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HOUSE OF LORDS

SESSION 1992—93
4th REPORT

SELECT COMMITTEE ON
SCIENCE AND TECHNOLOGY

FARADAY PROGRAMME

Ordered to be printed 20 January 1993

LONDON: HMSO

£19·40 net

HL Paper 50

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WRITTEN EVIDENCE

References in the text of the report are as follows:

(Q) refers to a question in the minutes of oral evidence reprinted in this volume
(p.) refers to written evidence printed in this volume

FOURTH REPORT

20 January 1993

By the Select Committee appointed to consider Science and Technology.

ORDERED TO REPORT

FARADAY PROGRAMME

CHAPTER 1 INTRODUCTION AND EXECUTIVE SUMMARY

1.1 Following a conference held at Highgrove in July 1991, His Royal Highness The Prince of Wales asked Sir John Fairclough to assemble and lead a Working Group on Innovation. The Group's Final Report was published in October 1992 (The Working Group on Innovation, Final Report, CEST, October 1992). One of the chief recommendations of the Group was the establishment of a series of research centres, to be called Faraday Centres. This concept was fully set out in a report commissioned by the Group from the Centre for Exploitation of Science and Technology (CEST) and published in May 1992 (The Faraday Programme, Final Report to the Working Group on Innovation, CEST, May 1992). The Select Committee[1] decided to conduct a short enquiry into the Faraday Programme as a contribution to the debate that must now ensue[2].

1.2 We consider that technology transfer is very important but we conclude that the case for a Faraday Programme has not been made successfully.

1.3 Like the Working Group, we recognise that there is a case for further promoting technology transfer between universities and small and medium sized enterprises (SMEs) and some physics based engineering industries. But the Programme is not necessary to give scientists experience of industrially relevant research nor for promoting technology transfer across the whole spectrum of science based industry.

1.4 Instead of setting up a new organisation as proposed in the Faraday Programme, we make the following recommendations:

— a modified form of LINK scheme should be devised so that research themes as well as individual research projects could be eligible for support.

— the Teaching Company Scheme should be expanded.

— in addition to their pilot of "One Stop Shops", DTI should support local efforts to promote Technology Clubs to help SMEs gain access to technology transfer schemes - whether the revised LINK scheme we propose or any other.

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1 Membership of the Select Committee is set out in Appendix 1.

2 The Committee held 6 meetings, heard oral evidence from 9 organisations or individuals, and received 34 pieces of written evidence. A list of witnesses is printed at Appendix 2. The evidence is printed at the end of this volume.

CHAPTER 2 THE PROPOSALS

The case for change

2.1 The case for setting up Faraday Centres is not set out in any one place in the documentation we have received but the arguments advanced in the Working Group Reports and in the evidence we received from Sir John Fairclough may be summarised as follows:

(i) the status, role and capability of organisations engaged in technology development and transfer need to be substantially enhanced (Final Report of the Working Group on Innovation (WGI), p.1) so as to provide a continuous flow of enabling technologies for future business opportunities;

(ii) successful innovation relies on a two way flow of ideas and knowledge between industry and universities (ibid, p.2);

(iii) existing facilities at universities are little used by small and medium sized enterprises (SMEs) who turn instead to contract research organisations (the exception being small and medium sized enterprises engaged in leading edge technology who will naturally develop strong relationships with universities) (CEST p.72);

(iv) for small and medium sized enterprises in engineering-based industries where physics is the foundation, relations with universities are particularly weak (QQ 16, 30; CEST p.72);

(v) hence there is need for a new kind of research establishment called a Faraday Centre, lying outside universities, grafted into existing "Intermediate Institutes", for example contract research institutes, to act as a bridge between industry and universities. Links with industry will be secured through contract research and with universities through research contracts, postgraduate training and staff exchange (Final Report of the WGI, p.1).

A typical Faraday Centre

2.2 Faraday Centre status will be accorded by way of "franchise" from a Management Group (see para 2.10 below) upon application from the Intermediate Institute (II) and the universities. An II might include any contract research and development organisation engaged in technology based work e.g. contract research organisations like some members of the Association of Independent Research and Technology Organisations (AIRTO), AEA Technology, PA Technology; government laboratories with agency status like DRA or RSRE; and research council laboratories. CEST have since informed us that university based research institutes or consultancies which are semi-autonomous, can undertake multi-disciplinary projects and have the freedom to respond quickly to market pressure are just as likely to qualify as contract research organisations.

2.3 The three principal criteria for judging eligibility of host institutions are:

success in the commercial development and exploitation of technology;

extensive interaction with industry; and

a demonstrable ability to generate income under contract.

Other criteria for selecting a successful II would include a turnover of over £5-10m; manpower of 60-250; a good customer base and proven relationships with universities; and a recent track record both in R&D and in marketing and financial management.

2.4 The host II would provide the infrastructure for the Faraday Centre. To bid for Faraday status, it would enter into a relationship with one or more universities from which the Centre might draw postgraduate researchers, exchange staff, and commission further research, as a customer, in

support of its own long term goals. The work carried out at the Centre would be exploited by the customer base of the host II.

2.5 The sphere of activity of Faraday Centres would depend partly on the strategic needs identified, with advice, by the Management Group and partly on the projects specified by the II and its university or universities in making their bid.

Staffing

2.6 Each Faraday Centre would have a director appointed by the host institute. It is expected that the director would also hold a university post.

2.7 There would be some core staff to meet the need for continuity. Most of the research would be carried out by the research associates on 2-3 year contracts with agreed academic goals, many of them engaged in PhD work. A typical Faraday Centre would have a staff of 30 of whom approximately 20-25 would be Faraday research associates paid slightly more than they would be under the normal research grant.

2.8 Supervisory staff would flow across the boundaries between universities and industry.

Management

2.9 The Director would report to a Management Board of the Centre comprised of representatives of the university, industry, the II and the Centre itself (Final Report to the WGI, pp. 6 & 8).

2.10 The programme as a whole would be overseen by the Faraday Programme Management Group (FPMG) which would decide topic areas and award the Faraday Centre franchise. The Group would answer to the Secretary of State of the lead government department and be answerable to him for the Programme. Its membership would represent industry, the Centres, and universities.

2.11 The FPMG would in turn work alongside an Industrial Research Technology Council (IRTC), a body which the Working Group consider would be akin to the Advisory Board to the Research Councils "but operate in the industrial innovation field" (Final Report to the WGI, p.11). The precise relationship is not described.

Funding

2.12 It is envisaged that a typical Faraday Centre would require a one-off government grant of £1 million for setting up, followed by a £1.5 million annual grant for "technology development" for salaries, overheads and equipment for the 30 or so staff of the Centre. This recurrent grant would be supplemented "after a few years" by £1.5 million p.a. of collaborative projects (half from industry and half from public funds) and £2 million p.a. of projects fully funded by industry. This would give an annual turnover of £5 million p.a. (Final Report to the WGI, p.13).

2.13 The funding profile can be summarised as:

establishment and basic research programme: 100 per cent public;

collaborative projects: 50 per cent public; 50 per cent private;

private or individual projects: 100 per cent customer (public or private).

Naturally the funding profile of a Centre will vary over time from predominantly public at the start to predominantly customer led (industry or Government) as the Centre develops. In addition, there will be variations between Centres because of topic, industry or technology.

Benefits

2.14 The chief benefit identified by the Working Group would be improved competitiveness of British industry. Some specific benefits for industry include improved staff skills, sharing of cost of expensive technology development, and a source of problem solving. Universities would benefit from a better understanding of the needs of industry, new career paths for graduates, and experience of industrially relevant research for staff (Final Report to the WGI, p.3).

Pilot studies and the Post-graduate Training Partnerships

2.15 The Working Group have recommended a pilot programme of up to 30 Centres with funding as set out in Table 1. Their figures do not appear to include the cost to public funds of the research which would be commissioned by Government sources from each Centre (see para 2.12 above). Since such funds would be won in competition with other research bodies, the Working Group see no reason to include them under the category of Government funding. The Working Group estimate that the value of this research to each Centre would, "after a few years", reach some £750,000 p.a. (see para 2.12 above). If these costs are included then the real cost of Faraday Centres to public funds is higher than the estimates.

TABLE 1

	Faraday Centres		Funding
	New	Cumulative	£m
Year 1	5	5	12.5
Year 2	10	15	32.5
Year 3	5	20	35.0
Year 4	5	25	42.5
Year 5	5	30	50.0

2.16 In February 1992, the DTI and DES announced the funding of five Post-graduate Training Partnerships between contract research organisations (IIs) and universities whereby, over a period of two years, 100 graduates will be able to undertake research of industrial relevance at the II and gain a higher degree. Although this is not meant to be a pilot for the Faraday Programme, it will test a key feature of it.

CHAPTER 3 VIEWS OF WITNESSES

The analogy with the Fraunhofer Gesellschaft

3.1 Inevitably, the proposed Faraday Centres have been compared to the German Fraunhofer Institutes, although Sir John Fairclough was at pains to point out that, while the Institutes were the "starting point for some of our deliberations", his group did not aim to replicate them. Faraday Centres were intended to emulate two attributes of the Institutes - first, the involvement of young people in industrial research leading to a higher degree so that technology transfer and the flow of scientific manpower into industry might be enhanced; and secondly a sharing of facilities between industry and the applied research community in academia (Q 1). The Working Group proposals did not, for example, seek to set up new institutions.

3.2 Sir David Phillips who, with Sir Mark Richmond and others, had recently visited three Fraunhofer Institutes and the German Federal Research Ministry (BMFT) described to us in detail the organisation of the Institutes (ABRC pp. 60-63).

3.3 Since 1949, 37 Institutes had been set up in former West Germany with 9 embryonic Institutes in the East. Their turnover was 800 million DM and they employed about 2000 permanent technicians and administrators, 2000 researchers on short term contracts and 2000 researchers on unlimited contracts. About 29 per cent of their income came from industrial contracts with the balance (including capital costs) coming from the public funds of the Federal Government and the Länder. Fraunhofer Institutes are used by large as well as small companies and they thus represent a subsidy to German industry.

3.4 Some of the key features of the system which Sir David identified and which appear to us to be relevant to the consideration of Faraday Centres were that

— Fraunhofer institutes were physically adjacent to a university;

— institutes were set up only where a suitable individual or group of people of high quality had been identified to lead it; and

— institutes were new foundations and were never grafted on to old research establishments lest the new institute be adversely affected by the prevailing culture at the old.

3.5 These key features were underscored in evidence by Sir Mark Richmond (p.101), Professor W D P Stewart (pp.99-100) and BP (pp.69-70). They all made the point in greater or lesser degree that certain key features which made Fraunhofer Institutes successful in Germany were absent from the Faraday Centre proposals for the United Kingdom.

General impressions

3.6 Most witnesses accepted the Working Group's objectives but many accepted the proposals for achieving them only with considerable reservation and some opposed the proposals outright.

3.7 Government witnesses tended to be agnostic. Thus the Chief Scientific Adviser, Professor Stewart, felt that there were aspects of the Faraday Institute concept on which he personally needed assurances, chiefly as to need and industry's participation. He stressed that "no decision has been made by Government to set up a network of ITCs" (Intermediate Technology Centres) (p.100). The Department of Trade and Industry felt that "... some of the features of the Faraday proposals could stimulate an overall improvement in the industrial relevance and quality of research and technology transfer ...", but then listed nine questions that remained to be resolved. These were principally concerned with the integration of the programme with other schemes, the identification of customers and their needs, the areas of technology to be covered and various management issues. The President of the Board of Trade was more direct. He told us that the philosophy behind the Faraday concept was very important across the horizon of R&D activities but "... it was not something that should be applied as a limited add-on to the many schemes and centres of activity currently in existence ... It is not my intention to proceed with that specific initiative. I think that there are much wider opportunities, and those are where we are focusing our attention" (Q 271).

3.8 The response of ABRC and the research councils was lukewarm. Sir David Phillips wrote on behalf of his ABRC group[1], following a visit to Germany to look at the Fraunhofer Institutes, that the identification of highly skilled entrepreneurial scientists who have close ties both with the universities and industry, together with appropriate funding (which should be made on a

[1] Sir Mark Richmond, Chairman of SERC; Dr Geoff Robinson, DTI Chief Science Adviser; Professor Ian Shanks, Chief Scientist, Thorn EMI; and Mr John Vereker CB, Deputy Permanent Secretary of the Department of Education.

competitive basis) for the provision of state of the art equipment, "would provide a more fruitful basis for enhancing interaction between industry and the science base, than attempting to set up a fully-fledged Fraunhofer-like system from existing contract research organisations in the United Kingdom" (p.62).

3.9 MRC supported the proposals but did not wish to see such Centres being given "special priority". From their own experience with MRC Collaborative Centres, they concluded that "there can be no single approach to technology transfer" (p.97). NERC was more cautious and wanted existing technology transfer schemes to be evaluated before further schemes were started (p.98). The Chairman of SERC was "very doubtful whether the funding of fully fledged Institutes" on the German Fraunhofer lines was desirable, and considered that a "huge programme" of work was needed before a Faraday Programme could be launched (pp.101-102). SERC would, however, be prepared to manage a properly funded scheme at two or three centres and might even use some of its postgraduate research funds in engineering to support them (QQ 99-103).

3.10 Independent research organisations and other bodies who saw themselves as prospective candidates for Faraday status mostly favoured the proposals. Thus AIRTO endorsed the scheme wholeheartedly (p.68). Their hope was that, unlike LINK and other schemes, the Faraday Programme might provide untargetted funds for industrial research, while educating industrially oriented researchers (QQ 228-232, 236-238). AEA Technology, WRc, BHR Group Ltd, the Sira Group of Companies and the Defence Research Agency also supported the idea (pp.60, 112, 68, 104, 81). Universities, by contrast, were on the whole opposed to the Faraday Programme. CVCP, while supporting viable technology transfer schemes, viewed "with interest" the Faraday proposals but wanted more rigorous examination of their feasibility (pp.77-78). They did not want "yet another set of structures" (Q 199). Individual universities and colleges were more outspoken. Cranfield were "both very supportive of the principles underlying the Faraday Programme and cautious about the means proposed to give practical effect to those principles". The Rector of the Imperial College of Science, Technology and Medicine expressed "reservations" and "serious doubt" as to the proposals (pp.87-89). UMIST supported the idea subject to appropriate funding (p.109), as did the Vice-Chancellor of the University of Leeds (p.108).

3.11 Industry, our other chief group of witnesses, was divided. Broadly speaking the large, chemistry-based industries like ICI, BP and the pharmaceutical companies were cool or hostile (Q 177, pp.87, 69-70). ABPI, for example, were concerned whether either the Faraday Programme or DTI initiative had "any relevance to the pharmaceutical industry" (p.66). Dr Langley of ICI thought the Faraday programme would be "pretty low on the pile" (Q 195) of collaborations in which they were interested, while "nothing, but nothing, must be done to clobber any side of the science base in the United Kingdom" (Q 179). Thus larger industrial organisations, at least in the chemical industry, would not "make any outstanding plea for the creation of these centres" (Q 177). GEC were highly sceptical of the likely benefits of Faraday Centres as against university-based projects (pp.85-87). Unilever were very cautious and called for a proper pilot study (p.107).

