DTI is doing in promoting the importance of innovation and promoting awareness of technology transfer is the right policy. It is too early to say whether that policy has been followed effectively, although I do welcome that in the innovation unit in the DTI there is a substantial number of people seconded from industry. I think that has been a good move.

Mrs Campbell

193. What that means though is that instead of targeting specific firms the money is very very thinly spread and the comment has been made to me by industrialists that what that means is one glossy leaflet per firm extolling the virtues of innovation. Is this adequate?

(*Sir Robin Nicholson*) No, I do not really agree with that. The old policy of the DTI—and I have used this phrase before—often ended up supporting marginal projects in marginal companies. I am not sure that was a very good use of taxpayers' money. You cannot spread it across the board in the way that that comment you made implies because really the DTI is not going to teach Glaxo anything it is not aware about on R&D. Therefore if you like there is a top layer of companies which I would say are doing well globally, are responsive, understand the value of R&D and are highly competitive and that is fine. We just need to multiply that number by two, five or ten or whatever it is and it is that next layer, underneath which the DTI policy is aimed. Therefore if you look at the amount of money which is being spent, it is significant in the context of that layer of industry.

Dr Bray

194. On the question of the effect of tax incentives on research and development and of research and development on growth in productivity or output, are you aware of the analysis that we put in our last report on this?

(*Sir Robin Nicholson*) Yes.

195. The figure that we quoted there of a tax credit within the EC rules leading to potentially, according to the work that we quoted, an increase in GDP growth of 0.8 per cent per annum within five years is a pretty large sum: 0.8 per cent of GDP is £50 billion. Is the Council, as far as you are aware, pursuing this?

(*Sir Robin Nicholson*) We have not discussed that particular point at this stage. I am sure it is something which will come up. I believe that the use of tax credits in R&D policy should be further studied by the Government and there are strong grounds for doing a limited study in a specific area. It will not surprise you that I was rather in favour of what ACOST advised the Chancellor of the Duchy of Lancaster in the run-up to the White Paper which was to look at tax credits in areas where industry and universities were collaborating. I felt it would be an incentive to develop that partnership more strongly. There are other areas where this could be done, for example in small companies where it has been done

[**Dr Bray** *Cont*]
successfully in Germany. To do it across the board would be probably not a good use of money at this stage. I feel it should be done on a pilot basis and the results carefully studied because, as the Committee will be aware, it is a highly controversial area as to what is cause and what is effect.

196. There is a huge amount of evidence on this in the States because the particular structure of the tax credit there put every company in a different position. You get a very large sample and you can see how the different companies responded related to the circumstances of those companies. Is it not much more relevant to look at the US than penny pieces of experience in the UK which are addressing irrelevant things? What has the relation between industry and the universities got to do with total faculty productivity? You just do not get any output measure there.

(*Sir Robin Nicholson*) I do not agree with that. I do not think the United States experience is readily transferrable to this country. I think a huge amount of money which is involved in giving these sorts of tax credits on a broad base. If a certain amount of money is available I as an industrialist would prefer to see it going into the education system because I feel it would have more effect on GDP than tax credits.

197. Against that kind of timescale? How could money put into important areas of education produce a pay-off in economic growth within less than five years?

(*Sir Robin Nicholson*) It is an interesting turnaround. If I may say so, you are being very short-term on this. We need longer term solutions and I do not feel that using tax for a once-off stimulant is the right way to go about it. What we are looking for is a change in culture which I believe is occurring and we are looking for a spreading of excellent performance from a relatively small number of companies to a larger number.

198. But this is to ignore all the spillover arguments. The people who benefit from research and development are not just the company who does it but the industry that they are in, the country they are in and indeed other countries too. Measurement of who draws the benefit from that is a well established result in economic analysis. The fact that you should be questioning it against all the economic evidence really suggests some kind of gap in the literature on which scientists draw in forming their opinions on these matters.

(*Sir Robin Nicholson*) You must be aware that it is not all the economic evidence. You must be aware that there are many interpretations to these results.

199. With respect, could you send us a rebuttal of the Bronwyn Hall analysis of US tax credits?

(*Sir Robin Nicholson*) That is not a proper question to address to me: it is a perfectly proper question for you to address to the Chancellor of the Duchy of Lancaster. I stand by the ACOST analysis of this.

200. But that is five years out of date.

(*Sir Robin Nicholson*) It was completed in February so it is not.[1] It is up to date. I think that the interpretation of the figures you quote is still open to doubt. It is really a simple question of priorities. I cannot remember the figure in pounds that the Committee recommended in its previous report but if that sort of money is available in public spending I would use it partly for a limited trial on tax credits along the lines I have indicated and I would put the rest into education.

Chairman

201. You have come to the end of your question period. Thank you very much for coming and answering with your customary lucidity and your usual courtesy. Thank you very much indeed.

(*Sir Robin Nicholson*) Thank you very much. Can I just apologise to you and members of the Committee for my non-appearance on the previous occasion and thank you very much for inviting me again.

Chairman: We are very glad to have you now.

[1] ACOST's Report, "Innovation and the Tax System", was published on 4 July 1994.

Memorandum submitted by the Centre for Exploitation of Science and Technology (17.5.94)

Postgraduate Training and the Faraday Principles

SERC and DTI started the Postgraduate Training Partnerships as a way of trying some of the Faraday Principles. This trial is proving a great success. (Report enclosed†).

More should be made of this initiative.

The forward Look comes over as a very detached document. Science, Engineering and Technology is a human activity. Real people working on new areas of understanding and applying that understanding to various applications.

Review of LINK

LINK is a knowledge-based programme and we need to use many more of the people-based ideas like TCS, CASE, IGDS as delivery mechanisms.

I enclose a copy of "Approaches and Lessons†". Some help I have given to the Technology Foresight project.

Examination of Witnesses

DR ROBERT WHELAN, Chief Executive, Centre for Exploitation of Science and Technology and DR NEIL JOHNSTON, Manager, Centre for Exploitation of Science and Technology's Environment Programme, examined.

Chairman

202. Good afternoon. Thank you for coming. I am sorry we are a little late but you are well aware we have had Sir Robin here and we started a little late ourselves. Welcome to Dr Whelan and Dr Johnston in relation to the Centre for Exploitation of Science and Technology. You know that we are considering this evidence session in relation to our review of the Forward Look and we are very grateful that you should have found the time to come and join us today. Can I ask a question first of all of a general nature. CEST was established in 1988 on the recommendation of the ACARD. I do not know whether you were here in the discussion with Sir Robin earlier but we were referring to the rise and fall of certain of these groups which have a period of time had comet-like appearances in the scientific sky. Let us ask this question. You have this particular role of the exploitation of science and technology. We have seen the new look of the DTI's policy in innovative transfer and all the rest of it. We now have a reorganisation of the research councils, we have the directorate located in OST, we have the possible prioritising through Forward Looks and through other mechanisms that the OST are designing, such as Foresight. What is the need to have CEST in existence today?

(*Dr Whelan*) When CEST was established through the ACARD report on exploitable areas of science the Council of CEST really saw three activities: one was judgements on where new market opportunities might occur; one was judgements on areas of technology that were of some import; the third was judgements on obstacles to accessing those opportunities. What has emerged over the years—and unlike a number of other organisations CEST is very much alive and kicking and indeed has a larger membership now than when it started—the point that has emerged, is that the identification of important opportunities is but one facet of the process of exploiting science and technology. The other issue, which is reflected in some of the policy changes that we have seen, is that you do require to get initiatives and activity underway in order for those opportunities to be seized. In a sense the issue has two sides to it: one side is identifying important areas and the other is in fact creating the start of a new opportunity. Some of those opportunities will take place in companies but increasingly it has become quite clear that it is groups of companies, it is collaboration between various parts of the science base and industry which actually lead to those things coming forward. In fact it is that activity which forms an important part of what CEST does these days.

203. Are you satisfied that the role of CEST, as defined, will still be as effective, possibly more effective, than it has been in the past bearing in mind the very substantial changes that are going on now in the way in which science and indeed technology is being developed under the policies of OST, DTI and so on. Do you still think there is a need for it?

(*Dr Whelan*) Yes, I do. You are quite right to point out that some of the activities that we expect to come out of Technology Foresight in identification of important areas of opportunity are areas that we too look at and we will continue to do so. It is certainly true that creating the opportunities that are going to flow from those and turning them into some sort of reality is a very important role that my council sees that CEST should continue to play.

Sir Trevor Skeet

204. Could not all these be done by the Council for Science and Technology which is operating inside the Ministry, with access to the Chancellor and also the Prime Minister?

(*Dr Whelan*) I expect that the Council for Science and Technology itself will identify and point out opportunities into the system and quite rightly so. However, we all realise, those of us who have

†Not printed

[**Sir Trevor Skeet** *Cont*]
operated in the industrial area, that you actually require activity on the ground as well. We have all seen the important reports that have been produced by august bodies pointing out that there is an opportunity here and an opportunity there. I can assure the Committee, however, that it still requires groups of people actually to go and do it.

205. You have been turning out some extremely good reports over the years but the action has not necessarily been followed up on these reports. You say that you initiate movements towards them but you have no way of pushing them ahead.

(*Dr Whelan*) That is not really quite true. In pretty well all of the areas that CEST has worked in we have managed to create some significant industrial initiatives. Those in the area of the environment, work on the river systems and water technology are extremely well known; all the waste minimisation work that we did. We are the people who proved that it was possible to make substantial industrial profits out of better environmental performance and what is more we have not just said that, we actually went and did it. That is a very important argument in favour of CEST's particular type of approach. Even the very early work that CEST did in the area of packaging and things of that type has been exploited by a consortium of about 30-odd companies. In a sense these things can be brought through but it does require someone to mediate, organise, harass even chase after the DTI from time to time to make sure things come into play.

Cheryl Gillan

206. After that comprehensive justification of your existence, can we just look at the situation now? We used to get used to the old annual reviews of Government-funded research and development and I should like your opinion as to what you believe are the main benefits from Forward Look as compared to the previous way of doing things. Whilst you are on that I wonder whether you would care to venture your own opinion as to the level of collaboration between OST and DTI with the new Competitiveness White Paper. Do you feel that there may be some dangers of policy ideas slipping through the net? Would you care to comment?

(*Dr Whelan*) On the first point about the Forward Look, I would comment a little bit as a user because it is one of the documents that we use quite a lot, largely because of the collection of statistics and that is maintained in the new document. The Forward Look is a document in transition but on the other hand I believe that more could be done to use a document like that to encourage the more visionary strategic debate which is believed to happen at CST and bring that more out into the public area. Also, there is more to be done in explaining how the results of an activity like Technology Foresight are actually going to be used by industry. There was a tremendous amount of discussion about how they might be used by OST, Government departments of one responsibility or another, but there is actually very little discussion as to how they are going to be used by industry or by the university system because, although it might be used to indicate areas where programmes might be created, in the end you require proposals to come from bright researchers, be they in university or be they in industry, actually to take advantage of those. That is a very important aspect to do with exploitation of technology foresight that could have been better developed in this particular Forward Look. With regard to the issue of inter-departmental collaboration, that is going to be an increasingly important issue, not only because of the changing nature of the structure of industry itself, even the classical sector divisions have been quite rapidly broken down as companies change their shape and style, and that will of course apply to Government departments too it seems to me. The document Forward Look really does have to reflect those collaborations very strongly.

207. Do you think there would be an argument say for taking a Competitiveness White Paper and using it as a benchmark and reproducing it annually as something that would dovetail into the Foresight process and Forward Look?

(*Dr Whelan*) The competitiveness issues is a very important part of Forward Look. It does feature at the level of the panels in the Technology Foresight process but there is some merit in making sure that issues which are so broad across the economy as the issue of competitiveness are reflected in these types of documents like Forward Look, even if there is some element of repetition.

Mr Miller

208. You heard us quizz Sir Robin on the question of research priorities. Rather than rehearse the same series of questions again perhaps I could put it to you in a very simple way and picking on your phrase this "visionary strategic debate". In the context of this visionary strategic debate would it in your view be more helpful if Forward Look contained some rather more specific indications of particular research priorities?

(*Dr Whelan*) The Forward Look is going to have to be more specific in future, really because it is one of the key documents that is generally going to be widely read. Whether this Forward Look could be very specific or not is not clear but in the future it does have to become more specific. I would still make the point that we are only talking here about quite broad programmes. It is only the people who are active in the research field, be they in industry or be they in the university or specialist institute area who can actually define what the projects are themselves. I do not think we are ever going to be able to go down to lists of projects in the Forward Look. We are going to be concerned with the rationale behind particular important areas.

209. If we are having a visionary strategic debate there must be something concrete to look at in that vision, it cannot just be up in the ether, can it?

(*Dr Whelan*) No, it cannot, that is quite right. If you for example were talking about advances in human genome science—and everyone accepts that the UK has a strong speciality chemicals, pharmaceuticals, chemistry activity that might in some way use that—then it seems to me you can have really quite a good discussion as to the relevance and the way you might see those sorts of advances coming together. I would see that as being a fair discussion for the Forward Look.

Mrs Campbell

210. It seems likely that the Technology Foresight process would produce more detailed indications of research but I think a lot depends on the way it is done. You have had your own experience of doing a Foresight process, the Environmental Foresight ones that I am specifically referring to. I have to confess that I read that with a great degree of disappointment because I think that you were successful in identifying some commercial opportunities, for instance pollution charges, which has been floated in the press over the last few days. That is obviously something that will happen. You did not talk at all about better public transport or the need to reduce journeys completely through for instance better telecommunications. Do you not agree that the research priorities are going to be very much influenced by the scope of the Foresight process? Why was your own report so narrow?

(*Dr Johnston*) I am not entirely sure that it was as narrow as you suggest. If I remember correctly, Keith Mason, the person who wrote the report, referred very specifically to some of these softer issues, management issues, Government policy issues as having a key role in contributing to sustainable transport. I specifically remember him referring to public transport, to policies such as advanced scrapping of older vehicles, such as road pricing and so on and so forth. That is one of the key issues that worry us about Foresight. Foresight to us is rather more than setting priorities and indeed rather more than setting simply science and technology priorities. Many of the barriers to successful exploitation of technology are these soft issues and unless Foresight actually flushes those out and begins to identify mechanisms by which they can be addressed it will not have achieved quite what it could have done.

(*Dr Whelan*) We have also done a more recent project on the intersection of transport and communication as two very important issues which really do cut quite strongly across the environmental discussion as well. The interesting issue that comes out of that is that if you define your topic too tightly in a Foresight process, let us suppose you give it a label "transport" not to put too fine a point on it, then you could very easily pre-condition the process that you are trying to run, so that a lot of what are reviewed as peripheral issues but which are the factors which will enable you to create an opportunity or not, are actually outside the discussion. If you then look at a National Foresight process, you have to be extremely careful that the communication across your panels, the lateral communication, is extremely efficient. If the thinking about how you are going to use the output is not done very early then those things tend to get marginalised and you do not actually get a very successful result. As you know, I have written for Professor Stewart, at his request, a document to discuss this type of issue in working groups. It is in our view really very important to have it quite clear what results you are trying to get. In CEST we are actually trying to get an industrial initiative. In the work that we did in the environmental area, for example, in the transport and communication areas, we are trying to put together a city-based initiative which combines new transport technology, issues on urban health, particularly airborne pollution and also transport techniques. If those sorts of things can be put together on a city basis and I can persuade a group of companies, a local authority and city to do something in a coherent way, then we actually get a positive result from the process.

211. What worries me is that if you are looking very narrowly at the commercial opportunities you do not actually look very seriously at the ways of really improving the quality of life, which I do not think in the particular example I quoted come from tinkering around the edges with the amount of pollution a car produces. That is not going to produce anything like the improvements we could get if we could get a wholesale movement back onto public transport.

(*Dr Whelan*) There is no doubt that if you do not have an integrated transport approach which includes all the communications issues, and if you view transport as communication of things and communication as being transport of ideas and things of that type then if you do not have an integrated approach it is very difficult to deliver benefits in some of these environmental areas. I would not disagree with you at all there. There is no doubt that transport is an extremely important component of environmental disbenefit.

Chairman

212. What is the likely timescale of this suggestion you have made about a city-wide exposé?

(*Dr Whelan*) We have always to go through some sort of consultative process. It typically will take us probably six to nine months to do that. Then we hope that we can then bring something forward. In a sense we are only enabling people who are within these cities anyway to take an initiative. It does depend on finding the right groups you could work with.

Cheryl Gillan

213. Having heard evidence from Sir Robin earlier on this question will come as no surprise to you. During the year the OST is obviously agreeing with departments a series of output measures and performance indicators. I wondered whether you could tell us what you think might be sensible output and performance measures, particularly as far as judging success of Government in harnessing science, engineering and technology is concerned.

(*Dr Whelan*) Are you looking for output measures here from the industrial perspective?

214. From the Government's perspective.

(*Dr Whelan*) There is a great difficulty in putting output measures together. Supply-side measures are very easy, that is why all these numbers you see are all supply-side measures. There is work going on to try to identify a set of output measures which are loosely called innovation measures or something of that type, number of new products introduced, rough competitive positions of companies within particular groups of competitors and measures of that type. The difficulty comes that although we can identify output measures that we believe are some sort of proxy for efficient research and development, probably the links are still reasonably tenuous. That is one of the

[**Cheryl Gillan** *Cont*]
problems that one has in developing directly coupled output measures.

(*Dr Johnston*) We are of course talking about a human process and it might be that measures which focus a little more on the human aspect, particularly the flow of people from the science base into industry, recruitment and retention of science and technology graduates, involvement of companies in some of these people-based schemes, collaborative arrangements such as LINK, measures like that, might give you a rather more human face to it than some of these more abstract ones.

Chairman

215. Yet you will recall that in the way that they set it out in Forward Look the Government are looking to measuring, performance measures or output measures, in relation to spending for wealth creation and improving the quality of life. It is mega-stuff. Are there any ways that you are aware of in which this kind of assessment can be undertaken?

(*Dr Johnston*) In terms of wealth creation there are other measures such as added value. One might look at the percentage of products which have been introduced in the last three to five years, refreshment of an industry's technology base, number of patents and licences.

216. That is the physical counting of new activities.

(*Dr Johnston*) That is right. On quality of life I would look more to some of the environmental measures in terms of quality of the air, soil and water resource that the country has.

(*Dr Whelan*) You might look at crime. If you look at the research and analysis of the layering of society, how there is this delayering effect going on, then there are probably some indicators there which say something about quality of life, in my view anyway.

Mr Williams

217. Are there any glaring omissions from the Forward Look, either in the main volume or in the statistical supplement?

(*Dr Whelan*) Yes, there is actually a piece of good news that has been missed. When there was discussion about the White Paper we proposed the idea of Faraday centres and Faraday principles and those things. One of the initiatives that was started by the DTI and, as was, SERC, at that time to test one part of that concept was a scheme called Post-graduate Training Partnerships. This was quite a small scheme. There were five pairings of a university and an intermediate contract research institution. There were about 50 young research associates in the scheme per year, so we actually have a group of about 100 at the present time. The feedback that we are getting from that scheme is extremely good. Firstly we are getting very high levels of motivation in not only the students themselves, because they are working on what they view as industrially relevant work, they are getting some industrial experience, but we are also getting evidence that we have motivated an exchange of ideas between the lecturers, business managers in the various institutions, which is leading to new collaborations too. In a sense one is using the students to bring together, build a bridge, between two types of institutions. The other piece of interesting news is that questions were raised as to whether the academic science quality of the work that was done in a more industrial applied environment would be as good as it would be done elsewhere. The evidence suggests that it is at least as good and may actually in certain cases be better. That is actually a nice piece of good news to come out of a slight shift in thinking. What is more we also believe that there is a group in the North West which is going to adopt these principles for the North West Region around Manchester. We know that companies are collaborating with universities because of the Cooksons and Leeds partnership which uses the same principle and we believe that is going quite well too. In a sense we are doing a little test on how some of these principles might work as a precursor to doing something more ambitious and the results really do look quite good and it would have been quite nice to have reported that within the Forward Look.

Chairman

218. There is a prospect for next time.

(*Dr Whelan*) Yes.

Dr Bray

219. When drawing lessons of the Foresight exercise at the industry level you will recall the various visitors to Japan, including ourselves, found that if you go round firms asking what they think of the national Foresight exercise they have not heard of the document but then on further questioning about the process you find that in fact they do it internally within the company.

(*Dr Whelan*) Right.

220. It may take very practical forms. In Yamasaki, which we visited, it took the form of putting the electric drive directly onto the shaft of the lathe so that you cut out all the mechanical linkages. Presumably as the Foresight exercise develops in the UK the company level follow-up will be the responsibility of individual companies of course and consultancy firms, PA Technology, Cambridge consultancies and this work. Is there a level in between where groups of companies wish to get together either in the study or in pursuit of the implications or at an industry level which calls for CEST-type activities which are not encompassed within either the Foresight or the present company activities?

(*Dr Whelan*) Our belief is that there are some intermediate levels. We believe that the raw output of Technology Foresight will require some much more detailed study by probably sub-groups of companies, some of whom may not have been on the Technology Foresight panels. If you like, there is going to be an activity which will involve more detailed workshops around specific issues that are raised. I should be very surprised if that is not the case. The types of output that I believe we will see are likely to be collaborative to quite a large extent. There will always be companies who will be able to take away this information directly and use it, but the Foresight process, by its very nature, involves a sharing, some construction of trust between companies and I

[**Dr Bray** *Cont*]
believe that one of the outputs will in fact be a greater number of collaborations.

221. Would you see the practical effect of that being to widen the differences between those successful and less successful industries in the UK or in fact to narrow those differences?

(*Dr Whelan*) I would not expect it to widen, largely because the flows of information ought to be better. As you know, one of the findings about successful collaborations is that they are between partners who are judged roughly equal. In a sense they perceive each other as being reasonable partners. It is more unusual for example to find out a collaboration between companies, groups of companies, where some are judged to be much less capable than others.

222. In terms of the kind of picture shown in the R&D Scoreboard of some industries being very much weaker than their international peers and others comparable, you would expect the Foresight process to lead to no very great improvement of the tail, some raising of the upper half.

(*Dr Whelan*) Yes, that is right. If the sense of that is that it is not going to have too much impact on the leaders, it is actually the next quartile or so downwards where improved understanding of what might be possible stands a chance of improving their performance.

223. On the second rather than the fourth quartile.

(*Dr Whelan*) Yes; second/third I would have thought.

Mrs Campbell

224. You heard me ask Sir Robin about the DTI's change of emphasis from directly funding research and development to things like the advanced technology programme to the present emphasis which is one of creating an environment to encourage firms to secure economic benefit from science and technology through successful innovation. What is your view of that and do you agree with my comment that that could mean that the effort is so thinly spread as to be rather ineffective?

(*Dr Whelan*) There is no doubt that the problem which the DTI have identified, that of the uptake of new concepts within industry, is in my opinion one of the major problems. Putting aside the high technology informed companies for a moment, whether in fact the DTI has got itself in a position where it is spreading itself too thinly, there is probably some evidence for that frankly. I think that there is also evidence that regional initiative is the thing to encourage. The question really is how thinly you spread yourself and which regions you decide to put some emphasis onto. Probably that is about all I really need to say because that quite closely defines my view. Dr Johnston has done quite a lot of work in regions in Europe as well as the UK.

(*Dr Johnston*) Yes, I would add two things which seem to be principles of success in Europe and they are first of all a focus, not just a regional focus but a focus on a topic or a market opportunity or a technology. I do not think you can encourage firms to innovate but you can encourage firms to develop technologies, innovative technologies, to meet targets set by that industry or by Government. Zero emission vehicles in California is a classic case but there are plenty of others provided you have the focus. The other lesson that seems to come out very strongly is that with all due respect to marketeers it comes down to personal interaction. Brochures and databases and even to some extent seminars are generally not what is required. What you need is high calibre people who understand industry and how industry works and thinks and also can understand the technology actually to go out there and chivvy, harass, individual companies and bang heads together, it is as crude as that I am afraid but there is evidence, certainly from the Aquitaine area of France where Elf has a system set up that that is what really makes the difference.

(*Dr Whelan*) It is also worth commenting though, even on that initiative, that the number of individuals on Elf's team was quite small; we are only talking about half a dozen maximum.

(*Dr Johnston*) Two or three in fact.

Mr Miller

225. Was that the work they have done on bio-fuels?

(*Dr Johnston*) No, this is the CETRA initiative which you may be familiar with but basically they chose the best engineers from the 40-year-old age group, not those close to retirement, and they have made a tremendous success of it.

Chairman

226. Do you welcome the R&D strategy statements by the research councils and Government departments in Part 2 of the Forward Look? This is a different development from heretofore. Do you criticise it? Do you have anything to add, anything to praise about it?

(*Dr Whelan*) I would have to say I feel neutral about it. I did not really feel that it was an advance over other material that has been published either by the research councils directly or even as part of old Forward Looks.

227. No great shakes.

(*Dr Whelan*) It had no effect.

Mr Batiste

228. The statistical supplement shows that the number of business enterprise personnel engaged on R&D fell from 188,00 in 1986 to 142,000 in 1992. That seems on the face of it a very curious figure, bearing in mind it covers a period where there was a very substantial boom which was then followed by a recession when, we have already heard in evidence, most companies retained their R&D spend. Have you formed any impression as to how this situation arose and how serious it would be?

(*Dr Whelan*) Do you mean in the sense of whether there was an actual reduction?

Mr Batiste: What I am concerned about is whether in fact there were some statistical anomalies here to make these figures unreliable.

Chairman

229. Or a serious trend in the UK economy.

(*Dr Whelan*) There is probably some evidence that there have been headcount reductions, after all

[**Chairman** *Cont*]
during some of the privatisation processes some of the research laboratories that existed were reduced or slimmed down. The CEGB laboratory facilities were quite reasonably reduced during that period. Probably there is some evidence to suggest there has been a reduction but statistical distortion is a problem in the fact that the classification of what is an R&D person or is not can be quite tricky, particularly when you think of the way R&D personnel are used within companies these days. The R&D function has changed quite dramatically. There is very much more dispersion of R&D engineers down into production facilities of any sort. Whether those would still be captured within this sort of statistical counting or not is probably reasonably doubtful.