3.12 Physics-based engineering industry, including the aerospace industry, were more positive. SBAC supported the concept, subject to a broadening of the definition of the II (pp.106-107). The Faraday concept would particularly help smaller companies who were increasingly being asked to share the risks of improving technology in that sector (Q 186). The CBI also supported the concept, subject to a review of all existing technology transfer schemes (QQ 143, 164).

3.13 We turn now to consider more specifically the issues which gave cause for concern to those who provided evidence to us.

Relationship with other schemes

3.14 Many witnesses (UMIST p.109; SERC p.101, NERC p.98; Stewart p.99) drew our attention to existing schemes which already sought to achieve the same ends as the proposed Faraday Programme by enhancing the flow of skills between the research community and industry. For example:

> CASE Awards - The long established collaborative awards in science and engineering where industrial companies sponsor post-graduate students in projects lasting between one and three years. The projects are usually research oriented but can include studies in design and manufacturing problems. The student receives a normal studentship from a research council plus an additional maintenance grant from the company involved and spends a minimum of two months with the company.
>
> "Parnaby" Engineering Doctorates - This scheme was launched in 1992 by the SERC and consists of a four year course which includes a higher content of industrial engineering. Students will spend a significant proportion of their time in industry helping to solve one or more challenging engineering problems. Students receive an enhanced basic stipend and a minimum industrial contribution of £2000. Successful graduates will be awarded the degree of Doctor of Engineering (Eng D.).
>
> Teaching Company Scheme (TCS) - This is a scheme operated jointly by the SERC and the DTI with some involvement from the ESRC and other Departments. Able graduates ("associates") are employed on two year contracts to undertake a specific project within a company. In all, over 1000 programmes have been initiated and over 400 are currently operating successfully.
>
> LINK - This is a government-wide initiative which encourages industry to undertake collaborative research jointly with science base institutions (universities, GREs and RTOs). The research is pre-competitive but industrially relevant. 30 programmes have been announced with over 300 projects under way. Overall funding for these programmes is currently £400 million, half of which comes from industry.
>
> Postgraduate Training Partnership Scheme (PTPS) - This is the joint OST/DTI scheme already described at 2.16 above.
>
> Integrated Graduate Development Scheme (IGDS) - This scheme is run by the SERC and jointly funded by the SERC and the company. It aims to improve the technical and managerial effectiveness of graduate engineers and technologists in the early stages of their industrial career. Graduates in employment attend part-time modular masters level courses. 12 programmes are running and 6 more are planned.

3.15 But we also learned of institutionalised collaborations akin to Faraday Centres which were already in place at some universities. The University College of North Wales, Bangor, told us of its Bio Composites Centre (p.110); Cranfield considered itself to be "a number of Faraday Centres on each of our sites" (p.79); there were independently arranged jointly-funded collaborations (Q 209); there were research clubs which some universities had set up on a regional basis with small firms in mind (Q 204); there were also part-time PhD students working in industry and conducting research at universities on industrial-related problems (QQ 63-64); MRC had its own Collaborative Centres (MRC p.97; ABPI p.65); and research council institutes already did some commissioned or collaborative research which brought industry and universities together (NERC p.98; MRC p.97).

3.16 In addition there were the 19 Interdisciplinary Research Centres created at various universities which provide inter-departmental co-operation. The fields for IRCs were chosen by the research councils with a view to potential exploitability and applicability in consultation with

industry. Initially funded by the research councils they are eventually to be supported by private industrial and commercial concerns. A further two are planned.

3.17 Many witnesses felt that existing schemes should be reviewed before any commitment should be made to a Faraday Programme. For example, NERC wrote that "The differences between the proposed new scheme and the existing schemes is not clear from the documentation" (p.99), and "It is important that the success of such (existing) schemes are properly evaluated and any lessons learned before new schemes are started" (p.98). DTI wrote of the "need to ensure that any Faraday programme would be integrated into the overall technology transfer scene and would not lead to a further proliferation of schemes and organisation (p.82). They told us in evidence that they were launching their own review of all their schemes to ensure that they are effective and easily understood (Q 298). CBI also called for a review of all such schemes. There was need for "a much greater auditing of the skills and of the resources that we do have" before an allocation of funds could be made to Faraday Centres (Q 143). Professor Stewart wrote of the need to assess "whether there is a need for more bridges and whether new added value would arise from a set of dedicated institutes" (p.100).

3.18 Some witnesses thought that the objectives of the Faraday Programme could be achieved by further development of some of the existing DTI schemes, especially of LINK. Thus ABPI wrote that "... further support of the LINK scheme with research carried out at recognised centres of excellence could be considered an alternative to the current proposals" (p.67). CVCP also thought that the answer lay in modifying the LINK scheme so that similar support could be offered for research themes rather than specific research projects. This would offer "... all the benefits of the proposed Faraday type institutes but without introducing any particular new structure. We should be building on existing partnerships and existing strengths" (QQ 205). They were sure that "the Faraday principle could easily be accommodated within a wider LINK programme of this kind" (Q 219). The Defence Research Agency thought that the DTI's Research Initiatives, set up in 1984 but now defunct, had some similarity to the proposed Faraday Centres. They had been successful in promoting "good co-located research and technology transfer and spun-out commercial contract research activities" at universities and research establishments on various research themes (p.81). BP would have preferred to see more CASE Awards instead of the DTI pilot Postgraduate Training Partnerships (p.70). EA Technology approved the Postgraduate Training Partnerships as already announced, without further, more elaborate, institutional arrangements (p.84).

Universities

3.19 Many witnesses argued that, if a Faraday Programme were proceeded with, the centres should be located within universities - like the German Fraunhofer Institutes (Cranfield p.79; University of Leeds p.108;). The Rector of the Imperial College argued that universities were already adept at technology transfer - perhaps more so than the IIs. CVCP thought that placing Faraday Centres in IIs would "create another barrier that has to be overcome" (Q 218). Sir Ron Dearing was not convinced that setting Faraday Centres in IIs was "obviously right". "The greater the proximity between researcher and manager the more likely it is that it will not be a communication [for] the deaf to the deaf" (Q 110). Sir Ron thought universities or industry were a better location for such Centres than the IIs (QQ 110, 129).

3.20 The university world was not alone in the view that Faraday Centres should be located in HEIs. BP noted that the proximity of the German Fraunhofer Institutes to the universities lay at the heart of the links which resulted. "The recommendation to award degrees to workers at the United Kingdom intermediaries would only go a fraction of the way towards creating a system as effective as the FhG" (p.70). Other branches of industry were content with their existing university links (ICI p.87; ABPI p.65). Other witnesses wanted the definition of II broadened to include research council institutes (AFRC p.65; NERC p.98); medical schools (Peckham p.80); or any organisation which had "excellence in a particular area" (CBI Q 164).

3.21 Sir David Phillips, having studied the German Fraunhofer system, broke free of institutional arguments. "... Our perception of the most valuable part of the Fraunhofer system is the location in one place of highly-skilled, entrepreneurial scientists who have close ties both with the universities and industry, together with state of the art equipment. The Fraunhofer Institutes that we visited were extremely well equipped in technological areas, beyond the scope of provision in United Kingdom HEIs, and generally unavailable in all but the largest industrial research laboratories. We consider that identification of these highly talented individuals, together with appropriate funding (which should be made on a competitive basis) for the provision of state of the art equipment, would provide a more fruitful basis for enhancing interaction between industry and the science base, than attempting to set up a fully-fledged Fraunhofer-like system from existing contract research organisations in the United Kingdom" (ABRC p.62).

Funding

3.22 Witnesses feared that government support for a Faraday Programme would be at the expense of existing budgets and that industry would be unwilling to provide their share of the money.

3.23 The research councils were thought by many to be the most vulnerable to cuts in order to fund research at Faraday Centres. Thus NERC wrote that "Given finite sources of public funding for R&D, the creation of Faraday Centres is likely to draw funds away from their parts of the research establishment. ... Any redistribution of funds to support the Faraday Programme must not be at the expense of important strategic but non-industrial science" (p.98). This view was shared by witnesses from other research councils (SERC p.102; AFRC p.65); and from industry (ICI p.87). Witnesses showed similar concern for research at universities (Cranfield p.79; Leeds p.108; SERC p.101). Thus Faraday Centres "should not under any circumstances take funds away from existing institutions and collaborative programmes" (ABPI p.67); or be at the expense of "what little moneys there are available for enquiry led research" (BP p.70). New government money would have to be provided (CBI p.77; Cranfield p.79; IPMS p.90).

3.24 The second concern was that industry would not come forward with funds at the 50 per cent level expected by the Working Group on Innovation - a level markedly higher than the current contribution of German industry to the Fraunhofer Institutes (see paragraph 3.3 above). Thus Sir David Phillips wrote that "In the present economic climate, whatever mechanism is considered to embrace the interaction between the science base and industry, it is not clear that British industry would indeed be willing to invest more in R&D; the burden for supporting this activity would fall mainly on the Government" (p.63). Other witnesses were of like opinion (BTTG p.72; NERC p.99).

3.25 Evidence from industry itself indicated that their funds were not to be relied upon, especially in the early years. "Manufacturing industry is unlikely to make funds available to Faraday Centres unless it can see a significant advantage over established links with HEI's and contract research institutes. Only when a centre is established and has demonstrated a high level of competence is it reasonable to assume that manufacturing industry will begin to use Faraday Centres in preference to other sources" (GEC p.86).

3.26 Some witnesses, it has to be said, were not over-concerned at the possibility of some re-distribution of money from existing activities (IEE p.90; Sira p.105). This would be more defensible were this transferred spending likely to unlock an increase in industry's spending on R&D (NERC p.98).

Status of research - the PhD

3.27 Witnesses expressed some doubts as to the character of the research that would be conducted at the proposed centres. Sir Eric Ash questioned whether technology transfer required Faraday Centres to be centres of research. The proposals were based on two misconceptions, "First, that technology transfer involves doing more research. It doesn't. Technology transfer involves

arranging for development work to be carried out to exploit existing research results. Second, that higher degree students should engage in development work" (p.88).

3.28 GEC, also unhappy with the premise but for rather different reasons, wrote that "science and technology alone will not lead to new wealth-creating industries. Long term success is derived from competitive products and services, produced by efficient processes, and underpinned by competent sources of enabling technology. The key question, therefore, is whether a Faraday Centre becomes a useful source of enabling technology or whether commercial pressure will drive it to near-term product related activities. This near-term role would dissipate the funds for important speculative research and it would be seen by industry as yet another contract research centre" (pp.86-87).

3.29 There was also concern that the kind of research work conducted at Faraday Centres would be inappropriate. NERC saw "a danger that the Faraday Centres would focus their activities on current industrial problems and concerns" at the expense of newer environmental interests. They also considered that "the training received by post-graduate students within the Faraday Centres will be different from the normal academic route. It may be necessary to introduce a new qualification linked to industrial R&D that reflects this difference" (p.99). CVCP were of like opinion. "... the Faraday Centres will be concerned largely with developmental work which may not be considered suitable for doctoral research in the UK where universities nearly always require evidence of original research by students. Further thought needs to be given to whether students in the Centres should be working towards PhDs. The postgraduate training objective of the Centres is more likely to be secured if they are hosted by universities" (pp.78-79).

Administrative arrangements

3.30 A number of witnesses drew attention to various shortcomings in the administrative arrangements proposed by the Working Group. The tenor of many contributions we received was that the detailed arrangements would need careful consideration. As SERC wrote, the proposals were "rich in concept - but rather poor on detail" (p.102). A "huge programme of work" was needed to establish selection criteria, funding levels, evaluation, and relationships with universities and other technology transfer schemes. AEA Technology were concerned that the academic researchers in Faraday Centres would not necessarily have contact with commercial projects (p.60). Sira, an independent RTO, were particularly concerned at the precise relationship between the Faraday Centre as a limited company and the host II, the nature of staff contracts, the establishment of coherent funding arrangements and the character of the Management Group (p.106). AIRTO actually suggested a different management structure, replacing the proposed Management Group by an Industrial Research and Technology Council (IRTC) (see paragraph 2.11 above). CVCP spoke of the need for assessment, performance targets and "sunset" clauses (p.79). DTI also presented a check-list of administrative issues which would need to be addressed including funding, management, franchise and selection criteria (p.83).

3.31 Some witnesses felt that the Working Group had neglected to address the issue of intellectual property rights. Greater definition was needed so that participants knew exactly where they stood (NERC p.99). Universities would need to "see benefits from the intellectual property generated as a result of their involvement" (CVCP p.78), while manufacturing industry would "question the ownership and exploitation of intellectual property" (GEC p.86).

3.32 Witnesses also felt that, whatever the administrative arrangements, the whole concept of Faraday Centres had to be responsive to the particular needs of particular types of industry, size of firms, and regions (NERC p.98). Thus BP did not want the imposition of a "single solution" of this kind, believing that Government should "encourage a plurality of substantive proposals from industry and universities on how best to improve the transfer of knowledge and expertise ..." (p.70). MRC wrote from experience that "there can be no single approach to technology transfer". Their own Collaborative Centre concept had been suitable only for certain kinds of work. In some cases the need for the technology transfer process to take place in close conjunction with the innovative research activity meant in many cases that an intermediary organisation was not desirable (p.97).

CHAPTER 4 OPINION OF THE COMMITTEE

Is the case proven?

4.1 We consider that technology transfer is very important but the case for a Faraday Programme has not been made successfully and we doubt whether the Programme is a desirable addition to current schemes. The evidence we received demonstrated clearly that large companies, and in particular the chemistry based industries, were unlikely to benefit from the facilities offered by Faraday Centres. Their relationship with university based basic research was already close and long established. However it was frequently said, in corroboration of the Working Group's report, that existing technology transfer arrangements were less used by the physics based engineering industries and by SMEs (paras 3.11-3.12 above).

4.2 The reasons for these differences are not difficult to find. In the chemistry based industries the development gap between laboratory science and products and processes is much narrower than in the physics based engineering industries. So far as concerns SMEs, universities have in the past not taken enough interest in courting SMEs and SMEs have not, for their part, been sufficiently aware of what university science and DTI technology transfer schemes have to offer. We acknowledge, however, that recent years have seen a culture change at the universities, which have become much more proactive in courting industry, including SMEs, and offering them the benefits of their research. The large number of university based collaborations bears testimony to this (para 3.15-16 above). We particularly applaud the activities of the research clubs which some universities have initiated with SMEs particularly in mind, other local initiatives involving universities, and the part-time PhDs.

4.3 We also observe that AIRTO, when pressed, admitted to us that what particularly attracted them to the Faraday Programme was the prospect of untargetted funding for industrial research. Current DTI schemes and the research associations and contract research organisations did not at present provide for this (para 3.10 above).

4.4 The evidence leads us to conclude that the case for Faraday Centres has not been made successfully. They are clearly not necessary to give scientists experience of industrially relevant research nor for promoting technology transfer across the whole spectrum of science based industry. The changing attitudes of the universities and several of the publicly funded schemes, particularly CASE, LINK, Teaching Companies and the experimental PTP, already show how this can be facilitated. Generally speaking, new schemes should not be introduced unless the objectives cannot be met by existing means.

4.5 We accept, however, that there is a case for promoting technology transfer between universities and SMEs and some physics based industries in particular.

A new organisation?

4.6 The next question we have to address is whether, to meet the needs we identify, new organisations like Faraday Centres are required. We note the disquiet which many witnesses expressed over the want of greater administrative detail, the problems of IPR, and the suitability of the research for PhD status scientists (paras 3.27-3.32 above).

4.7 However we attach particular weight to those arguments which relate to location and funding. We agree with those witnesses who argued that intermediate institutes should not be hosts to Faraday Centres, that contiguity made for better technology transfer and, to that extent, that the Centres represented an undesirable barrier (para 3.19-3.21). In our view, to have any chance of success, Faraday Centres would have to be placed on university campuses. We also share the fears of witnesses that were a Faraday Programme to be launched in present circumstances it would be at the expense of government funding of the science base, both direct and indirect (para 3.22-3.26). We recognise that such a transfer might have merit were it likely to unlock substantially higher investment in research by industry but in the light of the failure of the Fraunhofer Institutes to generate more than 29 per cent contract income from industrial contracts and of the UK industry's

own track record in the past we have no reason to suppose that this would happen. For these reasons we oppose the proposals for a Faraday Programme based in IIs as proposed by the Working Group on Innovation.

Spirit of Faraday

4.8 The question now arises whether any desirable elements of the Faraday Programme might be effected by other means. We have examined the existing DTI schemes and note that different witnesses thought that technology transfer elements of the Faraday principle were already to be found in the CASE and LINK schemes. The new Post-graduate Training Partnerships catered specifically for the "training" of post-graduates by placing PhD students in industry and the very successful Teaching Company Scheme already placed graduates in companies to undertake specific projects for two years where they were also able to learn managerial and technological skills (paras 3.14-3.16 above).

4.9 While the Teaching Company Scheme is favoured by SMEs, SME take-up of other schemes is poor. Moreover in all schemes individual awards are targetted at specific projects.

4.10 We were therefore strongly attracted by the idea put forward by CVCP that a modified form of LINK scheme should be devised so that research themes, as well as individual research projects, could be eligible for support (para 3.18).

4.11 The advantages of such an approach are, in our view, compelling:

(i) It is economical and is unlikely to erode funding of basic research in the universities and research councils;

(ii) It ensures that the research will take place in existing facilities (including universities and RTOs) contiguous to other related research in the field;

(iii) It will be demand led and thus responsive to the differing demands of different industries, firms and regions;

(iv) It will be flexible over time to the extent that grants will be time limited;

(v) It will be untargetted without being unfocussed;

(vi) Subject to the findings of the DTI review it is likely to share a homogeneity with other DTI schemes;

(vii) The synergy generated by the interaction of cognate projects will be beneficial; and

(viii) To a high degree it will promote collaboration based on individuals of talent and centres of excellence, thus embracing the principle advanced in evidence by Sir David Phillips.

4.12 We therefore recommend a modified form of LINK scheme on these lines as an alternative to Faraday Centres. The scheme could, we think, be given a bias in favour of SME involvement.

4.13 We also recommend an expansion of the highly successful Teaching Company Scheme. We note with approval DTI's current review of its technology transfer schemes and we hope that our recommendations will be favourably received.

4.14 We still suspect that there is widespread ignorance among SMEs of the Government's technology transfer schemes. The modified LINK scheme which we have proposed will have to be both accessible and well advertised if it is successfully to involve SMEs. To some extent universities themselves may be induced to seek industrial partners. But we hope that DTI will actively promote the scheme, particularly in the regions. DTI hope that their pilot of "One Stop Shops", of which we were told by the President of the Board of Trade (Q 275), will be able to help

in the promotion of their schemes[1]. We consider that DTI should also support any regional or county development offices which intend promoting Technology Clubs to help SMEs gain access to technology transfer schemes - whether the revised LINK scheme we propose or any other.

CHAPTER 5 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

5.1 Technology transfer is very important but the case for a Faraday Programme has not been made successfully (para 4.1 and 4.4).

5.2 New schemes should not in general be introduced unless the objectives cannot be met by existing means (para 4.4).

5.3 While the array of Government and university based schemes is already impressive, there is a case for further promoting technology transfer between universities and SMEs and some physics based engineering industries in particular (para 4.5).

5.4 We recommend that a modified form of LINK scheme be devised so that research themes, as well as individual research projects, would be eligible for support; the scheme should favour SME involvement (para 4.12).

5.5 We recommend that the highly successful Teaching Company Scheme be expanded (para 4.13).

5.6 DTI should support any regional or county development offices which promote Technology Clubs to help SMEs gain access to technology transfer schemes - whether the revised LINK scheme we propose or any other (para 4.14).

[1]See also "A prospectus for One Stop Shops for Business", DTI, 1992.

APPENDIX 1

Membership of the Select Committee during the period of the enquiry

V. Caldecote
L. Dainton
L. Desai
L. Flowers (Chairman)
L. Gregson
L. Howie of Troon
L. Kirkwood
B. Nicol
B. Perry of Southwark
B. Platt of Writtle
L. Porter of Luddenham
L. Renwick
L. Tombs
L. Walton of Detchant
L. Whaddon

APPENDIX 2

List of Witnesses

The following witnesses gave evidence. Those marked * gave oral evidence.

AEA Technology
* Advisory Board for the Research Councils (ABRC)
Agricultural and Food Research Council
Association of the British Pharmaceutical Industry
* Association of Independent Research & Technology Organisations (AIRTO)
British Hydromechanics Research Group Ltd
BP
British Textile Technology Group (BTTG)
Centre for Exploitation of Science and Technology (CEST)
* Confederation of British Industry (CBI)
* Committee of Vice-Chancellors and Principals (CVCP)
Cranfield Institute of Technology., Vice-Chancellor
Director of R&D, Department of Health, Professor Michael Peckham
Defence Research Agency., Company Secretary
Department of Trade and Industry (DTI)., Chief Advisor on Science and Technology
Department of Trade and Industry (DTI)
Electricity Association Technology (EA Technology)
Economic and Social Research Council (ESRC)
* Fairclough., Sir John
GEC plc
* Higher Education Funding Council England
* ICI plc
Imperial College of Science, Technology and Medicine., Rector
Institution of Electrical Engineers (IEE)
Institution of Professional Managers and Specialists (IPMS)
Medical Research Council (MRC)
Natural Environment Research Council (NERC)
* Science and Engineering Research Council (SERC)
SIRA Group of Companies
* Society of British Aerospace Companies Ltd (SBAC)
Unilever plc
University College London., Provost
University of Leeds., Vice-Chancellor
University of Manchester Institute of Science and Technology (UMIST)
University College of North Wales, Bangor., Registrar
WRc plc

HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

(SUB-COMMITTEE II—FARADAY PROGRAMME)

Wednesday 15 July 1992

Sir John Fairclough, Dr R C Whelan, and Dr N Johnston

Ordered by The House of Lords *to be printed 19 May 1992*

LONDON : HMSO

£4·10 net

HL Paper 23—i

MINUTES OF EVIDENCE

WEDNESDAY 15 JULY 1992

Present:

Caldecote, V.
Dainton, L.
Desai, L.
Flowers, L.
Gregson, L.
Howie of Troon, L.
Platt of Writtle, B.
Porter of Luddenham, L.
Renwick, L.
Walton of Detchant, L.
Whaddon, L.

Examination of witnesses

SIR JOHN FAIRCLOUGH, Chairman of the Prince of Wales's Working Group on Innovation, DR R C WHELAN, Chief Executive, CEST and DR N JOHNSTON, CEST, called in and examined.

Chairman

1. Sir John, you are very welcome and we are very grateful to you for coming along to help us with what I hope will be a short enquiry of a topical kind, that we may possibly be able to assist you in what you are doing but we will see, of course, the outcome not the input. Would you care to introduce your colleagues and also to make whatever introductory statement you like. I think it would be helpful, however, if you could tell us at the outset how your Working Group got to be formed and the manner in which it works and then no doubt we shall be talking about your actual proposals.

(*Sir John Fairclough*) Thank you, my Lord Chairman. I am very pleased to have the opportunity to explain our work. On my right is Bob Whelan, who is the Chief Executive of CEST, and on my left, Neil Johnston, who has acted as Secretary for the Steering Group I led. He, in fact, has done most of the work! The work I led was formed by the Prince of Wales following a conference that he held last year to discuss the status of innovation in this country. Some of your Lordships may have been there. I think there were a number of reasons for wanting to focus with the feeling that he could perhaps make a contribution by focusing on innovation. His annual award (Prince of Wales Award—for Innovation) presented for 10 years really needed new life and to be rejuvenated. Shortly before that conference I was invited to lead whatever might emerge from the conference. I went into it feeling that we did not need any new innovation awards like the Prince of Wales Awards or for that to be repeated. I believe that there are too many already. They are below critical mass and what we lack is an integrating force. So I persuaded the Prince and his colleagues that we should have a clean canvas in which to have our deliberations. I brought together a group of very able and experienced people: Professor Graeme Davies, whom you all know: Dr Peter Doyle; Harry Fitzgibbons from Hambro's Bank from the venture capital industry; Bob Malpas, Chairman of Cookson Group plc: Hugh Merrill, who is the Prince's Assistant Private Secretary: Howard Newby, who is Chairman of the Economic and Social Research Council: Sir David Phillips: Dr Alan Rudge and Bob Whelan. Although this was a completely separate effort I did take advantage of my chairmanship of CEST in order to use the backing of CEST to support me and provide a secretariat for the Group's activities. That was the linkage in that direction.

We have met on probably eight or nine occasions now as a group and are coming to the end of our deliberations. The Faraday Programme proposal was one of two proposals we made. The second one is directed at providing some ideas on how we may better arrange our affairs at a community or regional level. We lack in many of our regions a coincidence of purpose between higher education and industry, particularly small and medium-sized companies and we were led to the thought of a City of Innovation. If one can have a City of Culture maybe one can have a City of Innovation and we are looking for ways for involving the Prince of Wales in such an endeavour. That work is not yet finalised but gives you an indication of the broad direction. The Faraday Programme emerged quite soon in our deliberations and we took advantage of the up-coming election in order to raise the issue. If I can now turn my remarks to the Faraday Programme. I would like to preface my remarks there by saying that we all came to this problem with a deep belief that we needed to build a higher degree of common purpose between higher eduction and industry. That was the common theme that underpinned our thinking. Another factor was improving the competitiveness of existing products and processes as a nearer-term goal which was something that we are inclined to neglect in this country. We are too wedded to the thought, the linear model, that scientific discovery leads to exploitable invention which leads to economic wealth. That undoubtedly is a very important factor and when it happens it is very significant but the foundation for industrial economic activity must be a more evolutionary approach in improving the competitiveness of existing products and processes. How best to do that led to the thought of a Faraday Centre that would bring applied science and industry together sharing common problems of a basic nature, not to do specific product development at all but to be engaged in research that would enable us to amplify our strengths where we have industrial strengths. I should say from the comments that I have read in the media and your questions, that you kindly sent me, my Lord Chairman, I think there is a common misunderstanding that what we proposed by way of the Faraday Programme was aimed at replicating the Fraunhofer Institutes in Germany. That is not our proposal. That was a starting point for some of our deliberations. We picked two

[Chairman *contd.*]

attributes of the Fraunhofer Institutes which we thought were very attractive. One was a route for more young people doing industrially relevant research who would, in the process of conducting that research, be awarded, if successful of course, a higher degree. They also would be available for recruitment by industry so you get young people doing industrial research flowing into industry and there is no better mechanism for technology transfer than that. That was a concept which we thought had great merit. Secondly, the idea that industry and the applied research community in academia could share a common infrastructure and where significant capital investment and facilities are needed to support the research, to create a centre where this facility could be shared as well as, of course, enabling relevant research to be done by young people pursuing degrees, that could be something we could perhaps emulate. Those were the two ideas that we thought of merit and so we proposed the programme. We do not support any ideas of bricks and mortar or that we wish to emulate the Fraunhofer institutes to the extent of believing that they are new institutions. We really would wish to amplify the capabilities of existing institutions. Our concept was that the intermediate institutions, the large number that exist, whose work is dominated by small and medium-sized companies, I would say—

(*Dr N Johnston*) It is about 80 per cent of the membership which is small and medium-sized enterprises.

(*Sir John Fairclough*) And how many companies is that?

(*Dr N Johnston*) In total that is about 20,000 companies. The membership of AIRTO organisations is about 20,000.

(*Sir John Fairclough*) So that was a factor, but we did not wish in any way to promote the interests of AIRTO exclusively. We saw that activity in those laboratories as being important, but we wished to have a programme which was sufficiently flexible that an existing institute and university could become a Faraday Centre where they have accomplished some significant research and it has reached a stage where some exploitation would be appropriate and merited. We also saw enormous resources in the Government's research establishments that they too could actually seek Faraday Centre status and engage in joint research with the university, on the one hand, and industry, on the other, and be a catalyst for the introduction of new technologies. So in no way were we trying to be overly-prescriptive in what we have suggested. We were very committed, however, to the concept of a place where academic research and industrial research could meet.

2. If I could just stop you at this point, I think we should try to get it clear that your objectives of producing more technology transfer would be by the transference of people who have been taken on in some way by these centres to do research under the influence of universities and industry and those people then, as you said yourself, those are the people who would bring about the technology transfer by their own transference.

(*Sir John Fairclough*) It would not be exclusively that, although we saw that as a very significant factor. Of course the work itself would be valuable and you would expect industrial researchers to be participating as well. However, if a Faraday Centre were able to offer half-way decent salaries to young people, they would have an incentive to go there, to get a degree and to do work that was coupled with the needs of industry. All would therefore benefit and that knowledge would transfer with them, assuming success. It is all a little idealistic and one would need to monitor it and be very careful about how one controlled it.

3. But if we take that as the major objective, I think you have to say why it is that a new institutional arrangement is required to do this when you already have some pretty vigorous schemes in CASE and PARNABY and teaching companies, LINK and maybe one or two of the European ones as well, all of which are doing this.