230. We saw, for example, when we went to Japan that quite a lot of the R&D function was devolved to manufacturing units.
(*Dr Whelan*) Yes; indeed so.

231. In a sense what you have just described would be best practice in the engineering industry but you cannot say whether these figures reflect that change or actually smaller numbers of people overall engaged in R&D.
(*Dr Whelan*) I cannot answer that question, no; I do not actually know.

232. Therefore you cannot base any conclusions on it.
(*Dr Whelan*) No, not too many conclusions. There is another point, just while we are talking about manpower and that particular two or three page section. You might note that some of the research councils and Government departments in respect of R&D seem to carry a lot of administration. I was a bit surprised at this: 38 per cent of the headcount goes on administration in research councils. I know they are administering grants but I did a straw poll this morning amongst contract research and development groups that I know and the level of admin was about 20 per cent. There are really quite significant differences there and one then asks the same question: are we actually measuring the same sets of people?

Mr Williams

233. Sticking to this subject of personnel. We were quoting our visit to Japan but one of the key figures that I came back with was as given to us by the CBI equivalent in Japan and that was that the number of research scientists and engineers there was 583,000 whereas in Britain the figure was 118,000, a five-fold difference. Twice the population but five-fold difference. Accepting your reservations as to how to define a person fully involved in R&D, nevertheless there is a startling difference there. As an economy should we not have a good number more involved in research and development? It is very disappointing to see that the trend, especially in industry, is the other way.
(*Dr Whelan*) Yes, but you cannot just equate either the amount of money that a company spends on R&D or the number of people it employs on R&D with whatever the level is that that particular company would require to be competitive. I hear your point but let us just suppose that the Japanese counted everyone in R&D who had a particular type of qualification as being a way of doing the measurement. Then you would come up with a different number.

234. But I am old-fashioned enough to believe that when we look at education in different countries it has something to do with the number of teachers; in the Health Service the number of doctors and nurses is a criterion in terms of quality of health care. I similarly say that in looking at research and development the number of researchers must be an important criterion.
(*Dr Whelan*) It is an important criterion but I should be more concerned with the quality of the total technical base that exists within the people within a company rather than the way in which you divided them up into some particular functional group or another. That is the only observation on that.

235. In the educational system at GCSE, at A level and higher education, we are very concerned about the total numbers growing but the numbers of scientists are not growing. There is nothing more disappointing that at this time of the year finding highly qualified degree scientists finding difficulty getting placements.
(*Dr Whelan*) That is a point also that comes out of the statistics in the Forward Look. The thing that is quite interesting is that research councils' PhDs show 13 per cent unemployment on these figures. In fact if you looked at those who go into short-term appointments or further training, then that figure starts to look like 30 or 40 per cent. You might argue that one of the major problems we have is an extremely serious graduate and post-graduate unemployment problem. The figures in Forward Look would seem to confirm that.

Mr Miller

236. You have talked about some of the local initiatives, the city initiatives and so on and also you touched very briefly on one of your European activities. The EC R&D programmes are taking an increasing share of Government R&D spending. Are these programmes in your view sufficiently focused on the needs of business and industry in this country?
(*Dr Whelan*) There is no doubt that if you look at the participation of UK companies, UK groups, within these European programmes that they seem to be reasonably attractive. After all there is a reasonable amount of effort in getting to these programmes and companies appear to be willing to make that investment. It is by their nature. The only way programmes can be set at the European level is really relatively broad and it is really down to the collaborations that UK companies choose to set up in the areas that they think are particularly important which is where the benefit will come out. Whether the programmes themselves are specifically targeted to the UK is doubtful. By their very nature they have to take a very general European view.

237. Take for example European strategies on air quality. They would need to be addressing, listening to your earlier analysis, by application of some of those strategies in local projects in the UK, the kind of things you described earlier.

[**Mr Miller** *Cont*]

(*Dr Whelan*) Yes, in the UK. That is why I phrased my answer in that way.

238. Because of that leap up to European and back down to local level how does one best evaluate value for money in these EC programmes?

(*Dr Whelan*) The evaluation of value for money in the programmes as far as the companies are concerned follows much the line it would on any other industrial collaborative programme. You are actually looking as to whether those companies are producing new products and new activity as a result of those programmes. The assessment that was done by PREST late last year in one earlier programme was that there were reasonably good benefits and benefits were perceived by the companies who had participated.

Chairman

239. And there was reasonable value.

(*Dr Whelan*) And there was reasonable value.

(*Dr Johnston*) Framework Four of course places an awful lot more emphasis on having dissemination and exploitation channels in place as the company actually applies for the grant.

Chairman: Thank you for your attendance and thank you for answering our questions; we are very grateful to you.

Supplementary memorandum from CEST

Letter to the Clerk of the Committee from Dr R. Whelan, Chief Executive of CEST (27.6.94)

At the enquiry last Wednesday there was considerable discussion on the need for output measures of R&D as distinct from input measures such as R&D spend etc.

The question of outputs occurs at two levels:

—the flows of knowledge and people, researchers, post graduates etc.

—the improved economic activity or quality of life.

It is to the latter that the interest of your Committee is directed.

Measurements which have attempted to correlate outputs of a financial nature to expenditure on R&D have revealed the link to be tenuous. There is general agreement that the ability of a company to benefit from R&D is very specific to that company, its products or services, its customers and suppliers—one of the latter being science and technology provision in the form of people and knowledge.

The investment that a company makes has to be directed against the key business processes which allow it to compete. So any measure chosen has to reflect the nature of those key business processes. Let me illustrate this by means of an example. If it were accepted that one of the key success factors for a railway were to have the trains run on time, then there should be a correlation between the resources spent on R&D and the punctuality of the rail system. On the other hand, the success of a computer product might depend on how fast its microprocessor runs at. In that case there should be a correlation between R&D and the speed of their microprocessors. In both cases there could also be a correlation with the overall performance of the company, but this may be more tenuous since in practice there is a set of key business activities which in concert gives the financial results. Following that line of thought there might be four perspectives[1]: customers, operations, innovation and learning and financial, which would make up a set of measures of R&D effectiveness.

Quality of life measures can be derived from crime, social schisms or participation in self advancement such as learning and training as well as the more obvious measures of environmental quality.

Of course, being top of the R&D scoreboard may not be the right place to be. If a company can compete and innovate effectively by doing less than the industry average R&D, then it has gained an exploitable competitive advantage. It might, in scoreboard terms, achieve this by being very productive in the lab, forming alliances, or focusing its limited resources on the things that matter rather than regarding the level of R&D expenditure as some macho indicator of its intellectual virility.

Indeed, there is some sterility in this debate which your Committee could heldp to refresh by encouraging greater consideration for what goals, on what topics and in what way R&D investments are made rather than just how much money.

I hope you find these comments useful.

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[1] This is used in the Nolan Norton Balanced Scorecard, a device for looking at company performance.

APPENDICES TO THE MINUTES OF EVIDENCE

Letter to the Clerk of the Committee from AEA Technology (17 May 1994)

THE FORWARD LOOK OF GOVERNMENT-FUNDED SCIENCE, ENGINEERING AND TECHNOLOGY

AEA Technology welcomes the publication of the Forward Look of Government-funded Science, Engineering and Technology as a replacement for the "Annual Review". This strategy document, laying out priorities and likely expenditure, is very useful to a science and engineering services organisation like ourselves in forming our strategies. This first edition of Forward Look is a commendable effort which we are sure will improve over the coming years as the Technology Foresight Programme begins to deliver.

Letter to the Clerk of the Committee from the Geological Society (16 May 1994)

The Forward Look of Government-Funded Science Engineering and Technology.

The Society has noted the appearance of "Forward Look 1994". Developments in this annual publication were heralded in "Realising Our Potential" (Cm 2250) published last year. Its objectives, as set out therein, presumably have only been partly achieved since the findings of the Technology Foresight Programme and the views of the Council for Science and Technology (para 2.37) will hardly have had time to emerge.

We note the essays on "Environment: soil contamination and its treatment" and "Materials: enabling our potential" and welcome these as indicating the Government's acknowledgement that high scientific priority should be attached to these areas. The economic importance of the latter, in particular, has been generally underestimated in the past. So also, has been recognition of the contribution that science can and should make in these areas. Both are key concerns of this Society and its Specialist Groups.

In "Realising our Potential" (para 2.41) it is affirmed that the Government will be ready to turn to the country's learned societies (amongst others) for external advice and guidance. The present communication is welcomed in that sense. The Geological Society is both the UK's senior learned society in the field and is responsible to the DTI for the title of C.Geol. As such it is happy to transmit the views of both academics and professionals.

Letter to the Clerk of the Committee from the Institute of Physics (17 May 1994)

Thank you for asking the Institute of Physics to comment on the contents and format of the Forward Look document. We are pleased to do so and welcome the opportunity to convey our views to the House of Commons Select Committee on Science and Technology.

Since the intention to publish a Forward Look was announced in the White Paper a year ago, the Institute has supported, with enthusiasm, the production of a document in which each and every government department and agency presents their objectives and future plans for science and technology expenditure.

The 1994 Forward Look is a formidable compilation which is extremely valuable as a source of statistics and which will be used extensively, certainly outside government and, I suspect, also by those who run the government machine. However, it is probably inevitable for a first production, that it is rather unco-ordinated and unfocused.

What of the future? The Forward Look is planned to be produced each year and from 1995 onwards will be influenced by the outcome of the Technology Foresight exercise. The influence of the Technology Foresight conclusions on the Forward Look should lead to a focusing of government science and technology expenditure into areas which are of optimum benefit to the nation. The Forward Look document from 1995 should, therefore, include cross referencing of science and technology expenditure between different departments and agencies and, crucially, evidence of co-operation and collaboration. Our nation is blessed with innovative scientists producing world-class science. How much more effective they would be if the science in which they are involved converged in areas which maximise the potential for wealth creation. The Forward Look, however, must also recognise, within any national science and technology policy, that fundamental science has a crucial part to play and support for science, particularly through the research councils, should not be exclusively directed at the creation of wealth.

From the current Forward Look, it can be seen clearly that expenditure on science and technology by government departments in general and the Department for Trade and Industry in particular is scheduled to decrease in future. For the DTI a 40 per cent decrease is projected over the four years to 1996/97. A report from your committee in April 1994 (*The routes through which the science base is translated into innovative and competitive technology*) makes the point that there is a role for government to play in creating a climate to encourage industry to invest in innovation. The Institute fully supports this conclusion and believes that one of the most obvious ways of creating such a climate is through continuing support by the DTI for science and technology projects within industry. If this is not the route, then it is unclear to the Institute how the Select Committee's sensible conclusion can be implemented.

As requested, this is a brief synopsis of the Institute's views on the Forward Look. If the Select Committee wishes to have further elucidation and advice, please do not hesitate to contact me.

Memorandum from the Royal Society (20 May 1994)

1. The Government Forward Look (GFL) is an important tool for the elaboration of national policy on science and technology. As described in the White Paper *Realising our potential* (Cm 2250), the GFL is intended, among other things, to: assess the extent to which current individual Departmental science and technology programmes are matched to the portfolio of publicly funded work best suited to the broader scientific and technological needs of the country; consider any gaps or imbalances in the national education, training and research effort; consider the balance between civil research commissioned by Departments and that undertaken by the science and engineering base; and address the scope for greater concerted action and collaboration both within the public sector and between the public and private sectors.

2. These are ambitious undertakings. In our response to the White Paper last August, we commented that the GFL would need time to become established, but could in due course prove highly influential. Now that the first GFL has been published, that remains our view: the GFL is a valuable policy instrument, but it is some way yet from, so to speak, realising its potential.

3. The predecessor to the GFL, the *Annual review of Government-funded R&D*, grew rapidly from modest beginnings in 1983 to become a valuable and authoritative compilation. The GFL could follow a similar evolution. We note, in particular, that this first edition was produced under considerable time pressure, and at a period of extensive organisational change. Moreover, the second edition will be able to draw on at least preliminary results from the Technology Foresight exercise. So the 1994 edition should not be judged against the expectation that it would deliver the full set of objectives proposed in the White Paper.

4. Against these constraints, the 1994 GFL is a useful document so far as it goes, and will be a constant source of reference in the coming months. It begins to take us on from the *Annual review* model.

5. Longer preparation time and the Technology Foresight exercise are two factors that will allow the 1995 edition to continue the process of development now started. But the principal challenge will be to produce a document that is more than the sum of its parts—to weld the information about the policies of individual Departments into a detailed, analytic statement about national science and technology policy as a whole. This was not an explicit aim of the *Annual review*, but it is an explicit aim of the GFL and it is inherent in the establishment of the Office of Science and Technology. It is an aim that the Society strongly supports, and is the main criterion against which future editions of the GFL must be judged.

Memoranda from The Royal Society of Chemistry (20 May 1994)

I am writing on behalf of The Royal Society of Chemistry in response to your Committee's general invitation welcoming brief written submissions commenting on the contents and format of the Forward Look document.