(*Sir John Fairclough*) All of those ideas, LINK, the Teaching Company Scheme, CASE studentships, all have similar objectives. I would suggest that the CASE scheme and the PARNABY PhD scheme has a stronger orientation towards training and development of existing knowledge than necessarily doing research on new issues and new problems.

4. If I may say so, in your glossies you are selling the idea that contact between universities and industry is so bad that some scheme has to be provided to put this right and, so the blurb says, "This is a unique opportunity" and so on. If you are now saying, "Well, actually that was all a bit of an exaggeration and this is another useful addition to the available portfolio of schemes", then we can talk about it on that basis.

(*Sir John Fairclough*) It depends on the perspective, my Lord Chairman. In no way did we set out to say that the Faraday Centre would be *the* way of bringing industry and academia together. It was another way which, we felt, had great merit, but in no way did we set out to say that it should replace existing schemes. One of the questions which needs to be addressed is what is the relationship between those other programmes and LINK and Faraday. I do think there are a number of subjects where the Faraday Centre fits and would serve our purpose best of all.

Lord Gregson

5. I was fascinated to hear Sir John talk about the possibility of the "tech-cities". Some years ago when this Committee visited Japan we were introduced to the idea of the technopolis which the Japanese have since advanced very vigorously and I understand the first five are now fully funded and really making a great impression on the regions of Japan and another seven are being proposed. I understand also from my contacts with Manchester there is a proposition for a technopolis of Greater Manchester and I would have thought that was the sort of thing that could be encouraged wholeheartedly and as rapidly as possible because it is that situation, my Lord Chairman, which is unbelievable and the Japanese have made it work and they have ploughed the furrow and it really now is beginning to happen very strongly in Japan and the thought that Manchester

[Lord Gregson *contd.*]

should generate this out of their own thoughts fills me with a great deal of enthusiasm.

(*Sir John Fairclough*) I know very little about the technopolis. I do know that the more we can encourage local initiative to bring a greater degree of common purpose between the two communities, the better we will all be served and if the technopolis approach does that, I think it is to be encouraged.

(*Dr N Johnston*) My Lord Chairman, if I could perhaps add to that, there is no doubt that in Japan and France the technopolis concept has been a very powerful one and they have used it to implant research and development activity in areas where there previously was not any. They have also used it as a catalyst for the congregation of groups of synergistic companies around R&D facilities. I think, however, that perhaps rather like science parks, there is a danger that the technopolis concept becomes hijacked in terms of property development rather than its fundamental purpose which is to improve the technology that is available and taken up by British companies.

6. That is not the proposition in Manchester of course.

(*Dr N Johnston*) No, not at all and I am not suggesting it is, but it can tend towards that direction. If I could go back to the HEI interaction, I think the point is that the relationship between higher education institutes and industry is particularly good for larger companies and particularly good for the processing industries, the chemical and pharmaceutical industries. The feeling was that the interaction with smaller companies, and I do not necessarily mean very small companies, but medium-sized companies of several hundred employees, was perhaps not that good and that in addition in the mechanical and physical sciences the interaction again was not necessarily as good as it could be.

Lord Porter of Luddenham

7. Could I ask why do you think it is not so good? We have had research associations in almost every industry in Britain, and you have told us the AIRTO has 20,000 members and so on, and we have had these for 40 years or so. They have been, as far as I can see, very similar to your Faraday idea where they have been funded partly by government and partly by industry and they have done the transfer and there is close liaison—I worked in one once—there is close liaison with both universities and industry. What is the difference between the Faraday institute and one of those?

(*Sir John Fairclough*) I would not wish to be negative on the AIRTO laboratories at all. Our motivation was to amplify their efforts and to grow their capability and skills in both directions with industry, on the one hand, and the universities, on the other.

8. So you would be simply calling what used to be the research associations "Faraday institutes"?

(*Sir John Fairclough*) No, no. I think we need a system that actually requires a degree of competition, that they would have to demonstrate skill and capability in some field or other which had industrial intellectual underpinning on the one hand and a university capability and interest in forming a partnership with them. Therefore on merit they would be awarded Faraday Centre status. It would be wrong, I think, to say all AIRTO laboratories should become Faraday Centres. One needs a system which distinguishes.

Lord Howie of Troon

9. I would like to come back to the question raised by Lord Gregson. I have not fully grasped the concept of City of Innovations nor indeed, whatever it was, the technopolis. I would like to think of it just as a kind of science come business park. I wonder if Sir John could define it for me?

(*Sir John Fairclough*) This is the second proposal that the Prince of Wales Steering Group made. It is nothing to do with Faraday Centres. Although there is a coupling, I do not wish to confuse the two.

10. I only mentioned it because you did.

(*Sir John Fairclough*) The logic of my delibertions went as follows: that we need to improve the competitiveness of existing products and processes. The bulk of British industry is represented by the smaller and medium-sized companies. How do you deliver capability and skill and knowledge to small and medium-sized companies? It is difficult to do it nationally. One ought to try a mechanism locally. Our case study work has demonstrated that the Scottish Office and their relationship with higher educations and industry in that community has served them very well indeed. Graeme Davies, a member of the group, observed that many of our great "red brick" universities were founded at the height of Victorian success by the city fathers of the day to serve their community. Therefore that led to the idea of building a new mechanism, a modern mechanism, of a modern-day city father, if you like, that could build a greater degree of coincidence of purpose. It was more about skills and people in that idea than it was about research and the Faraday Centre was really about research, as I have described it, and although one would like to see a Faraday Centre pursuing research in a field that is relevant to industry in the community, the two ideas are not connected but only through—

Chairman

11. Maybe I should say that this Committee is as passionate as you are in wishing to see contacts between universities and industry which are meaningful and lead to technology transfer and a boost to the economy. We very much want to see that brought about. I think what we are concerned about here in questioning you is to what extent you have a new scheme for doing something with the same things in mind but doing it in a different way which will add to the resources we already have for things of that sort. I have to say that at the moment I am not very clear what your new scheme is although we wholly applaud your objectives.

(*Sir John Fairclough*) The newness of the proposal is to create a centre where researchers share a common infrastructure and work jointly on problems that they are trying to solve of value to industry.

Lord Dainton

12. May I just ask, any infrastructure has a material side to it. Is it help for universities or industry or something new in which they both invested?

(*Sir John Fairclough*) My view is that the facilities will be the key to whether the Faraday Programme would be a success.

13. Exactly. It is a measure of commitment.

(*Sir John Fairclough*) It is a measure of commitment and many branches of research in terms of business foundation require increasingly sophisticated equipment, facilities and instrumentations. Neither industry nor universities party can afford the increasing sophistication of some of that instrumentation. The idea of taking a single centre, wherever situated, where the two communities could share the instrumentation necessary to conduct basic research on the one hand and applied research on the other in fields that are, of course, relevant to our industrial needs.

Chairman

14. Although in my understanding of what you had written it was that the highest authority was to be an intermediate institution.

(*Sir John Fairclough*) No, we were not proscriptive to that extent. There was a bias, Lord Chairman, in that direction but we purposely were not proscriptive.

15. That was just an example.

(*Sir John Fairclough*) We said in our first paper that we should amplify the role of intermediate institutions then when we came to the Faraday Centres we saw the intermediate institutions playing an important role but not exclusively.

Viscount Caldecote

16. Lord Gregson used the expression, "implanting technology in industry". That implies some existing institution going to industry and saying, "We have got something to offer you that will be useful to you." That is alright if industry is receptive but surely the position is if industry is receptive there are many companies that go to universities and research associations or whatever it is and use them very effectively. Is not the great problem that whatever institutions you set up if they do not see a need for work to be done nothing new that you set up will do any good. How do we get over that problem in setting up a new organisation? We are agreed about the objectives but it is the effectiveness of the new idea.

(*Sir John Fairclough*) The relationship between industry and the university works best in the chemistry and life sciences where what you produce in a test tube in a university laboratory is substantially the same product you end up shipping if it has commercial value. There is little engineering of the product. In the physics based industries you have to engineer the artefact and the relationship is weakest between our industrial community and the universities where engineering is involved.

17. Why is that? Engineering firms in the aerospace industry have seen a problem they could not solve themselves and they have gone to universities and got a very good answer.

(*Sir John Fairclough*) The enlightened companies do that. You know as well as I do that our best companies have always been active. We are talking about small and medium-sized companies which is most of British industry. That is the problem. Another dimension—and why I interrupted my two colleagues—is that if we could arrange the Faraday Centres or something like it that they would be doing world-class work then that in itself would have an influence on the science that we do in our universities. It would help in setting the agenda for science. Those problems or opportunities that would emerge from that work would have an influence on how the university and research council community spent their money, through the intellectual value of the work and not through anybody deciding at the centre that it would be good to do research on this or that subject.

18. Sir John talked about small and medium-sized companies. I agree that is a problem but how does setting up a new type of institution which could solve the problem when on the whole small and medium-sized companies do not see the advantage and value they can get out of academic research or applied research?

(*Sir John Fairclough*) It would give them access to facilities, skills and people that they normally would not have access to nor could they afford.

Lord Renwick

19. My Lord Chairman, I find we have been talking in the abstract, Sir John, and I would welcome it enormously if you could give us one or two examples. Reading quite a lot of the evidence here it seems that when we come to an example—I have only got one, the first one I saw was the Imperial College and the Water Research Centre—it does not seem terribly happy. It seems happy from the Water Research Centre side but Imperial College is not so happy that it is regarded only as research. Could you give us more idea as to how your Faraday Centres would work?

(*Sir John Fairclough*) An example that comes to mind is about new materials. There are many novel ideas for new materials, composite materials, combinations of metals and plastics, with a growing amount of interest in their application both for new products and processes, but also to replace existing material. That is a field that is generic in character where companies could share that knowledge. If you had a facility for making the new material on an experimental basis where the characteristics of the material itself need to be perfected, you would need to do some application research with the material itself, on the one hand, and in the formation of the new material, on the other. People could come together then and share that facility. There is room for PhD work from an academic point of view as well as room for real application research on the part of industry. You are sharing then a common facility in the very early days of a new material.

(*Dr Whelan*) I would like to comment that there is an excellent example at the present time of a technology where the United Kingdom has quite a good academic position and that is surface

[Lord Renwick *contd.*]

engineering and surface science. It is of an extremely broad industrial application, that is quite clear, but also each of those application areas has to be engineered into some particular product or process sequence, be it manufacturing a component for a car, or be it manufacturing something in plastic. The point is that the development, if you like, of those detailed processes in itself requires some quite fundamental engineering development. That could very properly be done in an intermediate institute, a Faraday Centre, which focused on surface engineering as an example and which would commission and draw upon the scientific base which we have in a number of universities in this country and at the same time deliver processes which United Kingdom engineering companies would be able to use in their products and process production lines.

Lord Whaddon

20. Here you have a Faraday Centre with 2,000 or 3,000 medium-sized companies in its area. How do you sell that idea to those thousands of companies who are overwhelmed with their own problems and work? Secondly, how do you finance it? Do they pay a levy for association?

(*Sir John Fairclough*) I think the AIRTO example is an existing theorem of how that is done.

(*Dr Whelan*) I think there are two points to be made. The first one I would draw your attention to is a small centre that CEST itself established in the field of adhesive technology which has developed a technique for communicating new technologies in that field to quite large numbers of small companies. In fact in the last two years of operation they have worked with over 400 small companies, so those techniques for dispersing science and technology into small companies are now being developed. The second point is the point that the contract research organisations in this country do have very large membership bases of small and medium-sized companies for which they have already developed a method of access and one of the arguments for considering those types of facilities as being homes for Faraday Centres was that you could use those access routes that are already established to put new technology that you would develop in the Faraday Centre itself, so in a sense you were reducing the risks that you would have in being able to exploit the technology by using a channel which has already been developed and is in existence. They may not be ideal, but they are a lot further along than almost any university department and the reason for that is that the university departments have had to rely on funding from large companies and they do not in general get their funding from small ones.

21. So you have an established channel for the Faraday Centre to sell its ideas once it has got them. Who pays for that work up to that point?

(*Dr Whelan*) Up to that point we have suggested that there should be really basically three methods of funding that a Faraday Centre can access. The first is a certain amount of public funding which comes to the Centre for its establishment and to support a basic research development programme.

(*Sir John Fairclough*) And I think that is the infrastructure.

22. You mean it comes from the Government?

(*Dr Whelan*) Yes. The second type of funding is access to any one of a number of collaborative funding programmes that already exist, be those national, like LINK, or be they European, like BRITE EURAM, et cetera. The third source of funding is direct private, single-source funding from industrial companies themselves. In fact those mirror, apart from the basic funding that I talked about, the funding sources that the contract research establishments are at ease with dealing with. Therefore, they should be able to construct that type of funding mix quite easily from their previous experience and contacts. We are trying, by thinking of the Faraday Centre in this way, to amplify and use skills that have been developed in the exploitation of technology by these contract research laboratories and others.

(*Sir John Fairclough*) Which would include the Government's research establishments and universities.

(*Dr Whelan*) When we produced these documents of course it created a good deal of debate within industry, universities and contract research organisations themselves and, as my Chairman said earlier, we have tried to avoid being over-prescriptive in the way these centres might be created and several universities and their associated companies that they have on science parks have pointed out that they can create this type of market-sensitive activity through new collaborations that they could establish and I believe that if a programme that has some of these characteristics we have talked about is created, it should be able to draw into itself these types of combinations which people will develop. If I could reply to Lord Caldecote's point about developing market and industrial pull for the output of these centres, I think that this is an extremely important point. Quite apart from recognising that there will be a market pull in the activities of existing contract research establishments—that is, if you like, their existence—the measurement of how far industry itself will see this activity as being valuable is one of the points that I think has to be ascertained in deeper studies, but we have explicitly mentioned that any centre which would aspire to Faraday Centre status must be able to demonstrate that it has the ability to create a market for new technology.

Lord Walton of Detchant

23. Could I just follow up three points? The first is that I am sure we all around this table share your objective of wishing to see far better and greater exploitation of British inventions and ideas in an industrial sense. I remember when I was on the Medical Research Council every invention or discovery had to be passed on to the National Research and Development Corporation and we know full well that that was not very successful as an objective. What I would like to ask you first is what makes you satisfied that the Faraday Centre concept is going to be more successful than all the other initiatives that have been attempted over the years in exploitation? Point number two is just following up what has been said by others. Is the Faraday Centre concept any more than a bringing together of

[Lord Walton of Detchant *contd.*]

teaching companies, science parks and offshoots of university and higher education institutions, on the one hand, and the research and development bodies, such as International Research and Development, of which I happen to know, in the north-east, and others? Is it any more than the bringing together of these into a kind of single, cohesive establishment or is there something really new and if there is I have not appreciated it wholly? The last point is that I see that large numbers of PhD students are being recruited into the Faraday Centres under the pilot scheme. Is there a danger that some of those people, where it is admitted that they may take five rather than three years for their PhD according to some of the figures in your documents, is there a danger that as they will be working essentially in applied and operational research and exploitation that they may have difficulty in persuading the external examiners of the excellence of their work when it comes to the end of their period?