The Society has not yet had time fully to digest the Forward Look document and accordingly would reserve its position on the points you raise. The new format—which assembles most of the retrospective material into a large statistical supplement and enables the main report to include a few "essays" and a greater concentration of mission statements etc—is more a half-way house than a finished product. The Society will naturally be interested to see how The Forward Look develops in future years and it is well aware that this represents the first step along the path to a more fully thought-out and comprehensive Forward Look, as the Chancellor of the Duchy himself has publicly recognised.

The Society is itself engaged in a detailed study of trends in science R&D funding, both in the academic and industrial sectors. If your Select Committee would ever wish to consult the Society, in its capacity as a completely independent scientific and professional body, on any scientific matters (especially chemistry) then by all means please let me know.

Further submission from the Royal Society of Chemistry (27 June 1994)

Further to our conversation—about ways in which The Royal Society of Chemistry might be of assistance to the current Select Committee inquiry into "The Forward Look"—I am pleased to enclose this formal submission which encompasses both new material and some observations about future analytical methods.

In the light of the Society's own research into the sources of statistical data which are available to anyone seeking to take a detailed analytical look at what is happening, your Select Committee might be interested in the following observations.

The Statistical Supplement to the Forward Look—and its predecessor the Annual Review of Government-Funded R&D—both provide a good top level view of Science and Technology in the UK. Both provide a wealth of information that gives an insight into the activities and spending of Government Departments and the Research Councils.

However, the Statistical Supplement is far less detailed (and hence less useful) in looking at the health and status of the University and Industry Sectors.

The Select Committee may wish to know that there are a number of accessible sources of statistical data within the public domain (predominantly Government information) that do provide a much better picture than the Forward Look Statistical Supplement for these sectors. The material I have attached has been selected merely to illustrate this point. As you will appreciate, these illustrations do little more than indicate the very full range of material that can be obtained and the analytical possibilities that could be utilized (by the Society or the Select Committee).

I hope this information will be of use to the Select Committee in its current inquiry—and indeed in future inquiries if this is to become a standard yearly exercise—and the Society would be glad to discuss any further assistance that it could be to the Select Committee and the best basis on which that could be done.

Attachments

Figure 1: University—By Discipline Expenditure (Universities' Statistical Records).

Figure 2: University—Income data By Source (Universities' Statistical Records).

Figure 3: Industry—CSO data By Sector.

Figure 4: Industry—CSO data—Chemical's Sector.

Figure 5: Industry—R&D Score-board—By Sector.

Figure 6: Industry—R&D Score-board—By Company.

Figure 7: Industry—R&D Score-board—International Comparisons.—By Sector.

Figure 8: Government—EC Country Comparison (Eurostat).

The Universities' Statistical records data gives information on Income and Expenditures, for research grants and contracts. The University Funding Council (and now the HEFC's) hold detailed breakdowns by discipline, university and source of research grant and contract funds by both Income and Expenditure. The CSO should be able to recast their Industry data from which Figures 3 and 4 are derived into the same form as Figure 5, without compromising any confidentiality criteria.

Figure 1

UNIVERSITY ACADEMIC DEPARTMENT SPENDING
All Disciplines – Research Grant & Contracts Spending
Real Terms – £1,000's
1991 = 100

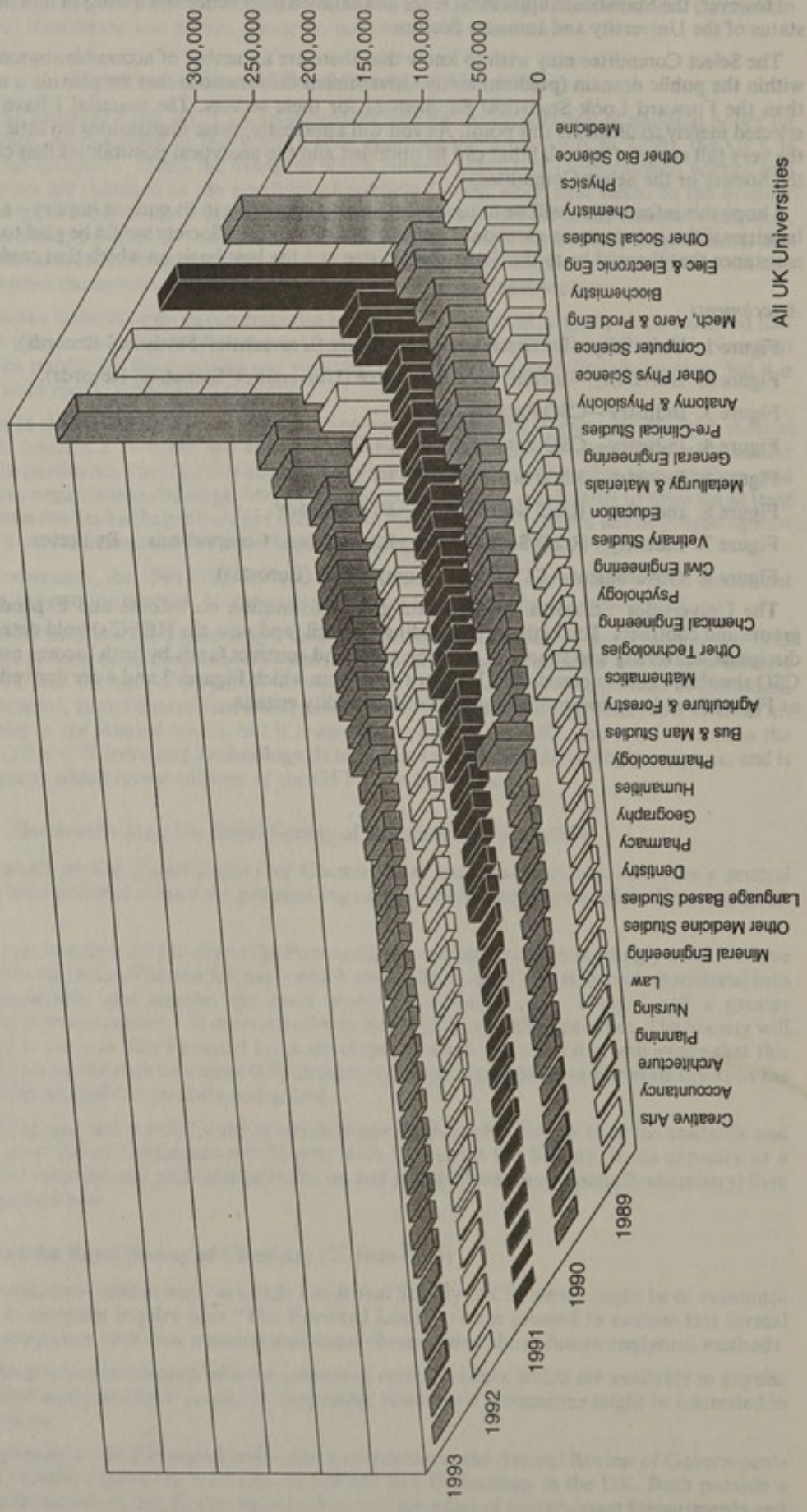


Figure 2

UNIVERSITY RESEARCH GRANTS & CONTRACTS
Income from UK Industry Sources
Real Terms 1992 = 100
£'s Thousand

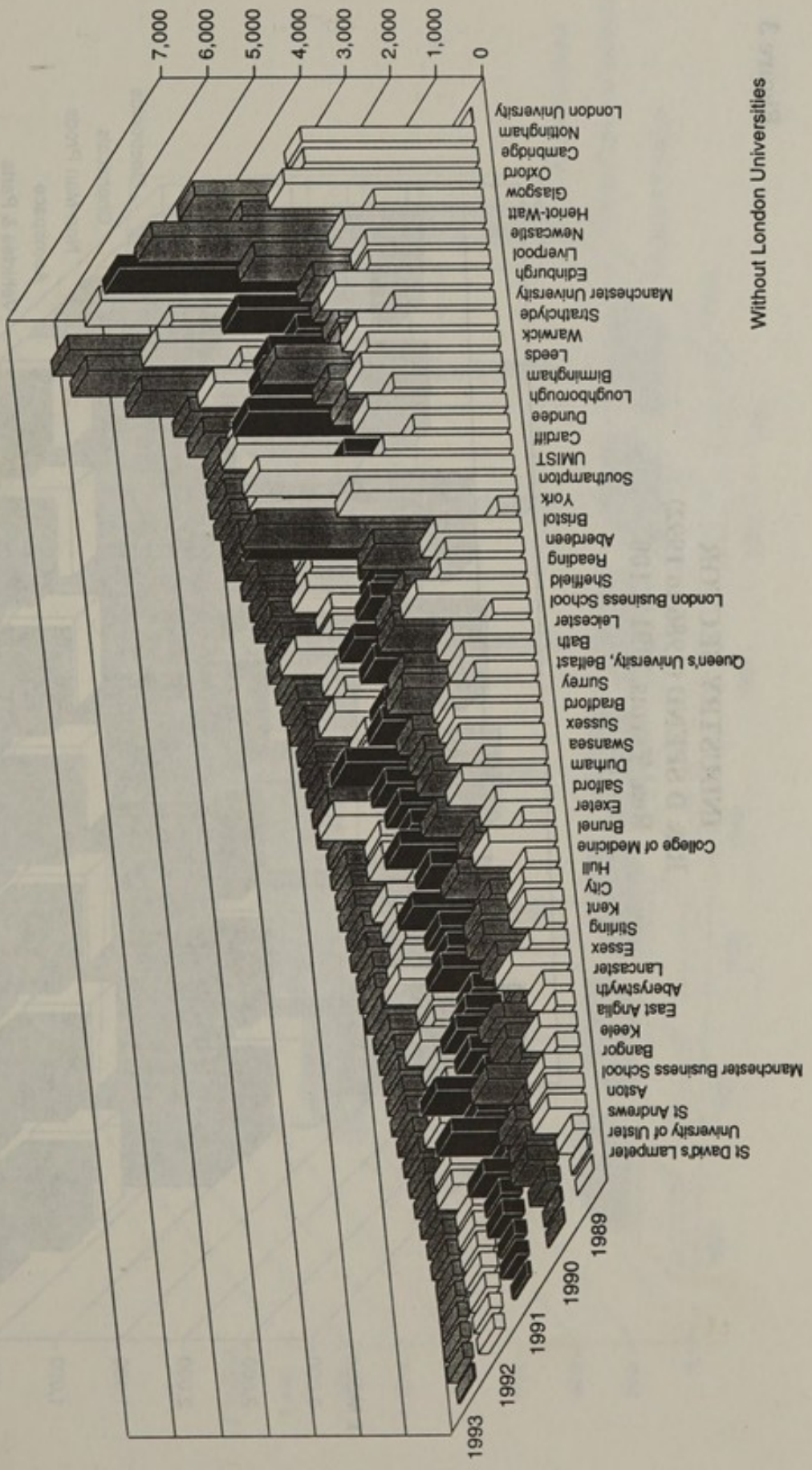


Figure 3

INDUSTRY SECTOR
R & D SPEND (1986 to 1992)
Real Terms 1991 = 100

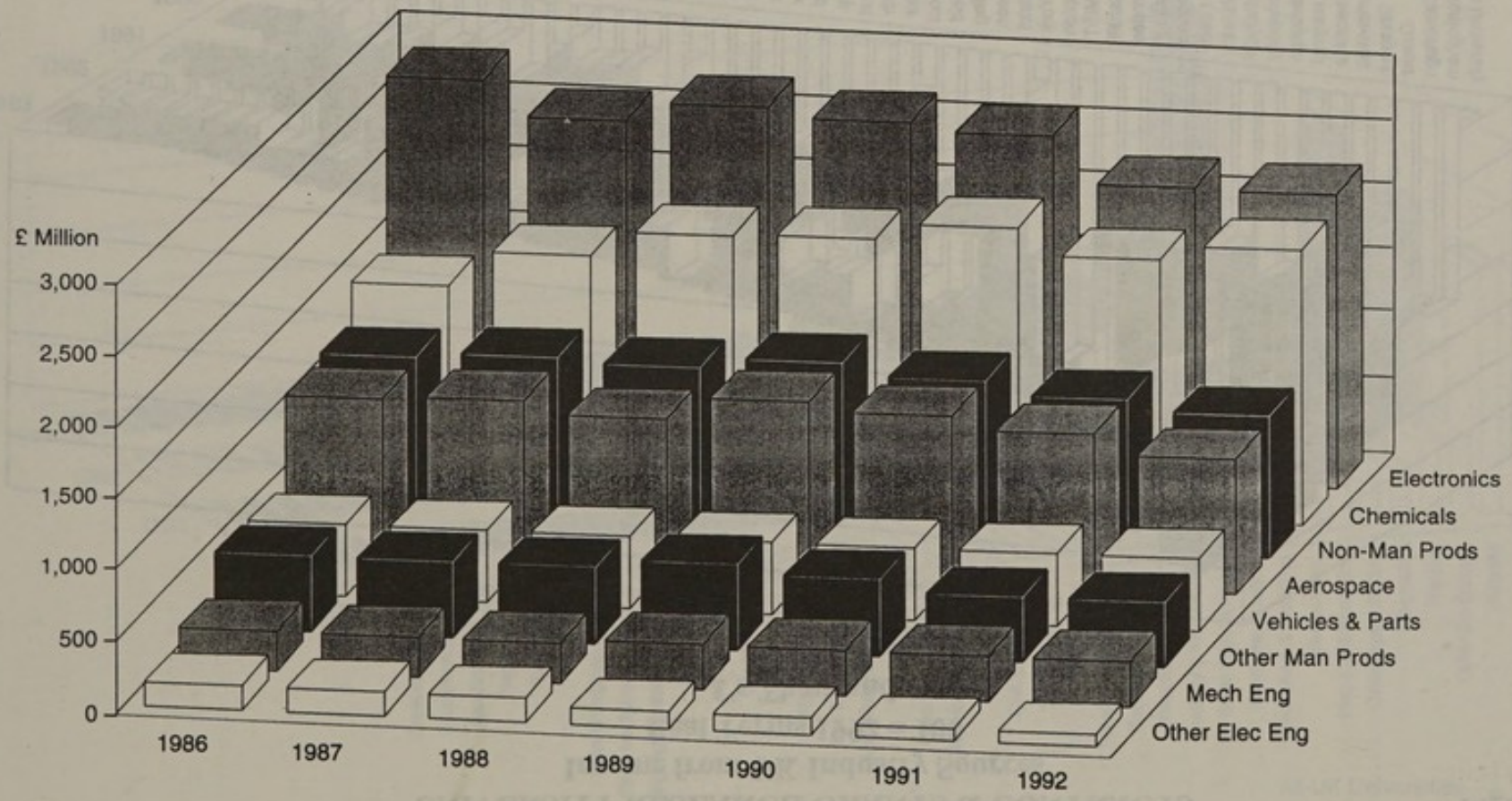


Figure 4

CHEMICALS INDUSTRY SECTOR
R & D SPEND (1986 to 1992)
Real Terms 1991 = 100

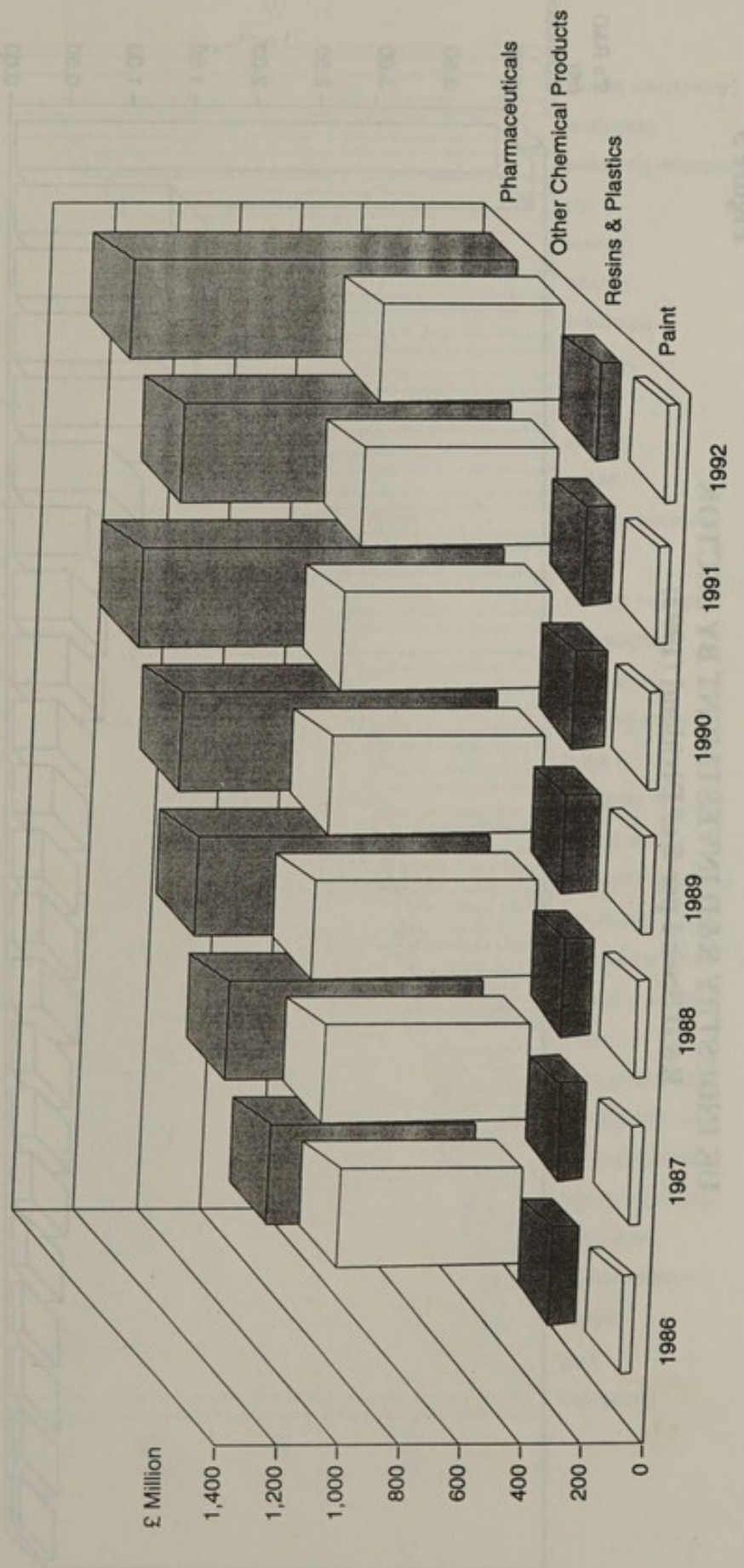


Figure 5

UK INDUSTRY R&D INVESTMENT BY SECTOR
R&D Spend per £ of Dividend (1992)

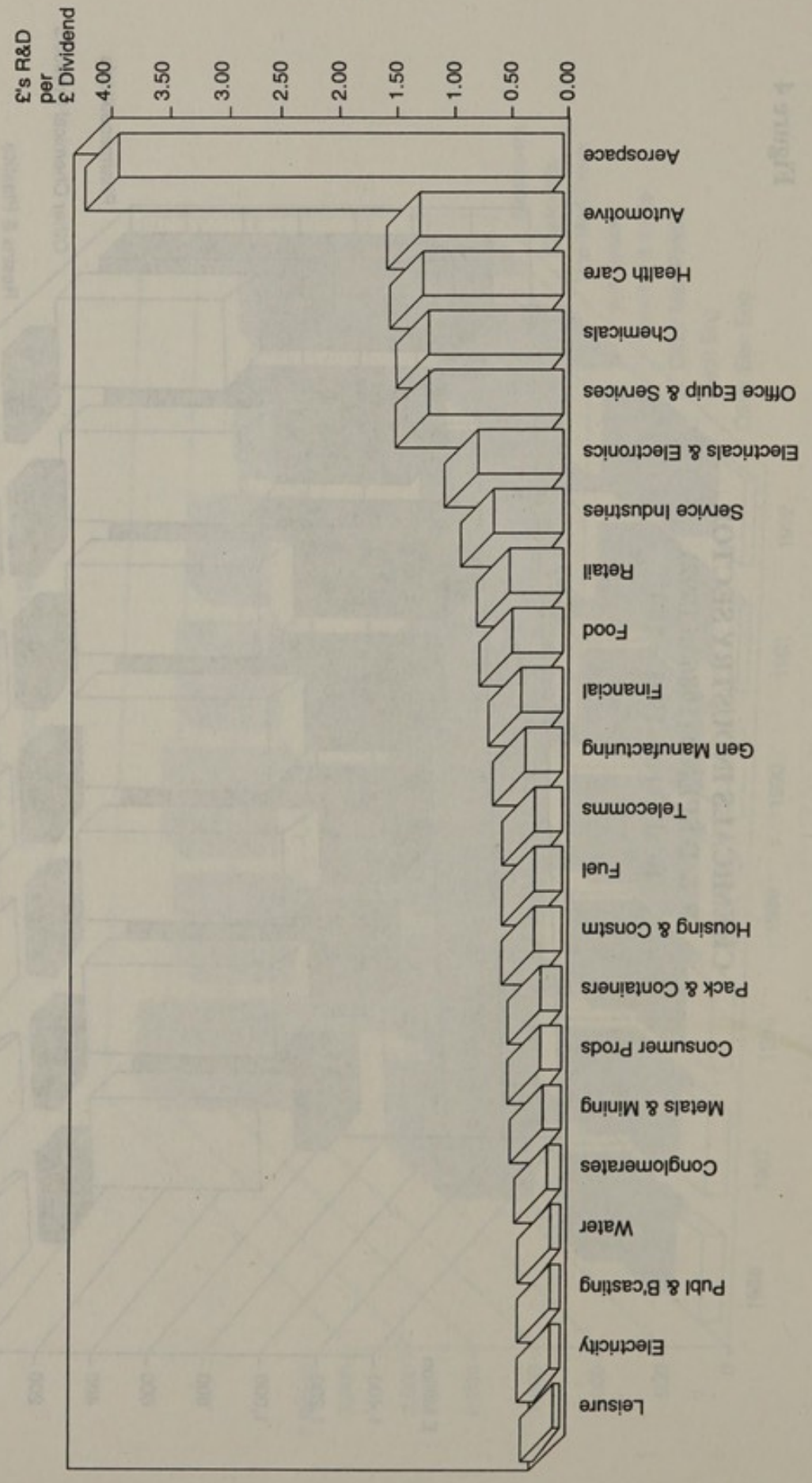


Figure 6

UK CHEMICAL SECTOR INDUSTRIES
R&D Spent per £ Dividend (1992)