(*Sir John Fairclough*) I think if I could deal with that last point first, the essential component of the arrangement would be the relationship between the Centre and the university. I think it is essential that the university has an arm around a centre in order to ensure that standards are maintained and developed. I would have hoped that such a relationship would develop further and that there would be an opportunity for academics to extend the sabbatical period in the centre doing research, overseeing, supervising activity and generally involving themselves in creating industrial activity. And so it would be a help in the interchange of skills between the university and the more industrially-orientated organisations. Your middle question was novelty. There is nothing new under the sun. I hope my earlier remarks will convince you that building strong bridges between the two communities is an essential requirement for our economic success. Anything we can do that develops that we should try. I emphasise that in no way are we trying to substitute the Faraday ideal for other programmes. It is in addition. There is a piece of work to do to extend the relationship to all of the initiatives that focus on building these bridges. That needs to be done, I think, by the development of people, which is an orientation of the PARNABY initiative. The CASE studentships also have a strong people development bias, contrasted with the Faraday Centre, where of course the flowing through of people is important but the engaging in relevant research and the knowledge that it would produce is also very important.

Lord Porter of Luddenham

24. John, you speak with great enthusiasm of the Faraday Centres as centres of excellence doing excellent research. You have spoken of the shortage of centres with good equipment elsewhere and this will be solved by having good equipment in the Faraday Centres. You have said that key people are going to be attracted there by higher salaries. You did not put it quite in those terms but it was quite clear that is what you meant.

(*Sir John Fairclough*) Halfway decent salaries.

25. Then when Lord Renwick asked for specific examples we were given the one of material science. There is certainly a centre of excellence for material science—it used to be called metallurgy—at Cambridge University.

(*Sir John Fairclough*) Can they afford the capital equipment necessary for a pilot process?

26. No but they can afford a little. If a Faraday Centre is set up in competition, it will not be able afford any. We must start on the bottom from the supposition that there will be no new money and whatever we do here would be in place of something else. It would be in place of an excellent Department at Cambridge doing material science.

(*Sir John Fairclough*) If the Faraday Centre example is accepted but takes the place of existing sources of research, I think that would be a great mistake. Our vision was that the Faraday proposal had sufficient merit and that it was wholly additive to existing activity.

Lord Porter of Luddenham] It has never happened before.

Baroness Platt of Writtle

27. The question of the additive nature of it, that makes it competitive. I find it very difficult, and I have been trying to understand it this afternoon, but we have evidence from people like Cranfield who are already engaged in this sort of thing. They are very enthusiastic and working well. If you set up Faradays on that basis that is excellent but does it need something new? If you set it up elsewhere surely it will be competitive?

(*Sir John Fairclough*) Could I take that point and Lord Porter's point where he used Cambridge's material science as an example, If neither industry nor the universities can afford, because of its speculative nature, to invest in a pilot process for some new material then we are in danger of doing nothing well in material science in terms of taking it forward into real applications in the market if one is looking for an arrangement where all these costs and facilities can be shaped. Now the work of material science at Cambridge may be impacted if a Faraday Centre came into existence. We would hope the knowledge and skills that Cambridge had would flow into the Faraday Centre or they would go on to other things but somebody has got to invest in the materials that have potential at the next level.

Lord Porter of Luddenham

28. One sentence and I will be quiet. I accept that you are building bridges between the Cambridge material science centre and industry by making two instead of one. You have an isolated island in the middle now which you call a "Faraday Centre". So you have to transfer your work from the Cambridge Department and from the Faraday Centre to industry. Why can industry and the department in Cambridge—in fact they do—not work very closely together and get its advantage.

Baroness Platt of Writtle

29. Also there is a science park there already.

(*Sir John Fairclough*) The science park would be a good venue for a Faraday Centre.

Lord Dainton

30. The science and technology field is not a seamless robe. It is very varied particularly in its relation with industry. Indeed, Sir John has mentioned how distinctive the chemistry and pharmaceutical industries are. Are you content that we have all the range of industries and have you identified areas in which your concept would be uniquely available either because there is nothing there already or because what is there already needs replacement. Speaking as a chemist, the situation there of course is very good—it has been there for along time—and the reason is because we got the tradition from Germany but there must be some areas that probably started you off in thinking about this.

(*Sir John Fairclough*) It is the physics-based activity by which I mean the engineering-based industries where physics is the foundation. It is those industries.

31. They are deficient despite Thorn EMI?

(*Sir John Fairclough*) They could benefit most from these intermediate institutions.

Lord Walton of Detchant

32. How are we going to persuade companies to improve Britian's standing in the R& D scoreboard when the top company we have is number 35. Surely unless companies themselves are prepared to put more money into research and development you are not going to be able to get the funding you require from industry for the Faraday Centres.

(*Sir John Fairclough*) That is a defeatist way of thinking about it. One needs confidence in the Faraday Centre. I would think not universally but in some companies it would be the main catalyst for them to make greater investment because they could see the relevance of the work to their future products and marketing.

Lord Dainton

33. Do you identify particular subjects which you would want to support which would fit in with your criteria of physics-based industries and whether there is a likelihood?

(*Sir John Fairclough*) We have not gone into that detail.

Lord Howie of Troon

34. I have been wondering about the franchise system. How is that supposed to work? Who would make a bid and who would grant the franchise? Would, for instance, Cambridge which we were talking about, be the sort of people who would put in a bid for the franchise?

(*Dr Whelan*) In principle yes. The interesting thing about the franchise concept was that it would enable an overall management group to broadly set the strategy and allow collaborative groups who felt they had the right sort of characteristics, if you like, to run one of these centre to fill in the detail and operate the franchise. It was a way of trying to avoid being overly proscriptive of the areas that you would want people to look at. The other point I think which follows on from perhaps the observation Lord Dainton was making is that when the Department of Trade and the Department of Education announced the Postgraduate Training Partnerships, there were 50 odd pairings that took place. Now the first thing I think that occurs to you is that those pairings in the bids do include statistics for areas that should be focused upon. They also suggest, to me at least, that there is at least some interest in constructing these laboratory pairings between centres which would regard themselves as being contract research centres and centres which would regard themselves as being centres of academic excellence. So I think we can sort of look upon that experiment quite positively because it provides us with at least a view of the level of interest. I believe that if the academic community were as negative about this as some people seem to indicate, then we would not have got the bids.

35. Before we leave the franchise business, could you tell me whether these groups putting in the bids would be self-generating or would you put out a tender or would you try to prod them into action?

(*Dr Whelan*) I think you have to produce some broad guidelines both on how you would see a centre operating and the types of general areas of technology that you think it would be appropriate for a centre to be created in. I think it is up to the bidders who want to operate the franchise to fill in the detail, so in a sense you have to prod the system, but you are really trying to get a response from them as to how they would exactly operate the franchise and run the Faraday Centre.

(*Sir John Fairclough*) We favoured the franchise arrangement because it would be for a limited period and one would have then a break clause to be able to make a judgment on whether the contribution that the centre had made was worthy of being continued.

36. How do you prod them? Do you put an ad in the *Sunday Times* or what do you do?

(*Dr Whelan*) Judging from the response to the pilot, I think as long as you put the broad rules out, you will get an extremely rapid response. I think the total was 58, of which nearly 50 fully qualified.

Chairman

37. I must say I remain a little confused about the basic concept here and the objective is to get university people and industrial people to work together on something that is likely to produce economically significant technology transfer. That is understood. You can do it, it seems to me, either by getting industrial people to work on the university site with the university people and you can call that in English terms an "IRC" or, in German terms, a "Fraunhofer institute".

(*Sir John Fairclough*) You can call it a Faraday Centre too.

38. Well, I am talking in terms of existing institutions. We already have a model of that with the IRC here and the Germans have done it very successfully over there. Or you can do it the other way round where university people work at the industrial site and we have things like CASE and so on where that takes place with the students present and that achieves many of the things you want to achieve, or you can have some intermediate situation where you take both industrial people and university people and plonk them in some third place.

[Chairman *contd.*]

(*Sir John Fairclough*) But we are not talking about new intermediate centres.

39. No, and that could be, for example, any other existing government laboratory or institute of some kind where the facilities exist or some of them do.
(*Sir John Fairclough*) We are trying to upgrade, in the context of the intermediate institutions, the AIRTO labs—

40. Well, what I am not clear about is why, if you are right, you are picking on that middle course rather than the others or are you picking on them all?
(*Sir John Fairclough*) We are picking on them all. We do not exclude any of those three scenarios.

41. So what you are proposing is a very general programme of backing any proposal anywhere for meeting those objectives and you do not really mind how or where it is done?
(*Sir John Fairclough*) No, if there is a proposal emanating from any of those three sources that realises the objective.

Lord Porter of Luddenham

42. Does the SERC not already do that?
(*Sir John Fairclough*) In what way?
Chairman] What about the IRCs?

Lord Porter of Luddenham

43. They will fund IRCs, the universities and they will even fund industrial research if it is not too near-market.
(*Sir John Fairclough*) Why, Lord Porter, are you arguing that there is only one way of accomplishing this objective? I accept that there are examples of great success on campus.

44. No, I was not, Sir John. The three suggestions put forward by the Chairman are all, to some extent, funded by SERC.
(*Dr Whelan*) With respect, Lord Porter, I think there is only one case of SERC ever funding a contract research establishment.

45. Certainly the research associations are funded by SERC or the equivalent government body, the DTI, or whatever.
(*Sir John Fairclough*) Lord Porter, there is a dimension I think that perhaps you may not appreciate; the dimension of the work where it would be very strongly goal-oriented research because it would set out to realise some industrial objectives. That is a distinguishing factor between the sort of research we see in the Faraday Centre and research that the university engages in.

Viscount Caldecote

46. Is that not what the Government now calls "near-market research" and which is greatly frowned on for government support?
(*Sir John Fairclough*) It is the production, producing generic knowledge of a technology that would be valuable to a community of interests.

47. I am all for it. I am just wondering whether you will get funding for it.
(*Dr Whelan*) I think that is one of the reasons why the situation of universities and their funding from specific companies fails in the enabling technology area. The relationship that exists between companies and the research that is undertaken in the university is generally one-to-one, that is, it will be a particular company funding work in a particular university and that the relationship is essentially one-to-one and is not dispersed very much wider than that. The point about using the contract research institutes for enabling technology development is that their ethos is to spread this technology as wide as possible, that is to say, they are used to working in situations where they are spreading technology through all their members and that may be a very large group of members, so in effect you are moving from a one-to-one situation to a one-to-many situation and I think that is really quite an advantage that these intermediate institutes have over specific university departments.
(*Sir John Fairclough*) I think there is a great distinction, Lord Caldecote, between the Government subsidising the development of specific products and processes and their support of generic technology and that is the knowledge one needs to start the process of product and process development.
(*Dr N Johnston*) I would like to remind the Committee that we said at the outset of our work that one of the focuses was smaller companies and many of the schemes that have been mentioned, whether it is teaching companies or CASE awards, although in some ways are intended to help smaller companies, in many instances they simply have not been taken up in great numbers by those smaller companies. They simply find the gap between themselves and their capability and understanding and the universities too large to bridge. It is those companies which already have a relationship with an institution, an intermediate institution which they trust and who can translate into terms which they understand and appreciate the benefits of technology and the services that that institute supplies and it is the refreshment of the technology base of that intermediate institution which the Faraday Centre sets out to do.

Lord Renwick

48. Can I start on a rather different subject that we have not touched on which is the intellectual property rights and, following on from what Dr Johnston said, it would be wonderful to get small companies interested in innovation, but one thing is they find it very expensive and, two, I believe a lot of very large companies have on their shelves a lot of innovation which for various reasons of their own they do not want to develop at this stage if only because it exceeds their current investment in current technology and to go to new layers of technology, which I am sure Sir John understands perfectly well, like the example of the development of liquid crystal, I believe at the RSRE, is surely an occaision where to my eyes anyhow a lot of the research was done there but a lot of the exploitation of liquid crystal was done overseas. Does Sir John think the Faraday concept would help in those three areas?

[Lord Renwick *contd.*]

(*Sir John Fairclough*) We would hope so. If you take liquid crystal as an example, I could have replaced liquid crystal in my example of composite materials—it would have equally applied—that in the early days of liquid crystal when the capability was first emerging one could envisage a collaborative arrangement by a group of companies which were interested in exploiting liquid crystals coming together and taking it further.

Baroness Platt of Writtle

49. I have listened to this with great interest and like everybody else round the table passionately believe in the importance of industry and academia getting closer together than it is and that resulting in technology that can be utilised and applied and it is obviously the development situation that we lack in this country. I just wonder whether what you are suggesting is too diffuse. Obviously this question of small and medium-sized enterprises is very important. I happened to be involved in something in my own county this month where they are setting up technology clubs with European money which seems to be on the level of small and medium-sized enterprises. When you are talking about franchises, I can imagine that working for them but then earlier on you also mentioned the importance of much bigger projects which might be the sort of UMIST[1]/Cranfield/Cambridge kind of projects where you are talking about investment of large capital sums. I cannot see that is going to fit in with a franchise situation a short-term. It must be longer-term.

(*Sir John Fairclough*) I think 10 years would be quite adequate.

50. Instead of thinking of Faraday Centres one ought to think in terms of the Faraday principle. You seem to me to be setting up a principle which might apply to a whole lot of places already which would be good. They might perhaps improve on it and then that would be more open to application in different ways. The more you talk the more it seems to me it is too diffuse but perhaps you would like to react to that?

(*Sir John Fairclough*) We were obviously limited in the scope of our work in the sense that we were invited to make a proposal of how we might improve the innovative vitality of this country. I took the idea to a stage of being of an implementable programme. How you would administer it I think was beyond my remit so many of the questions you have been asking is to do with how you would make the concept work which we did not feel it was appropriate for us to indulge in and be over-proscriptive but rather present it at a level of a concept and some broad guidelines on how it might work. It would be up to the government of the day to decide how it would be implemented. My Lord Chairman, you could be enormously helpful in that regard.

[1]Note by the witness: University of Manchester Institute of Science and Technology

Chairman

51. I do not know about that; we will see! Would it be fair to say your objectives are clear enough and we are not quarrelling with them at all, but really what you are asking for is for the creation of a pot of gold, jointly by universities in kind, I suppose, and industry in part in kind and the government, which could be administered by some agencies set up for the purpose called "Faraday", if you wish, for any scheme involving universities and industry and the transfer of technology. You could adminsitrate it wherever it took place and by whomever it took place and that would be really what you are urging for—something along those lines. You do not seem to be at all dogmatic about how it should be done.