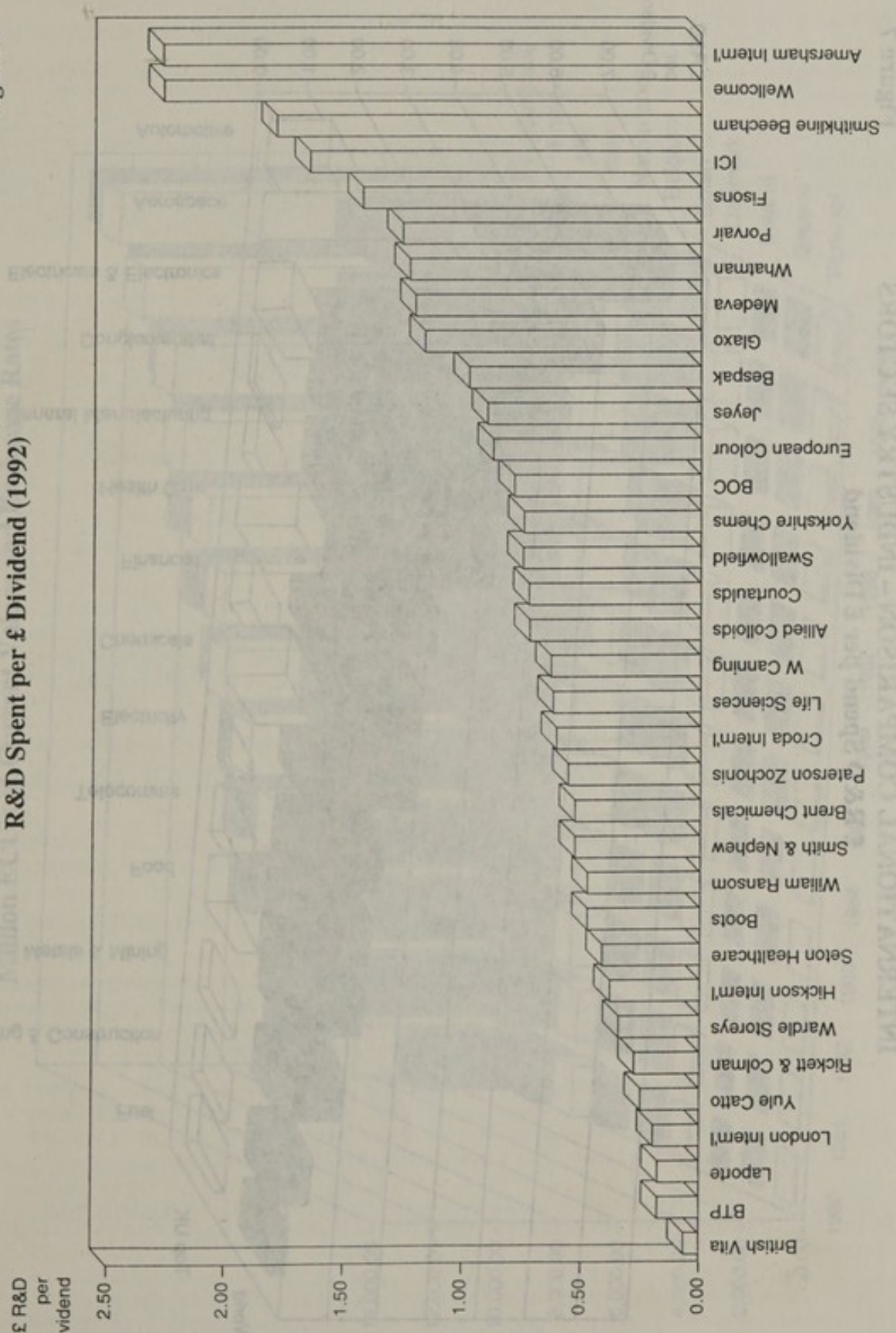


Figure 7

INTERNATIONAL COMPARISON – INDUSTRY SECTORS
£ R&D Spend per £ Dividend

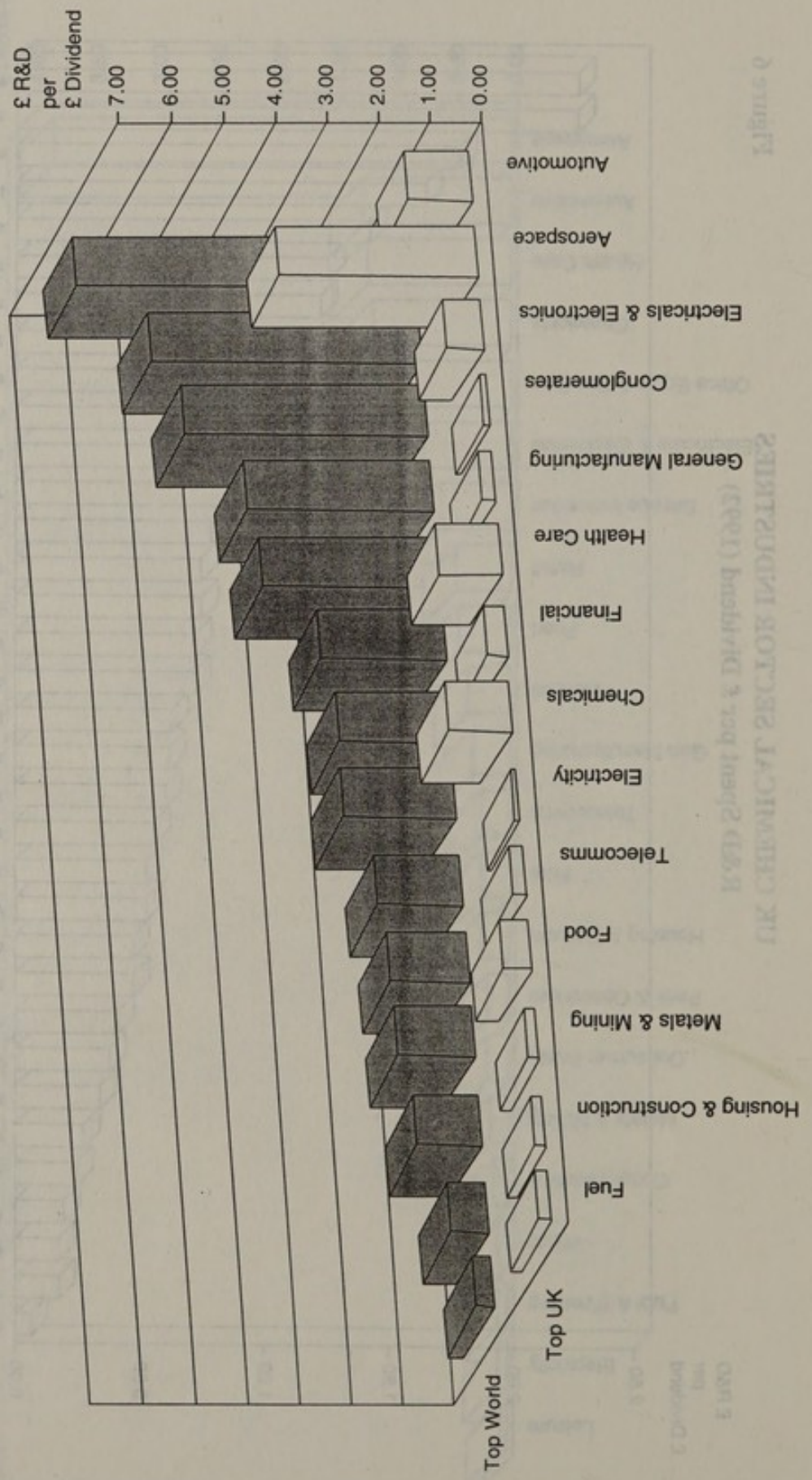
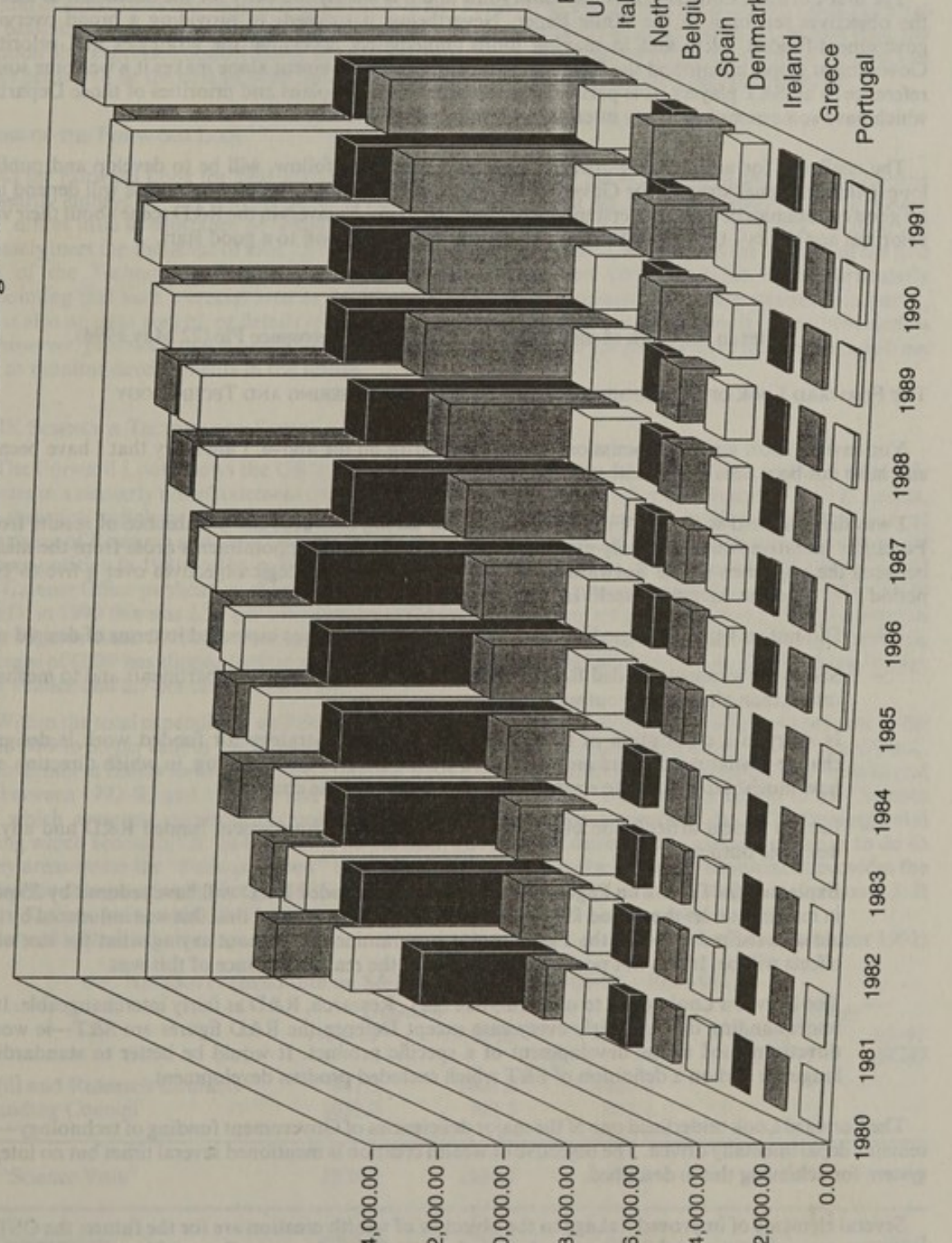


Figure 8

EC MEMBER COUNTRIES – GOVERNMENT FUNDED R & D BUDGETS
Million ECU's at Current Values and Exchange Rates



Letter to the Clerk of the Committee from The Medical Research Council (23 May 1994)

FORWARD LOOK OF GOVERNMENT-FUNDED SCIENCE, ENGINEERING AND TECHNOLOGY

I am responding to the request for brief submissions commenting on the contents and format of the Forward Look document.

The first Forward Look is necessarily embryonic and it is clearly too early for the document to meet fully the objectives set for it in the White Paper. Nevertheless it succeeds in providing a broad overview of government-funded R&D and in making more immediately accessible the strategies and priorities of Government Departments and the Research Council. This achievement alone makes it a welcome source of reference to all S&T players. It is particularly valuable to see the plans and priorities of those Departments which have some complementary interests with those of the MRC.

The challenge for next year's Forward Look, and those that follow, will be to develop and publicise a longer-term national strategy for Government-funded S&T. The success of this process will depend in part on good communication and understanding between the various players in the R&D scene about their various priorities and needs—this year's Forward Look gets that process off to a good start.

Letter to the Clerk of the Committee from British Aerospace Plc (22 May 1994)

THE FORWARD LOOK OF GOVERNMENT-FUNDED SCIENCE, ENGINEERING AND TECHNOLOGY

You invited short written submissions to the Committee on the above. I am sorry that I have been away and have not been able to respond earlier.

I was disappointed with the "Forward Look" even taking into account the absence of results from the Foresight Initiative which was fully explained in the text. These disappointments arose from the mismatch between the objectives of the Forward Look—it "...would set strategic objectives over a five to 10 year period . . ." and the document itself. In particular the document:

- Did not set out a strategic framework of high level objectives expressed in terms of desired results.
- Shows Government funded R&D to be managed by allocation to departments and to mechanisms rather than allocated to output strategies.
- Is short of a description of those measures which the strategy for funded work is designed to change—what parameters are considered by the OST to need shifting, in which direction and by how much? How does the strategy intend to achieve these changes?
- Lacked a clear articulation of the connection between Government funded R&D and any set of desirable outputs.
- Explained (in Table 1 on Page 14) that Government funded R&D will have reduced by 25 per cent in real terms over the period 1992–93 to 1996–97 and commented that this was influenced by launch aid and the reduction in the Fast Reactor programme but without saying what the size of these effects will be. It was not possible to judge what the real significance of this was.
- The Forward Look seems to use terms like S&T, Research, R&D as fairly interchangeable. It is my understanding that in nearly every case except Defence the R&D figures are S&T—ie work not directly related to the development of a specific product. It would be better to standardise the language and on a definition of S&T which excluded product development.

The Forward Look underlined one of the major deficiencies of Government funding of technology—that it remains departmentally driven. The objective of wealth creation is mentioned several times but no integrated system for achieving this is described.

Several elements of improved linkage to the objective of wealth creation are for the future: the OST plans to pursue trans-departmental issues are welcome, the DTI White Paper on Competitiveness will be received with great interest, the new structure of the Research Councils has a new opportunity to assist in this integrating role, and the Foresight Initiative has not yet produced any results but is widely supported and we hope will produce very useful results. So much may change in the next year or two and the Forward Look makes reference to these plans and should not therefore be entirely discounted. Nevertheless, as a current

statement of a strategy for Government funded Science, Engineering and Technology it serves mainly to underline current shortcomings.

I hope the Committee will find this short statement useful to their examination.

Memorandum from the Institution of Professionals, Managers and Specialists (3rd June 1994)

1. The 1994 Forward Look of Government Funded Science, Engineering and Technology was published at the end of April. In its response to the 1993 SET White Paper, IPMS welcomed the Forward Look initiative as the basis for developing a coherent national strategy on science and technology. However, at that time, the Institution also expressed doubts about the effective translation of overall strategy into practical policies and this has proved to be the case in both substance and format as the rest of these comments indicate.

PURPOSE OF THE FORWARD LOOK

2. As the Forward Look for 1994 itself notes, coming so soon after the White Paper, the Forward Look is "necessarily embryonic". It is nevertheless disappointing that except for the short "essays" the "Forward Look" differs little in substance or format from its predecessor the "Annual Review of R&D". It does not adequately meet the challenge of looking forward over the next 5-10 years, although in the absence of the first report of the Technology Foresight exercise this is perhaps also understandable. It is particularly disappointing that such a crucial area as the Ministry of Defence produces no mission statement in part 2. There is also no clear sign of, or details relating to, a cross government strategy or how it will be provided. It does, however, produce a useful overview of the situation one year after the SET White Paper and a base from which to monitor developments in the future.

THE UK SCIENCE & TECHNOLOGY SCENE

3. The Forward Look shows the UK's annual investment in R&D, public and private, is £12.6 billion. It also notes in a masterly understatement that this is "rather less than some other G7 countries". (3.12). In fact, as the statistical supplement (section 1.6) and the more detailed Cabinet Office publication "International comparisons of Research and Development Spending" (1992) show the UK has slipped badly both compared to its own position in 1981 and by comparison with other OECD countries. Thus, for example Table 1 (p.15) of the Cabinet Office publication shows that whereas in 1981 the UK was spending 2.42 per cent of its GDP on R&D, in 1990 this was 2.21 per cent and the UK had slipped from 3rd position among OECD countries to 7th. Figures since 1990 show no improvement. Indeed, as it shows in Forward Look table 1.6.4. the percentage of GDP has slipped further to 2.1 per cent in 1992 compared with 2.6 per cent in Germany, 2.4 per cent in France and 2.7 per cent in the USA.