(*Sir John Fairclough*) I would not dissent from that. I think one of the problems we have is the discontinuity that exists between the Department of Science and the Department of Education. Indeed we have a third member in the community—the Office of Science and Technology. One is looking for a programme that would be fully supported by all of the interested departments of government and would be fleshed out answering many of the practical questions that have been raised and where it would fit with existing programmes, one is looking for a mechanism that would give it focus in administrative terms.

Viscount Caldecote

52. It seems to me that the way forward is to have a go and see how a few of them or one or two of them might work. I do not quite understand this precursor that the Imperial College has talked about, this Faraday precursor project. Is that a sort of prototype Faraday Centre and if it is not would it not be a good plan to try to direct our energies to try to get two or three prototype Faraday Centres set up, see how they could be funded, see how they work and expand from there?

(*Sir John Fairclough*) The idea of the DTI's so-called pilot programme was exactly that, to learn how to do it. As Peter Lilley, when he was Secretary of State, said to me then, "They are not pilots in the sense of deciding whether we should pursue the idea or not, but they are pilots in the sense of finding out how best to arrange them".

Lord Porter of Luddenham

53. Several of us want to ask this question, it is a trivial one and you can ignore it if you wish, but why do you call them "Faraday" Centres when Faraday was the one man who was his own man and his only clash with an institute delayed his discoveries for three years?

(*Sir John Fairclough*) The idea of using Faraday's name emerged late in an evening after dinner, I have to admit! The idea was appealing because Faraday's contributions covered the whole spectrum of basic science through to engineering. He was very fortunate in not knowing whether he was a chemist, a physicist or an engineer and it was that that gave his name.

[Lord Porter of Luddenham *contd.*]

Baroness Platt of Writtle] And the 200th anniversary.

Chairman] That seems to be a very suitable note on which to end. Thank you very much. I think that the matter has been clarified considerably in the course of our discussion and we have to thank you and your colleagues for that.

Printed in the United Kingdom by HMSO
Dd 0502959 C5 9/92 201830

ISBN 0-10-480293-6

HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

FARADAY PROGRAMME

Wednesday 28 October 1992

ADVISORY BOARD FOR THE RESEARCH COUNCILS AND SCIENCE AND ENGINEERING RESEARCH COUNCIL

Sir David Phillips, KBE, FRS and Sir Mark Richmond, ScD, FRS

HIGHER EDUCATION FUNDING COUNCIL ENGLAND

Sir Ron Dearing, CB and Professor Graeme Davies, F.Eng.

Ordered by The House of Lords *to be printed 19 May 1992*

LONDON : HMSO

£4·95 net

HL Paper 23—ii

WEDNESDAY 28 OCTOBER 1992

Present:

Caldecote, V.
Dainton, L.
Flowers, L .(Chairman)
Gregson, L.
Howie of Troon, L.
Kirkwood, L.
Nicol, B.
Perry of Southwark, B.
Platt of Writtle, B.
Porter of Luddenham, L.
Renwick, L.
Walton of Detchant, L.
Whaddon, L.

Memoranda from Sir David Phillips and Sir Mark Richmond will be published with the Committee's Report

Examination of witnesses

SIR DAVID PHILLIPS, KBE, FRS, Chairman, Advisory Board for the Research Councils, and SIR MARK RICHMOND, ScD, FRS, Chairman, Science and Engineering Research Council, called in and examined.

Chairman

54. I think the Committee regard you two as old friends and colleagues of us as well as of each other. Will you please answer our questions in whatever way you like between you. Before considering the CEST proposals specifically, I wonder whether I might ask you this: we must obviously welcome any attempt to increase collaboration between universities and industry and to improve the innovative capacity of industry, but do we need more bridges between industry and universities at the present time or do we need to fund and maybe administer the bridges we already have better?

(*Sir Mark Richmond*) There certainly are a lot of bridges at the moment. I think one of the things one can say clearly is that those do need some rationalisation, but it seems to me that the one thing that is missing is an arrangement, which I think I said in my evidence to you, would help to change the mind set of young people from the one which is frequently dedicated to pure science, to one which is more concerned with the application of science to industry. I am not saying that should apply to all young people coming out of the universities.

55. So double the number of CASE awards, for example?

(*Sir Mark Richmond*) That could be one way forward. When we were both in Germany I think we were struck by the way in which the Fraunhofer system worked. That had the effect of providing a different output to the academic route. One route would be for bright young people to stay to do research in a university department and the other would be to shift the points and have them go and do their research in a Fraunhofer institute. These were brigaded very closely and very effectively together, the university route and the Fraunhofer route. I think the effect was to produce people with a rather different mind set.

56. Sir David?

(*Sir David Phillips*) I do not think I have anything to add to that. I agree with it.

Lord Dainton

57. In some of the evidence—I think from ABRC—attention is drawn to a marked difference between the German situation and the English situation vis-a-vis research students, namely, the great age difference and therefore greater maturity. That raises the question whether what they have done in Germany would work here with the younger cohorts. What is your view on that?

(*Sir Mark Richmond*) Certainly the average age seemed to me to be nearer the late twenties and early thirties. We heard from a number of very bright young PhD students in the Fraunhofers who had gone in and reckoned they would spend five years in that capacity, and one of them, I think, had only made up his mind about three years into the PhD quite what he was going to work on. It was a very different system but in general they were much more mature people, that is for sure.

58. That would make them more likely to be thinking of earning their living with industry?

(*Sir Mark Richmond*) Yes. I still think in Britain there is perhaps a place for something of this kind and it could be by building up CASE awards, it could be by putting more students into teaching companies, it could even be by developing the DTI/IRO scheme more. I think it would give an output. Another side of this is that people feel the PhD as a qualification is not actually an ideal qualification for people going into a life in industry and commerce.

Viscount Caldecote

59. As to the need for more and more effective bridges between the academic world and industry, to what extent is the problem that industry does not pull the people across the bridges that exist already, and make use of the people and the bridge connections they have already? If you make more bridges and there is not more pull from industry, you will not achieve very much.

(*Sir David Phillips*) I think that is a very sector-dependent question, Lord Caldecote. We do have some sectors of industry which have very close links with our educational institutions and where the influence of industrial need on basic research programmes, for example, is quite strong and where the difference between university research

[Viscount Caldecote *contd.*]

programmes and industrial research programmes is rather small. On the other hand, we have sectors of industry where that is not true, where the difference between what people want to do in industrial research laboratories and what they do in the universities is rather wide. That is true of the big companies and there is a special problem there as to how you bridge that gap. Then we have a whole range of what are commonly called small to medium enterprises which really have no tradition of links in general with higher education. That, I think, is a twin problem. Higher education institutions over the last ten years, let us say, have put a great deal of effort into putting "welcome" on their doormat and taking steps to attract people from the small to medium enterprises in to see if they could help. I do not mean by saying that that I think higher education has done all it could in that direction, I think there is more to be done; but at the same time there is a mind set, or perhaps a certain fear of technical scientific expertise, in small to medium enterprises, or perhaps it is more a lack of realisation of what technical expertise could do for them.

60. Will the SME people use the new bridges if they are set up?

(*Sir David Phillips*) I think when the new bridges are being designed if they do not actually cater for SMEs then the effort is nugatory.

Chairman

61. Then again can you not gear some of the CASE awards particularly to the SMEs—some are already?

(*Sir David Phillips*) And teaching company schemes.

Lord Dainton

62. The trouble about gearing towards SMEs, which are not very well aware of what science engineering and technology can do for them, is that it leads to disaffected students. They find an industry which is below their expectations and it turns them off.

(*Sir Mark Richmond*) It is a very interesting area, I think that is the first point to make. I was talking to the people in the direction of the Fraunhofer rather than the institutes themselves. They did admit that the SME problem—let us call it that—was one they found very hard to address. They found the contacts with SMEs were either through large companies who were then using SMEs as their suppliers or by the use of demonstration units that they have in many of the Fraunhofers where people from SMEs come in, use the equipment and actually effectively test the latest type of equipment to see whether it will serve their particular process.

Baroness Perry of Southwark

63. It is very noticeable that both your responses understandably concentrated on the full-time PhD student, but one of the uncoordinated and informal models which does exist is the part-time student employed in the industry following a PhD quite often jointly supervised with necessarily very close working arrangements between the HEIs and industry, and working on an industrial-related problem. Have you, in your discussions, thought of ways in which that model might be more formalised and perhaps better funded by research councils?

(*Sir Mark Richmond*) Yes, I think we are thinking very hard at the moment about ways in which we could try to tackle this problem. The latest DTI/IRO scheme would have people working in industry effectively full-time and coming into the university only infrequently. It seems to me we do have to think of models in which there is a much more frequent and rapid exchange. It is very interesting, in fact, that in CASE we discovered that a fairly high proportion of CASE students actually do not take up the opportunity to work in industry, which is a remarkable fact.

64. If I could follow that up. I was thinking of the model where the student is already employed in the industry and, for reasons which are agreed between her or him and the employer, they are pursuing for their own purposes for their own studies but something which is related to industry, which industry has defined for itself. That is the model which is there and exists, and it seems to me that it would benefit greatly from being encouraged and formalised?

(*Sir Mark Richmond*) Yes. We have a graduate scheme in place at the moment which works basically in that way. I have to say that industry are not always that keen to let people go at that stage.

Lord Gregson

65. As a Director of a German company I must say I get the impression in Germany that FIs are yesterday's idea. Certainly two of them which I visited as a Director of German company had a very frosty feeling about them and were not very active, and were more like a museum than an active institute, quite frankly. There is no doubt that between the German Government and German industry they are looking much more towards the Japanese model of such an institute being based in industry with the universities from outside. Are we in any danger of joining a bandwagon that has seen the best of its time? We are quite good at this at times, looking abroad and seeing something that was very good historically and joining in at the wrong time.

(*Sir David Phillips*) There is a naughty rejoinder I could make to that, Lord Gregson, which is that the people in the head office of the Fraunhofer Gesellschaft in Munich said to us, "Why are you so interested in the Fraunhofer system? Why don't you go and look at what the French are doing?" which had some element of what you are saying. As to the frostiness or mustiness in some of the institutes, the Fraunhofer people admit quite openly that they are over-invested in some sectors of industry, particularly in IT, but the *Länder* in Germany have tended to argue that they want an IT Fraunhofer Institute, hence the over-provision.

66. Just like the Chinese.

(*Sir David Phillips*) Secondly, although there may seem to be this over-provision, and they may be fundamentally intended for small to medium sized companies, the major companies, Siemens for example, make very good use of the facilities being

[Lord Gregson *contd.*]

provided in these institutions, and are no doubt being subsidised by the government as a consequence.

67. Is it possible that in suggesting that we should look at the French system that they are planning, in practice, to look at the Japanese system?

(*Sir Mark Richmond*) The French system, I gather, is really based on the Teaching Company Scheme in which the students work in a company, so I think we are agreeing with you.

68. The Germans are definitely getting very excited about adopting the Japanese system whereby the government supports R&D institutes within industry?

(*Sir David Phillips*) I would have thought that was essentially in major industries, and what one would be looking for then would be the sort of trickle-down effect Sir Mark was mentioning of supplier companies to these major companies benefitting from the technical advances.

Lord Gregson] There is one other sector as far as the SMEs are concerned. You probably know that SMEs are required by law to be a member of the Chamber of Industry or the Chamber of Trade, and the Chamber of Industry or the Chamber of Trade organise both training and R&D on behalf of SMEs, and the same thing applies in France. They have tended to copy that from the French. It is not necessarily around the FIs.

Lord Howie of Troon

69. In the first page of Sir Mark's letter under (i) he says: "The distinctive role of the Fraunhofer system is to take excellent scientists and engineers who have academic distinction as their driving aim and to make them no less excellent scientists and engineers who have commercial exploitability as their index of achievement." Do I gather from this exchange you have just had with Lord Gregson that they have failed in this aim?

(*Sir Mark Richmond*) Let me explain how the Fraunhofers we saw were set up. They were basically institutes that were contiguous with university engineering departments, physically contiguous. An established academic university professor had been appointed as Director of the Fraunhofer Institute, and he really in a way worked as an operator of the points. As the flow of gifted young people came forward, using I suspect a rather personal approach, he would say, "How about you for industry? How about you for academia?" It was run as a coherent whole. That was the thing that I felt was working well in this particular area. The good ones, of course, where the Fraunhofer bit was very relevant to industry (and, paradoxically, those were frequently the ones where the amount of income was rather low). The one that particularly impressed me, was the Fraunhofer previous laser technology, where they were only getting about 15-20 per cent of their income from industry, but it was clear that these were people from SMEs coming in actually to test the new technology, and these young people who were doing degrees were right at that interface between the companies and the new technology. The ones that were not working so well, in my opinion, were the ones which were getting 80 per cent from industry, because there was nothing new and the industry was basically using them as a subsidised facility.

Chairman

70. Could I put a question to you which brings it slightly closer to what we are actually concerned with. The Fraunhofer Institutes are very closely associated with the German universities?

(*Sir Mark Richmond*) Correct.

71. The CEST Working Group proposal is something that is based on the Intermediate Institute, further removed from the universities?

(*Sir Mark Richmond*) Correct.

72. The question I want to put is whether you feel that there is anything in your study of the German system which leads you favour CEST, the differences favoured by CEST, or not?

(*Sir Mark Richmond*) Some of the Intermediate Institutions are clearly very distinguished and have very high commercial engineering, technological and academic standards. One could take those institutions as the starting point. Another message we got, and I think it is one that applies here as well Germany, is do not try to invest existing institutions with these characteristics. You have to start from the beginning.

Lord Walton of Detchant

73. Could I raise a point in relation to this? It is clear Fraunhofer institutes have been essentially based on physics, information technology and engineering. So far as one can judge, the same seems likely to be the case with Faraday intermediate institutes as proposed. It does not seem there is any proposal for similar initiatives in the growing field of bio-technology. Is this something that ought to be looked at? Is it something which in the growing bio-technology industry is likely to be helpful?

(*Sir David Phillips*) I think that partly reflects what I said earlier on about the differences between different sectors of industry and their relationships with higher education. I think the chemical industry, the pharmaceutical industry and now the bio-technology industry, which is closely linked to those, have historically rather little difficulty in relating with higher education. For some reason which we could debate at length, physics-based industry seems to have been more distanced from higher education and that is where the emphasis has been in Fraunhofer institutes.

74. Could I raise one other point because I think everyone is disturbed by the fact that many of those going into what one might call "pure science" and who graduate with a pure science degree go out into something totally different—accountancy, financial markets and so on. Many of them do not take the opportunity of going into industry where their scientific skills can be used. This is the question I put. The CASE Scheme has been criticised, nevertheless in many instances it has been successful. Is there a case for tying such studentships to an agreement that, if they are industry-financed, the individual should then after completing the PhD work for a specified period in industry?