4. Within the total expenditure on R&D in the UK publicly funded R&D has fallen from 43 per cent of the total in 1989 to 35 per cent in 1992; and within that publicly funded proportion a major fall has taken place. The Government claims to have increased funding for the Science and Engineering Base by 6 per cent in real terms between 1992–93 and 1994–95 and plans to hold funding steady. But this only relates to the "Science Vote" which accounts currently for only 37 per cent of Government spending on S&T. Departmental spending which accounts for the remaining 63 per cent, has declined dramatically and will continue to do so in many areas under the "Forward Look" to 1996–97. Table 1.2.3. in the statistical supplement provides the raw data for changes over the decade 1986–87 to 1996–97. A summary of its main features is given on p.3. It shows a 32.8 per cent overall decline in total public funding for R&D between 1986 and 1996.

Summary of table 1.2.3. £ million (base year 1992)

Net Govt expenditure on S&T in Real Terms 1986–87—1996–97 (i)

	Out-turn		*Plans*	*% Change*	
	1986–87	*1992–93*	*1996–97*	*92–93 / 86–87*	*96–97 / 86–87*
OPSS(ii) and Research Councils	841.3	1021.8	1085.0		
HE Funding Council	1032.7	963.3	878.8		
Total "Science Vote"	1874.0	1985.1	1963.8	+5.9	+4.8
Civil Departments	1707.9	1218.2	910.1	−28.7	−46.7
Defence	2784.8	2220.9	1826.4	−20.2	−34.4
Total Departments	4492.7	3439.1	2736.5	−23.5	−39.1

18 May 1994] *[Continued*

	Out-turn		*Plans*	*% Change*	
	1986–87	*1992–93*	*1996–97*	*92–93 / 86–87*	*96–97 / 86–87*
Indicative contribution to EC	136.7	250.8	313.3		
Grand Total Real Terms	6503.4	5675.0	5014.0	−12.7	−32.8
Cash Terms (iii)	4534.0	5675.0	5725.6	+25	+26.3

i. The S&T figures are used but they differ very little from the R&D figures in terms of quantum and pattern over time.
ii. OPSS forms a very small percentage. £19.8 million in 1992–93.
iii. Cash terms are taken from table 1.2.2. in Forward Look.

5. The virtual halving of civil departments' S&T expenditure over the decade will have major consequences for research councils, institutes and GREs who rely heavily on departmental funding and is one of the factors which lie behind the Government's determination to privatise and rationalise the public sector research establishments (PSREs). Moreover, the money saved by major cuts in defence research has not been diversified into civil research but had gone straight into the pockets of the Treasury.

6. Nor is the decline in civil S&T spending only the result of cuts in nuclear energy (pariticularly the fast reactor programme) and increasing receipts from Launch Aid as the Government suggests. While they have clearly played a part the cuts in DTI have gone much deeper than that. Over the period 1986–87 to 1991–92 when the Department of Energy was separate from DTI and covered nuclear expenditure, DTI expenditure declined from £462.1m to £330.9m in cash terms. Over the period 1992–93 to 1996–97 its budget excluding the ex-Department of Energy component and excluding launch aid is set to increase marginally from £220.3m in cash terms to £242.5m; which is still likely to mean a decline for DTI spending in real terms.

7. As far as energy spending is concerned not only has the nuclear energy S&T budget been severely cut, thus damaging long term research into the nuclear option for the 21st century, but non-nuclear S&T has also suffered, as can be seen from table 2.18.2 For example, expenditure on "renewables" is to be cut from £22.9m in 1991–92 to £16.3m in 1994–95 and we now know from the Government's recent review of renewable energy research that the budget is to be cut further to £10m in 2005 in cash terms.

8. Moveover, other departments have been reducing expenditure substantially. For example, the MAFF budget which not only finances its own GREs but also plays a major role in funding AFRC (now BBSRC) has declined from £224.8m in 1986–87 to a planned £154.2m in real terms in 1996–97.

9. The Government appears to be looking to the prvate sector to fill the gap in public funding. It says in para 3.5 that "it has been encouraged by the growth of private sector civil R&D funding over the last decade "and as the economic recovery continues to gather pace" it will look to it to resume the growth in its R&D outlay. The statistics in the Forward Look do not support such optimism. Both the essay on Private Sector Investment in R&D and section 1.4 of the statistical supplement show that there has been an overall decrease in expenditure in real terms by the private sector over the period 1986–1992. (£8,536m in 1986 and £7,930m in 1992; see table 1.4.1.) The "Forward Look" does not contain forecasts for private sector expenditure but there is little evidence on the past record and recent trends to suggest that there will be a dramatic improvement to compensate for the massive decline in public spending. Evidence from specific sectors which have been recently privatised do not auger well either. For example, the experience of the electricity industry since privatisation is that the commercial sector is often unable or unwilling to fund basic research, and in agriculture following the withdrawal of public funds from "near market" research in the late 1980s there was concern that the private sector failed to make up the shortfall in funding.

10. The consequence is that much valuable research whether related to economic growth or the quality of life is not done at all and that where commercial funding does fill the gap there is pressure to concentrate on the short term. For example, Universities engaged in collaborative projects have recently warned both of a risk of conflict between research and commercial objectives and that a two tier system will emerge. Whilst disciplines such as pharmaceuticals, biotechnology and electronics are so far doing better at attracting industrial sponsorship than medicine, engineering and social sciences, they are also vulnerable to external funding being withdrawn. there is also evidence of commercial funders exerting pressure to narrow the

researcher's approach. According to the Association of Industrial Liaison Officers "because universities need to increase funding, there is pressure to take on work which is income generating first rather than knowledge generating".

RESEARCH PRIORITIES IN THE PUBLIC SECTOR

11. This chapter of the Forward Look presents a digest of Departmental research programmes. The underlying theme is that there should be greater collaboration with industry and increased emphasis on the commercial exploitation of results. However, it would have been helpful to have an indication of which are continuing programmes, which are new, where the research is being undertaken and whether any programmes have been completed or withdrawn. The results of the Technology Foresight programme, when available, may provide useful information about the context and objectives of research.

12. We would like to draw particular attention to the DTI and MoD plans. We have already noted above that the funding in these two major components of the public spending on S&T is in substantial decline. But we are also concerned about the content of their S&T programmes. The DTI lists as its priorities an increase in the number of industrial secondees in its Innovation Unit, developing a network of Business Links and boosting its "Managing in the 90s" programme to assist inthe spread of best practice. Although IPMS would agree that improved liaison programmes have a valuable role to play, there is barely a mention of the need for strategic research—merely a grudging statement that DTI will continue to support S&T to underpin statutory obligations. IPMS made similar points in our evidence to the Science & Technology Committee's inquiry into "The routes through which the science base is translated into innovative and competitive technology" and does not repeat them here. The report of that Inquiry and the DTI Committee's report on the "Competitiveness of manufacturing industry" both made recommendations on the crucial role of DTI in providing funding for R&D both within and outside the public sector. It is especially disappointing therefore that the recent White Paper on Competitiveness ignores their advice and reiterates the approach put forward in the "Forward Look" which is to concentrate on the "marketing aspects" of technology transfer and "business links". There is a very grave danger that the reduction in S&T staff in HQ policy divisions, the decision to dispose of the position of Chief Scientific Adviser and the privatisation of the DTI research laboratories will reduce its ability to act as an "intelligent customer", thus reducing the quantity and quality of commissioned research still further, and leaving a policy vacuum whereas the DTI should be the driving force for S&T in the service of economic growth.

13. On Defence, while clearly the primary focus of defence research must be to retain the appropriate capability to meet UK defence needs, it is disappointing that, as in the SET White Paper, very little attention is devoted to diversification and meeting UK civil needs. Such diversification should not be at the expense of meeting defence needs but should be resourced from some of the savings on defence S&T currently being remitted to the Treasury.

TAKING FORWARD "REALISING OUR POTENTIAL"

14. This chapter reviews a number of initiatives taken to progress the policies set out in the White Paper "Realising our Potential". These inciude:

SET 7 and Science Careers

15. IPMS welcomed the initiative in establishing National Science Week—SET 7, actively promoted it and organised a public debate during the course of the week, and will support similar events in future. However, as many people including William Waldegrave have pointed out, there is little point in trying to encourage young people to go into SET if their pay and careers in the UK are less rewarding than other professions and occupations. Recent studies for the Department for Education and the Department of Employment both identify a decline in pay of scientists and engineers relative to finance and management as a disincentive to scientific study. Moreover, many of those who do graduate, and especially post-graduates, take their expertise overseas. A survey by the Royal Society in late 1993 found that one quarter of British born Fellows were living abroad, and that low salaries and the low status of science in Britain were frequently cited as reasons for moving.

16. Although the SET White Paper itself recognised that improvements in the supply of high quality science and technology staff depend on better careers and rewards and that short term contracts are blighting the careers of scientists, it made no serious proposals to remedy most of these deficiencies. IPMS welcomed the White Paper's recommendation that Research Councils should take account of the future careers of academic research students and reduce reliance on short term contracts. The same recommendation should be applied to the Research Council's own staff and to the Government research establishments. The recent Efficiency Scrutiny study on "Career Management and Succession Planning" also recognised the problems and concluded that short term contracts should not be encouraged. A sharp reduction in the use of short term contracts would be a major contribution to improving the morale of scientific staff and the supply of science recruits.

17. We would also highlight the need to maintain and increase the flow of high calibre STEs into senior policy making positions in the Government service both in scientific and generalist roles. This is particularly vital because of the increasing technical complexity of many political and administrative decisions and the need for "intelligent customers" for S&T in government departments. The maintenance of an "effective demand" for S&T in both the public and private sector is, as if not more, crucial than the "supply side" issues.

18. Although the statistical supplement has a section on "Science, Engineering and Technology Personnel" the Forward Look says very little about this vital component of S&T strategy. While the section on the Department for Education has a short section on schools and further education, the Department of Employment section is primarly concerned with its own research across the board and says very little about the SET labour market as such.

19. As far as internal government and research council staffing is concerned the submissions from research councils all include comments on education, training and career development. Those produced by Government Departments do not. Indeed the information provided is even less that it used to be under the "Annual Review". Since the role and status of SET presonnel is as vital within government as it is within society as a whole, it is essential to provide both data and strategy on this aspect. At the very least it would be helpful if this information could be provided on a standard basis, so that good practice could be more widely disseminated. There are, for example, some useful statements about reviewing the balance of short term and long term appointments, establishing a database to track career paths and provide data on labour market trends and providing mid career training.

Increasing Efficiency and Effectiveness.

20. The Forward Look states that it is through widening market competition that the Government seeks to secure high quality scientific services and good value for money. It also urges Departments to examine critically their own ability to act as intelligent customers. As IPMS has argued previously, there are several problems in the Government's approach. The pressure to compartmentalise institutionally the roles of "customer" and "contractor", rather than simply recognising their separate roles, will greatly hinder the free flow of people and ideas improverish the quality of advice and reduce the ability to act as intelligent customers for research. In the commercial world good customers take the trouble to cultivate close links with suppliers, they do not normally shop around at "arms length". Moreover, under the original "Rothschild principles" set out in 1972 it was the intention that customers should sustain the general research capability in their charge and the "contractors" should receive some finance, not immediately related to a specific programme of work via a surcharge (10 per cent was suggested as appropriate) on the customer's programmes. It is essential that clearer mechanisms and obligations should be introduced to ensure that departments play their full role in funding strategic and basic research relevant to their responsibilities.

21. The degree of competition which is necessary or desirable also needs to be considered. In many areas there may be no realistic possibility of creating intra UK competition. Indeed, an insistence on competitive tendering may fragment research effort, impede co-operation and information sharing and undermine the capacity of UK research to compete internationally. Research capacity once contracted-out or a bid lost to competitors is often lost for ever. If the new contractor fails to deliver there may be no alternative or "in-house" experts to pick up the pieces, or to bid for the contract next time round.

22. Moreover, while Government departments and GREs are being encouraged to obey very strict rules on competition, their competitors often are not. There is a real fear of subsidised competition from UK universities where accountability and costing of research overheads are not so strict; from private companies whose own accounting procedures enable them to run "loss leaders" in order to capture the market, and from institutions abroad, whether public or private, where similar practices and subsidies may apply.

23. These problems of unfair competition will be exacerbated by Directive 92/50/EEC "Relating to the Co-ordination of Procedures for the Award of Public Service contracts" whereby the effect from 1 July 1993 public authorities procuring services are required to advertise in the EC official journal contracts worth at least ECU 200,000. The precise impact of the Directive is unclear and the expectation is that because of the complexities in applying the definitions and exclusions in the UK context, clear ground rules will only be established on a case by case basis in the courts. In general, however, because the UK has gone further than other member states in separating, privatising, and contracting-out public research activities, the potential impact of the Directive is greater than elsewhere. There is a serious danger that UK public research establishments will be exposed to greater competition without reciprocal opportunities, and will lose research contracts in the process. As a result the UK public research infrastructure will be damaged and its capacity to compete in future and to deliver the objectives of economic growth and quality of life undermined.