[Lord Walton of Detchant *contd.*]

(*Sir Mark Richmond*) I think one of the difficulties is that they are not industry-financed—

75. I know, but they could be.

(*Sir Mark Richmond*)—they are taxpayer financed. Industry has said you can only put a moral obligation on people to do that and it is very difficult to enforce it because there is no point in employing a disaffected young person.

Lord Porter of Luddenham

76. Do you see any fundamental difference between the old research associations of which there used to be about fifty—some of them excellent—and what is proposed for the Faraday institutes? I see a difference with the Fraunhofers because the Fraunhofers are going to be associated with the universities, but do you see any difference really between those situations?

(*Sir Mark Richmond*) Many of the intermediate research laboratories we are talking about at the moment are laboratories of the research associations. As I said earlier, and I think you are agreeing, some of them are excellent.

77. Do we need new names—unless, of course, it is a way of getting more money?

(*Sir David Phillips*) I think there is a difference, that the older research associations (and I agree with what has been said about the excellence of many of them) were to some extent contract research organisations doing the work that the contributing companies wanted to have done; so they have over the years, excellent as many of them are, developed a relatively static staff doing the sort of work that they think their client companies will need to have done. I think the difference is that the Fraunhofer system is inherently more dynamic, it involves a flow through of, in the German case, students starting in the university and going on into industry with relevant experience in between and a rather small—

78. That is Fraunhofer, that is my point. But the Faradays are not proposed to have that type of student. Is there a difference?

(*Sir David Phillips*) It depends what you mean by a Faraday. As defined in what I would call the Prince of Wales Group's report, to which CEST made a considerable contribution, they are built on intermediate institutes and the problem would be how you change from a relatively static organisation to this dynamic relationship both with higher education and with industry. That would be a problem, but that, I think, is the essence of what is now intended.

79. They said there is a tendency to prefer a private institution in industry, if they are going to consult, to universities. Do you think there is any truth in that?

(*Sir David Phillips*) I believe the Department of Trade and Industry, which is conducting very wide consultation on these issues throughout the country, has been asking that very point and I do not think it looks likely to come out in the way in which you suggest.

80. Which I suggest?

(*Sir David Phillips*) That industry prefers private research organisations.

Lord Porter of Luddenham] That was their suggestion. Thank you.

Baroness Platt of Writtle

81. Taking up the point of movement of young, bright and entrepreneurial scientists and engineers between industry and academe, is it not partly that in Germany that has always happened to a much greater extent than in this country, where to a first class honours degree person it would immediately be suggested, "Wouldn't you like to go into research?" and they might stay there, whereas in Germany they might be viewing a lifetime in and out of both, which I would want to encourage—but I do not know whether it is acceptable in this country in the same way as in Germany.

(*Sir David Phillips*) Lady Platt, I think that is part of the culture change we are all interested in bringing about. I listened to Dr Riesenhuber recently giving the first of the Zuckerman lectures. He was asked a question about that and said that in Germany they have the advantage that most industries are led by distinguished scientists and technologists and there are, therefore, role models for aspiring young scientists who see themselves being potentially the chairman of Siemens, Hoechst and so on. I think that is part of our culture problem.

Lord Gregson

82. The Chairman of Sony when he gave the first DTI lecture said exactly the same about Japan.

(*Sir David Phillips*) Yes.

(*Sir Mark Richmond*) You see, you do then get on to this question as to whether this discussion we are having, which is a very, very important element in it, is addressing the whole problem. I suppose one of the questions that hangs in the air is, if you had these and produced this output, would they be used? One is not convinced that they would necessarily be used across the whole of industry. So there are culture changes elsewhere to be achieved.

Chairman

83. Let us be optimistic about it. We will produce these people over a period of three or four years. That gives us a little time to change the culture.

(*Sir Mark Richmond*) Yes.

84. If one looks at it like that, what one has to try to make sure is that there—

(*Sir David Phillips*) I do not want to sound desperately pessimistic, but I would be prepared to bet one could find a paper by Playfair in say 1872 that said much of what we are saying.

85. If industry, specially the SMEs, could be persuaded to contribute to this scheme, the Faraday scheme—let us forget about Fraunhofer—they might be willing to take the products of the scheme. What reason is there to suppose that industry would back this scheme any more than it has backed other things in the past? Even Fraunhofer only attracts less than 30 per cent funding from industry with their much better record than we have. Why should we suppose we will get even that? Yet the Government

[Chairman *contd.*]

seems to be assuming we will get a good bit more than that.

(*Sir David Phillips*) I think, to be fair, as far as I can understand it, government departments—particularly the DTI—are looking rather seriously at these issues. I hope they are also wondering about alternative approaches. To quote Dr Riesenhuber again, he mentioned the well-known German scheme in which qualified scientists and engineers were planted at public expense in appropriate small to medium enterprises and after a few years succeeded in breaking down the inhibitions in those companies so that they were then prepared to go and consult qualified technologists about their problems. That is yet another way in which it might be approached which was very successful in Germany.

Lord Gregson

86. Do you see any conflict between establishing such agencies and the Defence Research Agency who have been kicked out of the nest into the wide world and told to earn their living by securing civilian research contracts? There is a very large organisation that has been kicked out into the wide world to compete.

(*Sir Mark Richmond*) Clearly there are bits of the Defence Research Agency which are extremely highly regarded in terms of technology and technology transfer. RSRE at Malvern would be one that comes to mind. I had assumed such an institute might be one of the candidate institutes for development.

Lord Gregson] It would be a strange bedfellow, would it not?

Baroness Nicol

87. I cannot quite understand whether the Faraday centre is completely to take over the host institute or whether there is going to be any residual activity left round the edges? Is it a sort of cuckoo effect—when it goes in nothing is left of the original organisation? If that is so, what happens if at the end of the first five years when the review takes place it is thought to be unsuccessful? Are we then left worse off than we were before?

(*Sir David Phillips*) I assume, Lady Nicol, that you are there speaking of the model where an existing Intermediate Institute is designated as a Faraday Centre. I would have thought then that it became a Faraday Centre, and adopted this dynamic principle of trying to move people through from higher education into industry, and it would be judged on that basis. If it were unsuccessful after a five year review then presumably it would be deprived, in some appropriate managerial way, of the public funding that it was getting. That gets us on to the issue of public funding where I think it does have to be said that, whatever the aspirations of the Fraunhofer Gesellschaft to be independent of government funding, in fact they are not, and they do represent a considerable and rather open subsidy to industry.

Chairman

88. Could I take you to an apparent conflict between ABRC and CEST. You stress, quite rightly in my view, a targeting of highly talented individuals. Many of the SERC schemes are targeted that way too.

(*Sir David Phillips*) Chairman, I should perhaps explain myself. I was after all a member of the Prince of Wales Working Group and the signatory of the report you are alluding to as a CEST report.

89. I beg your pardon.

(*Sir David Phillips*) It was a Prince of Wales Working Party. I am signatory of that report, and I agree that there is an apparent conflict between the emphasis there and the emphasis of the ABRC approach. I did not really think it worthwhile making an enormous issue of that, because I think we should be prepared to take advantage of whatever valuable institutions exist and, as Sir Mark has said, there are very good Intermediate Institutes whose cultures might well be changed in this direction. We all know that individuals, or a few individuals, can quite often change the ethos of institutions if they are given the chance to do that. I would not want to exclude, any more than I think Sir Mark would, using Intermediate Institutes; but I do have a bias towards the procedure which is in fact favoured by the Fraunhofer society, which is to begin by identifying first-class scientists and engineers with the right entrepreneurial skills and appropriate industrial contacts around whom to build these centres. That, I think, is the way I would prefer going about it. I would not exclude making use, if that is not too derogatory an expression, of existing Intermediate Institutes of high quality and potential.

Lord Gregson

90. Is not CEST far too small for the task it might attempt?

(*Sir Mark Richmond*) We are not talking about CEST as a body that would do this.

Chairman

91. Who would do it? Who would actually see it through?

(*Sir Mark Richmond*) It seems to me that CEST is not really set up to do that sort of thing.

Lord Gregson

92. Is it set up to do anything?

(*Sir Mark Richmond*) I think classically there you are looking to a research council. It is interesting that the DTI/IRO scheme the SERC runs the agency for them.

Lord Walton of Detchant

93. May I just go back to one small point, because I think I may not have made my point entirely clear to Sir Mark. The last thing we want is to have a disaffected young scientist working in industry. The point I was trying to make was whether there was a case for suggesting that at a time when the funding of research studentships is perhaps not as generous or

[Lord Walton of Detchant *contd.*]

widespread as it might be whether there was a case in industries which are seeking to employ high quality scientists for physical engineering for them funding such studentships with the agreement that they would, at the end of the studentship, offer that individual, say, five years' employment in a particular sector in which their expertise would be used. I am thinking of something along the lines of the military cadetships.

(*Sir Mark Richmond*) My impression at the moment is, where CASE is involved the industry concerned does substantially supplement the stipend, and does not enter into a formal commitment, but at least makes it clear that they are looking at that person as a potential employee. That exists at the moment.

Lord Renwick

94. Is there not a good example among the sandwich courses at universities for graduates where I have been told that up to 90 per cent of the graduates are leaving that specific university, which happens to be Brunel, and are employed to go into business. Is it possible to use or encourage the take-up of that sort of idea among other universities?

(*Sir Mark Richmond*) I think it is widespread. Lord Gregson will know better than I, but when I was in Manchester my impression was that there were a number of courses in the engineering departments, both at the university and UMIST, where all the students were sponsored by the university.

Lord Gregson

95. As it does at Brunel, because I am Chairman of the Advisory Committee at Brunel.

(*Sir Mark Richmond*) That is widespread, I think. That is a very effective way for recruiting by the companies. But today we are talking actually about postgraduate qualifications and not undergraduate, and it is very different. The demand for PhDs by industry, particularly in the physics-based industries, and that leaves aside the question of whether that is the right type of qualification, is much less tightly coupled than it is in the biological and pharmaceutical industry, for example.

Lord Dainton

96. Is that not in part due to the similarity of the activity which is engaged in by the research student, shall we say, in those subjects, to what he or she does when he or she enters industry? It would be very valuable to have your opinion on the physics-based industries, because we do not in this country have what the Germans have in abundance in their universities, which are departments of applied physics, which are much closer to engineering then any of our physics departments? There are a few departments of applied physics but they tend to specialise in applied optics. Would it be your feeling that in a sense the problem has not got a single solution, but there are many things which have to be done simultaneously, but one of the crucial problems is the one of physics, which you have both stressed. I wonder, and this is perhaps a question which is better directed to the next witnesses than to you, whether one ought not really to be trying to achieve, on the one hand, for big industry, more dual appointments for universities, as has been the tradition in Germany since Berlin in 1812; or, secondly, in those industries where there are small enterprise SMEs, that represents an entirely different problem where something akin to the old research student Fraunhofer Institute is revamped to suit our conditions. I do not think that would really work in the physics side unless you had done something to reorient some of the physics departments as they now stand or adding on polymer physics applied optics or whatever?

(*Sir Mark Richmond*) We can talk about this question for a long time. I think you are right to identify the greater gap. I think other countries actually deal with in a more effective way than we do, but I come back to a point that was made earlier—they also use the output of the system more effectively. Underlying it all is a question, which you would be able to answer much better than I, as to whether there is something in physics which inevitably makes it further from the market than chemistry. I think there probably is but I cannot put my finger on quite what it is.

Baroness Platt of Writtle

97. Is it not possibly partly that anyone who is wanting to go into industry would have wanted to apply their physics more and therefore would have gone for engineering?

(*Sir Mark Richmond*) Yes.

Lord Gregson

98. Using the example of UMIST in the area of applied physics, and the situation with any institute in this country, the thing that worries me is that they have a number of research projects and research organisations attached to them which are supported more from overseas than from the United Kingdom. What worries me greatly in effect is if we set up such institutions with input from industry being supported by the Japanese, the Germans and the French and very few United Kingdom companies. This is a living example at UMIST and they are desperately worried about it.

(*Sir Mark Richmond*) One of the devices the SERC has used—as we said at the beginning there are many devices—is the IRC, set up in certain areas in relation frequently to physics-based science. Our experience is that the Japanese are much more interested in participating than British companies in general.

Chairman

99. I think we must draw your evidence to a conclusion fairly soon. May I just ask you to say a little more as to how you see the Faraday programme being run? It could be run by SERC, the Research Councils, by OST, it could be run by the DTI. How do you see it being run?

(*Sir Mark Richmond*) As is evident from our involvement in the existing IRO scheme, I think the Research Councils in the physics-based area of science and, for example, the Engineering Research Board, would be the ideal set-up to run this.

Lord Porter of Luddenham

100. One must follow up that question by asking you whether you would wish to do so?
(*Sir Mark Richmond*) Yes, I think—

101. In taking into account the fact that it is very unlikely that there is going to be additional funding—just assume there will not be, which is pretty sure—what would you sacrifice?
(*Sir Mark Richmond*) Just before I get on to the question of the sacrifice, can I just say that I think I would start this in a relatively small way. I do not mean I would start it by giving very small sums of money to a number of institutions; I would actually try an experiment with two or three places where there was a substantial amount of funding. I think one would look to the DTI to provide some of that funding and consider whether one should not divert some of the SERC funds to support such an enterprise.

102. Could you give one example of which funds you might divert?
(*Sir Mark Richmond*) The question which does arise in very acute form where we are at the moment deploying quite a large sum of money in funding PhD students in engineering is whether that is actually providing the sort of output that meets the need. I think there is a question which is really worth looking at there. That is implicit in our willingness to fund best graduate qualifications of a different type like Parnaby out of our own funds.

103. I was not aware what you were going to sacrifice.
(*Sir Mark Richmond*) By implication one would transfer some of the funds which currently go on classical PhDs in engineering to this sort of activity.

Chairman

104. You reduce the Engineering Board grants?
(*Sir Mark Richmond*) The Engineering Board might run this, but the thing I noticed in a very cursory read of the Prince of Wales report was the thought of having five institutes at a cost of £1.5 million each. It seems to me, if I may say so, that is ludicrous. The Germans would think of putting at least ten times that in and would feel it would not succeed unless you did so.

Lord Kirkwood

105. Is it not the case that the ACME directorate, which works within SERC, has also the same sort of goals as the proposed Faraday centres? Is not the purpose that you fund it is to provide enabling and supporting technology for manufacturing industry?
(*Sir Mark Richmond*) I think I am saying there is a case for looking at the funding that we carry out at the moment across the spectrum of activities and rationalising it. I would have thought a development of a scheme of this kind, provided it is done sensibly and in the nature of an experiment, would be well worth supporting.