24. The impact of the application of the customer-contractor principle in all these respects should be closely monitored in the "Forward Look" and S&T areas should not be opened up to full competition unless people are convinced it provides good value for money for the customer department, the maintenance of UK public science capacity, and the public, and until the problems of ensuring a level playing field have been overcome.

25. The Forward Look notes that "on the supplier" side the Government is undertaking a scrutiny of public sector research establishments with a view to privatisation and for those which cannot be privatised yet, to rationalisation. In fact the research establishments are not simply contract "suppliers". The scientists in the government laboratories form the vast majority of scientists in the civil service and are in effect the "SCIENTIFIC CIVIL SERVICE". They form an integral scientific network between and within departments and agencies, not simply performing their defined "operational" projects but acting as a flexible, wide ranging, readily available and essential government S&T resource of independence, integrity and international reputation.

26. This interconnected service is vital for mobilising a strategic and co-ordinated national response on science and technology as envisaged by the White Paper. To approach the scrutiny from the point of view of which bits are commercially profitable and privatisable would ignore these often intangible and unquantifiable functions which are currently performed by an integrated whole. To privatise and fragment the scientific civil service in that way would have a severe impact on the scientific quality of govenment decision-making.

27. Nor does IPMS accept that privatisation necessarily does or can produce a higher quality of service, or that it represents the "best value for money" either for direct customers or for the taxpayer. In fact Government research establishments are already varied in structure and sources of funding and are developing a flexibility and responsiveness that is able to accommodate a range of contractual arrangements and operating demands. It is also important to remember that there has already been a prolonged period of change, culminating in the restructuring of research councils from 1 April. Public research in general would benefit from a period of stability. Continuing uncertainty is likely to have an adverse impact on the commitment and morale of highly skilled and dedicated staff, the main asset of research establishments. Time should also be given for changes currently underway and for the new Whte Paper initiatives, including Technology Foresight and the Forward Look, to work their way through.

Woman in Science, Engineering and Technology

28. IPMS was represented on the Working Group and gave evidence to both the SET White Paper and the OST Inquiry Committee on this issue. IPMS welcomed the report and are anxious to see it implemented. We are particularly concerned, therefore, at the absence of the Minister for Science at its public launch and the fact that he has still not expressed a view on its modest recommendations. We are also disappointed to note how few of the appointments to the various bodies established following the White Paper have been women. It is vital that the OST report is followed by action and that the situation of womem in science is closely monitored in future Forward Looks.

Wealth Creation and the Role of Departments

29. We have noted above how disappointed we are with the content of DTI and MOD policies and the implications of declining government funding for both wealth creation and quality of life objectives in the major S&T spending departments.

30. We note in paragraph 5.15 that the OST intends to agree with Departments during the course of this year a series of output measures and **performance indicators** for measuring achievements in respect of wealth creation and other quality of life objectives. It is important that they do measure quality as well as quantity and take account of the fact that some programmes may have neither any short term commercial payback or immediate outcome. It is also important that indicators or "outcomes" are presented in a consistent way year on year. For example, it is important that the analysis of "outputs" such as patents and publications are not simply presented as a one-off "essay" (which incidentally confirms that the decline in "in-puts" in the UK is being matched by a decline in "outputs") but are regularly monitored.

31. In Annex A we have indicated the areas of the SET White Paper which we consider should be regularly monitored, using performance indicators refined for the purpose where possible and relevant.

Science and Engineering Base

32. IPMS welcomes the statement in the Forward Look that the science and engineering base should not be turned into short term problem solvers for industrial customers. An appropriate balance must be struck between long term strategic research, which the public sector is uniquely placed to fulfil, and meeting the market needs of industry. It is unfortunate however, that the Forward Look goes on to suggest in coded terms that the work of the research councils will, in fact, be driven by short term considerations. There are thinly veiled threats of job losses and it is stated that rewards for staff will reflect the relevance of research to industry and other users. Moreover, it is not reassuring when the new Dirctor General of Research Councils in order to finance a set of new initiatives to encourage researcher links with industry costing £15.4m; has asked Research Councils to find retrospective "efficiency savings" from their own budgets to cover half the cost.

THE CHANGING INTERNATIONAL CONTEXT

33. The Forward Look states that the strength and diversity of the UK science and engineering base has put it at the forefront of international collaboration. It is to be hoped that this will continue but the general position set out in para 3 above, together with some of the other policies being pursued may make this more difficult. Within the European Union the UK has the harshest rules on attribution and IPMS shares the concerns of the House of Lords Science and Technology Committee about the effect of this on willingness to bid for EC funds. The Forward Look also repeats the Government's support for the allocation of European contracts through competitive tender, but does not mention the difficulties in developing an intelligent customer role at this level. This is also noted in advice to the House of Lords enquiry into the European Fourth Framework Programme. Nor does it mention the problems of the procurement directive spelled out in para 23 above.

TECHNOLOGY FORESIGHT PROGRAMME

34. IPMS welcomes Technology Forsight Programme and the attempts which have been made to involve a wide range of opinion both in setting up the process and in nominations to panels. It is particularly important to capture the views of SMEs and of working scientists and others at the "cutting edge" whether they be research providers or those involved in marketing or defining the "customer" demand. It is also important, particularly in the "quality of life" aspects of research to involve a wider range of interested parties such as consumer and environmental groups, trade unions and the public at large. We doubt whether these objectives have been fully met so far and are particularly disappointed that neither the Technology Foresight Steering Group, nor the chairs of the Sector Panels include any women.

STATISTICAL SUPPLEMENT

35. We have commented on and drawn from the various aspects of the Statistical Supplement in the foregoing paragraphs as far as the format of the statistics are concerned. We have the following comments.

R&D performed in UK Industry

36. Statistics will need to be collected to match key indicators. For example, statistics will need to be disaggregated to sector or even company level, depending on the strategy emerging from the Technology Foresight and Forward Look process.

R&D Performed in the Public Sector

37. Although Government departments and research councils are covered in some detail in the Annual Review, other public bodies are not—eg British Rail; AEA Technology. The statistics should be more comprehensive on both R&D performed the other dimensions mentioned below.

R&D Personnel

38. The sections on personnel both within government and in the UK as a whole, are inadequate for proper monitoring, effective foresight, or an informed labour market. Current statistics whether internal or external to Government omit the gender dimension completely and in many cases they do not include the technician or "non-graduate" level who are a crucial part of high quality labour force needed if the UK is to compete effectively.

39. Within Government—more detailed statistics are required on gender, type of employment—eg full time, part time, fixed term contract, and all levels in the hiearchy should be analysed. Currently there is a gap in statistics at the crucial grades for measuring the entry of STE personnel into leadership/policy-making positions—ie UG4–7. It is possible to obtain STE figures below UG7 and at UG 1–3 individuals and their backgrounds are listed. It must be possible to determine the background of those at UG7 to UG4 level especially with departments and this should be done.

40. In the UK as a whole the current statistics on STEs are inadequate to the task of monitoring the impact of policies or understanding what is happening in the STE labour market, especially below gradute level. Better statistics are not only required for core STE occupations, but also for STE staff in other occupations such as management, financial and consultancy functions both at different levels within a company/organisation and in separate organisations or sectors. Such statistics need to cover not only cross

sectional and longitudinal aggregate statistics, but also the career paths of individual STEs going beyond first appointment after graduation. As in the case of statistics within Government, national and international statistics should include gender, non-graduate as well as graduate, and where possible, information on patterns of working.

ANNEX A

MONITORING WHITE PAPER OBJECTIVES

This annex sets out some of the major objectives in the SET White Paper and suggests ways in which performance might be monitored. Paragraph references in brackets refer to the original White Paper "Realising our Potential".

(a) *Protection of/and Building on Strengths in Science & Technology (1.16)*

There are several ways in which the general strength of science and technology can be measured. Key indicators include:

- level of public and private sector funding.
- publications and prizes are measures of scientific "excellence" but other indicators relevant to specific objectives should be added.
- patents are key indicators of the health of transfer of science into technology/application.
- ability of infrastructure to attract international projects and inward S&T investment.
- audit of physical infrastructure including facilities and euipment.
- audit of human resources (S&T personnel at all levels including support staff).

Specific indicators of the economic and quality of life objectives should be developed. Specific linkages to S&T may be difficult to monitor precisely but correlations could be analysed, especially as the Technology Foresight and Forward Look process begins to define particular sectors of importance.

(b) *Government's use of funds and its efforts in science and technology will be made more explicit and open (1.18)*

- the impact of Government policies for S&T should be monitored.

(c) *Technology Foresight will be used to inform Government's decisions and priorities (1.18(2)).*

- is it tapping the expertise of people closest to emerging scientific, technological and market developments?

Is better understanding and interaction between scientific community, industry and Government departments emerging?

- review and evaluation after several years of operation to check performance against objectives.

(d) *Council of Science and Technology (1.18(3))*

- are advice and reports of CST open?
- does the composition of the Council and expert advisers represent the full range of scientists and sectors (public, private and scientific)? Does it include women and young scientists and those at the "cutting edge" as well as "the great and the good"?

(e) *Technology Transfer and Innovation*

Do Government schemes for technology transfer re-emphasise the importance of the interchange of ideas skills, know-how and knowledge between the science and engineering base and industry? (1.18(4)).

Is there easier access for SMEs to innovation support programmes? (1.18(5)).

- measure impact of all innovation programmes on SMEs and their access to them.
- level of awareness among companies, particularly SMEs and areas with low R&D funding/personnel.
- analysis of R&D spend in private sector (including "Independent Scoreboard", etc.)
- monitoring effectiveness of "Business links".
- evaluation and review of success/failure of shift of DTI policy from supporting R&D directly to stimulating innovation awareness.

Technology Diffusion and Transfer.

— need to measure "innovation"—eg OECD development of possible indicators.

— measure success of LINK and other collaborative schemes, especially in reaching new areas and stimulating partnership.

— measure impact of Faraday Principles (2.16).

Number of schemes established and effectiveness in transferring people and ideas. Funding for schemes—(if this is not provided, the Government may need to pump prime).

— monitor application of "near market" guidelines. How do define areas of "market failure", need for strategic research. (2.20).

(f) *Role of Government Departments and Customer/Contractor Principle (1.18.(9)) and chapters 4 and 5*

(i) *Ministry of Defence*

Objectives set in paragraph 4.7 for greater civil impact of defence research.

— degree of diversification of research and technological development (and personnel) into civil use.

— effectiveness in meeting its primary MOD objectives.

(ii) *Civil Departments*

For all Government departments whether Defence or Civil para. 5.14 is relevant. It says:

"The Government recognises that science and technology is integral to the missions of many departments and that changes should strengthen the effective provision of scientific expertise and advice."

— define missions and set appropriate indicators.

— impact of "Next Steps" privatisation or other forms of ownership which could divorce "operational scientists" from HQ "core" in departments on the ability to deliver policy objectives and provide "intelligent" customers for departmental contractors, and to supply S&T personnel for policy-making.

— impact of customer/contractor principle on:

transactional costs/admin. overheads;

ability to provide long term strategic funding independent of any particular project (application of Rothschild 10 per cent surcharge).

length and type of contracts and ability to generate longer term perspective essential for many forms of R&D.

— Impact of customer/contractor principle and greater commercialisation, market testing and privatisation on the ability to provide "quality of life" and other public interest research— eg health, safety and environment.

(g) *Better arrangements for drawing together Government initiatives in science and technology co-ordination cross departmental science and technology issues, ensuring value for money from the science and technology which the Government applies in its statutory, policy-making and regulatory roles, and monitoring performance against the new Forward Look (1.18.(10))*

The key test of the results of the Efficiency Scrutiny will be whether they can meet objective (g) and performance criteria set out in Sections (c), (e) and (f) above and (h) below.

(h) *Better EC co-ordination and effectiveness (1.18(11))*

— are arrangements for co-ordination in place?

— success rate in obtaining EC contracts and influencing scope and content of EC programmes. In particular, monitor impact of Services (procurement) Directive 92/50/EEC.

— impact of "attribution" policy on ability and motivation of departments to suggest and bid for EC projects.

(i) *Meeting the Country's needs for Scientists & Engineers*

— better measures of "demand" and "supply".

— monitoring pay and "status" of scientists, technologists and engineers.

— monitor careers and patterns of employment including short term contracts.

— number reaching positions of leadership in government, industry and City.

— spread of STEs to other sectors of the economy and their impact—eg does growth in number of STEs in City have any impact on City attitudes to innovation, R&D and the need for "patient" money?

— gender-monitor results of OST Report on Women in STE.

(j) *Public Understanding of Science*

— Measure of developments through attitude surveys.

— Better funding for institutions—eg Science Museum, Natural History Museum, Royal Botanical Gardens at Kew, who have major roles in enhancing public understanding and raising profile of science.

— Activities of GREs and other public sector research establishments in developing links with local Schools, Colleges, Industry and Community and funding to do so.

— Ditto for private sector companies and research organisations.

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