Lord Gregson

106. Certainly in my experience the Fraunhofers in Germany are much nearer the market than anything you or any other Research Council does. Is this not one of the most important features of the plan, that it is very near the market?
(*Sir David Phillips*) There, I think, Lord Gregson, you may be referring to the Government policy that public funds are not used to support near-market research. I think that is a most unfortunate doctrine which has led to an increase in the gap between academic research and industry, and it arises from the way in which people have equated applied research and some part of development with near-market research . That is not necessarily a connection and the Government, in my view, needs to be prepared to support applied research and development of those technologies which individual companies are not going to be able to fund themselves, which are essentially genetric in nature.

Chairman

107. I am very glad you said that. Before we let you go, can I ask you if you would be prepared to talk for a few moments about the current and likely future funding situation, this being the first chance we have had to speak to you about it since "black Wednesday", or whatever it is called. Has there been any immediate threat on the spending round? Are you being asked to put in forecasts for the near future which will be severely cut, and what has been the effect of the devaluation of sterling on international subscriptions? Can you give succinct answers to questions like that and is there anything you would like to say to us? We are not doing an investigation on this now, you understand.
(*Sir David Phillips*) I will start with a very short statement. My understanding is that the announcement about the Government public expenditure round may be made on Thursday, 12 November, but that is not absolutely certain. The signals that we are getting are really no different from the signals all of you read in the press, that we are in for a rather stringent round, and consequently, being prudent people, we no doubt wonder what we would do under different circumstances. But we have no absolute evidence of what those circumstances will be. On the other hand, Sir Mark is having to face up to the consequences of the devaluation of sterling and so on and he is much better placed to talk about them than I am.
(*Sir Mark Richmond*) We have an arrangement with the Treasury whereby we buy forward to pay subscriptions. Most of those subscriptions are paid in foreign currencies and we had actually bought forward using the strong pound the money needed for the CERN subscription, which is about £55 million plus a year. We bought forward with valuable pounds all the money needed to take us up to the end of March 1993. We had to buy the next slug of Swiss francs to pay the sum from 1 April 1993 on 1 October this year; it cost us a shade under £3 million more than we intended to spend. That is about a third of the annual total. We also have a similar situation in relation to ESA. As the value of a nation's currency drops compared with others, so by a complicated arrangement the subscription drops. So we can look forward to a lower subscription to CERN eventually but to be paid in devalued pounds, and I am pretty sure we will lose on the roundabouts more than we gain on the swings, but we do not know yet how

[Chairman *contd.*]

serious that is going to be. We will know around the turn of the year.

108. So a bit more pressure on different arrangements for dealing with currency switch—

(*Sir Mark Richmond*) Would be very helpful.

Chairman] All right. Thank you very much indeed. I am sorry we have been a little bit rushed.

Examination of witnesses

SIR RON DEARING, CB, Chairman, and PROFESSOR GRAEME DAVIES, F ENG, Chief Executive, Higher Education Funding Council England, called in and examined.

Chairman

109. Sir Ronald, Professor Davies, thank you very much for coming—we meet in strange places.

(*Sir Ron Dearing*) I am glad to see you, my Lord.

110. You heard a little bit of the tenor of the discussion before you joined us as witnesses. The first question we put to our earlier witnesses I would like to put to you also, if I may. Although one obviously welcomes any attempt to increase collaboration between universities and industry and improve the innovative capacity of industry, is it really necessary to have more and different bridges between the two, or would it do as well—or possibly better—to improve the ones we have got, such as double the number of CASE students or improve the teaching companies scheme or whatever?

(*Sir Ron Dearing*) I start perhaps with a prejudice to make the things you have more effective before deciding to embark on new initiatives. One recognises the reports by the Prince Charles Group led by John Fairclough and there has been the subsequent development of that. Yet, I am not absolutely sure that I, coming rather ill-informed to the subject, was able to see that there had been an in-depth analysis of the nature of the problem such as to lead to the conclusion that one should move from what one has (not that they are quite suggesting that) to something so new. Although I do think, given that the Germans have had some success with the Fraunhofer Institutes, we should look at the German experience in a British context, I was not led from that to an easy judgement that to set them up as Faraday Institutes in Intermediate Institutes was obviously right. I have very limited experience of research activities, but I worked with the Post Office once we had a research operation. In addition I am and have been on the boards of companies which have had research operations, and one judgement I have is that very relevant to getting value out of research in terms of products or processes, is proximity. The greater the proximity between researcher and manager the more likely it is that it will not be a communication the deaf to the deaf. I have found it very difficult to establish mutual understanding of goals between managers and researchers. Secondly, there needs to be a mutuality of advantage between the two parties. Therefore, I tend to think that it is very worth exploring in a modest way the Faraday Centre concept, but starting by saying how can I do it in a way which satisfies the criterion of proximity? One would say to oneself, perhaps Cranfield and BHR is a good possibility, and it is an institution where I notice the Department of Industry's research student partnerships is being pioneered. My answer to your question is, therefore I would begin by evaluating what we are doing and seeing how to improve it; but, yes, I think there is some scope, particularly in relation to helping small to medium sized firms, for exploring the idea of Faraday Centres.

(*Professor Davies*) I would obviously endorse all of that, and really add that there are two other aspects of the problem. While one recognises that there is a lot of anecdotal evidence which says that the transfers and the interactions are not working as effectively as they can, it is a difficult issue about which to establish unequivocal proof. The concerns that I have been party to have often been about horizon and risk. There is a temptation with a number of the current initiatives that build bridges for them not to allow the small and medium enterprise to actually raise their point of view or point of focus further than the immediate future. The idea of embarking in a collaborative way upon activities which are going to provide the seed corn for their activities some distance in the future is not common cause. Costs are often very high and there needs to be a way of finding an equity of risk that can be shared between the industry and perhaps the government. If you put the horizon out far enough then the general type of generic or enabling activity that might be undertaken in such an Intermediate Institute may provide a resource base for a number of industries, small and medium size, rather than for specific ones. I notice in the comments that were made by our predecessors as witnesses that there was some discussion in the general context of what was near-market. I think I would agree with David Phillips, that one has to be very careful about the concept of near-market and the unfortunate use of the definitions of applied research. If one moves away from that and says that it is seeking to establish a condition to exploit markets when they appear by having a slightly longer horizon and having an element of risk which is in the national interest, then it would seem to me to be an enterprise worth pursuing.

111. Have you got any evidence that industry, especially the SMEs, are going to respond any better to the Faraday-type proposals than they do to existing schemes that are in full swing, if not in the fullest possible swing?

(*Professor Davies*) It is very difficult in circumstances like this not to draw from one's own experience. Let me give you an example: I often felt, when I was an active academic researcher and was very taken with schemes like the CASE scheme, that one of the problems was that when I had an

[Chairman *contd.*]

immediate interaction with my client, and they would come to my department to discuss our research, to persuade them that perhaps they should spend three days in the department and spend the other two days talking to my colleagues about issues which were not their immediate short-term concern was extraordinarily difficult. The idea of a centre which fulfilled what I would loosely call the melting-pot role which brought people in so that they were not only in a dialogue which they saw of immediate utility, but were in a dialogue which perhaps explored utilities they had not thought about could in itself be very valuable. We do not have, I believe, a very good mechanism for that. Sir Mark alluded to the IRCs, and it is my judgement (having had the experience I had when I was Vice Chancellor of Liverpool of having an IRC) that they do provide a melting pot situation which perhaps could be reflected on the less scientific side, on the technological side, to advantage.

Lord Gregson

112. I am a little bemused, Chairman, because we are using terms and language about sharing the risk, equity sharing. Unless the Government have published something since I last read what the Government had published, that is not in their vocabulary. This is more the language of the last government that Sir Ron served, than the present Government we are talking about. This is not within the context of the suggestions of the research institutes we are talking about. It is too far away from the market to have any risk, is it not?

(*Professor Davies*) I suppose what I was thinking of in terms of risk was risk in a broadly based concept. It is the risk that says, if we do not participate or search for technologies that will replace the immediate technologies then we (in the national context) will be left exposed. It is that form of risk. I am not thinking of it in terms of what I would call the straight immediate investment risk. If I gave that impression I am sorry.

(*Sir Ron Dearing*) Can I say a word, Chairman, in relation to the question you were putting. As you have heard my response was a cautious one to innovation in this area, but I guess—

Chairman

113. Spoken like a true Treasury man!

(*Sir Ron Dearing*) Yes, of course. I have a lot to answer for.

Lord Gregson

114. He came from that source!

(*Sir Ron Dearing*) I guess if one was putting up money for this, one would invite bids from higher education institutions, Intermediate Institutes and other such enterprises. If I were judging them I would want to look at their track record in the past in being able to attract research and development funded by clients, as opposed to the government providing money for speculative work. I would want them to do some market research to show that if increased resourcing were available there was a potential market for the product. I would also want to look very much at the quality of the leadership of the institution, to make sure that it had enterprise, drive and quality to give a probability of success and investment. Finally, with respect to what Sir Mark Richmond said about the scale of the funding of the Fraunhofer, I would start relatively modestly and build up in relation to achieved performance. In that way one could explore the market. I was thinking in pilot terms of three to five institutions rather than a large number, and validating within three years.

Chairman

115. What I was going to ask you, given the amount of money in the pot is finite, and is not going to be increased in the present climate for a little while to go—

(*Sir Ron Dearing*) Absolutely.

116.—money put into this particular scheme will come from other schemes, from your budget or somewhere?

(*Sir Ron Dearing*) Yes.

117. Given all that, do you really welcome this initiative even on the limited scale you are talking about of three to five?

(*Sir Ron Dearing*) I understand that the British Government, from memory, makes available about £4.8 billion for research which it funds of which £2.2 billion is for defence.

118. R & D?

(*Sir Ron Dearing*) Defence R & D, and the rest for civil. if we talk about £10 million a year out of the national spend of 2.2 per cent of GDP, I do not thin it is a very difficult matter for government to make that minute adjustment in its overall funding.

Lord Porter of Luddenham

119. Chairman, if I could follow that up, of course, it may be a minute adjustment in the total but if you look at where it comes from it could be 100 per cent—and has been. Could I ask you the same question as I asked Sir Mark? This is really very much following your question, Chairman. Supposing there is no extra money, Sir Mark was generous enough to say, yes, he would like to fund Faraday institutes and did say how he would do it; he would do it, as I understood it, by cutting some of the existing engineering grants. Now, if you are going to have them in your university, what are you going to cut? Would you be prepared to try to get rid of staff in some of the departments or get rid of some of the departments to take these?

(*Professor Davies*) Clearly the latter responses are quite beyond our province because the way in which an institution handles its particular staff is a matter which lies within the institution. If I can pick up the question in a slightly different direction. Our new funding methodology is essentially intended to recognise volumes of activity rather than, for instance, to count undergraduate student numbers, as it did previously. It would mean that where there were active research staff, research fellows and research students who were within these institutes or centres linked to higher education institutions, they would count as part of the volume multiplier in the

[Lord Porter of Luddenham *contd.*]

funding for research. That is, it is redistributive funding in the sense that a baseline allocation is distributed in proportion to activity. A powerful case could be made to the Funding Council that it should make some other redistributions so that perhaps the engineering and technology baseline pot for research was augmented or the science pot was augmented at the expense of some form of activity within our total budget.

120. In a sentence, you do think within a given university it might be possible to persuade the engineering faculty to distribute its funding or its activities to support a Faraday centre?

(*Professor Davies*) I think so, because the funding methodology is in itself intrinsically transparent and so the way in which resource accrued as a consequence of the activities that would be going on inside a centre could be identified. We would not, I believe, as a Council be prepared to earmark funding. This is not in the nature of the way the Councils is currently operating.

Lord Dainton

121. I am sure Professor Graeme Davies recognises the nature of using a funding formula is to project the past into the future. Therefore, it is essential to have some money for initiatives of this kind. If you are going to do that, as you said to us earlier, you have to have a good case made for it, so we come back to what is the best way in which one can discover—because we are not certain of it yet—what is the best way of achieving this improvement in the situation—I will not use "cultural change", the phrase is too hackneyed and imposes far too many different meanings—to get more able people into industry and doing it particularly in the small and medium sized enterprises which need it but often do not know they need it. I wonder whether you have looked again at some of the old research associations which were located in universities. You were at Sheffield, you will know about glass technology and what happened there. Leeds had the Wool Industry Research Association and the University Textile Department which were in a good symbiotic relationship. I think things have changed considerably. Perhaps you could comment on this, because you heard Sir David and Sir Mark comment about the problem being particular to physics, or of greater magnitude there than in, for example, chemistry. Physics seems to me, and I expect you would agree, to be the underpinning, to say the least, of engineering now. Why then is it that we have in technological universities lost physics departments? Ought they not to be restored and brought in in relation to the engineering there and made the basis of this changing attitude that you want to achieve?

(*Professor Davies*) There are about five questions here. Let me pick them out one at a time. As regards research associations, the experience that I share with at least some members of your Committee, has been that, although they were conceived with the idea that they might have a longterm horizon, it was short-term goals that dominated activity, that this frequently lacked intellectual demands, and the calibre of many of the good people that were in the research associations was such that they moved out and that the recruiting of extremely good, able, bright young people was not very easy. I think in a sense it is partly because of the way work they undertook was controlled. In many instances they were controlled by people whose livelihood depended very much upon solving the short-term problems and there introduced an element of the dead hand. When one comes back and answers the question about physics and applied physics, again I must necessarily hide behind institutional autonomy. Although as a Council we are committed to seeking to steer rather than to plan in a detailed sense, one could see ways in which one could perhaps seek to encourage developments in the applied sciences that underpinned technology. I think it would be rather difficult to do that.

122. You must be aware of the device I used when Chairman of the University Grants Committee to invite universities to tender for activities of this kind. You, having developed a sort of stance yourselves, that leaves the initiative with the universities, like the four-year engineering course, for example.

(*Professor Davies*) Indeed. In fact, in fairness to my Council we have already given notice about the new funding methodology for teaching and made it clear that, if funds suffice, a proportion of the allocation of teaching funding will be on a bid basis. I would expect us to seek initiatives which we saw as being of a national portent rather than parochial content.

123. May I pursue this further in relation to what centres are going to be, Faraday or others, with some means yet to be thought out—probably a pilot because I take Sir Ron Dearing's point that we do not have enough clear evidence yet and need to proceed by incremental progress. Would you be in cahoots with and have discussions with the Science and Engineering REsearch Council on these and have a package which was funded by both?

(*Professor Davies*) I believe firmly the form of collaborative evolution of these ideas is quite important. One of the things we have been working on as a Council quite deliberately is to make sure the bridges we build into the Research Councils are extremely strong. They were in the past. I think they faltered a little in recent years and we have reconstructed them. So I would see the dialogue of development being very much a dialogue in which we look to see the ways in which we could share our initiatives and co-ordinate them. It seems to me you get a multiplier effect if there is an initiative being led from the Research Councils and we are in cahoots with them, so we can bring more than one gun to bear.

(*Sir Ron Dearing*) Can I intervene since we are talking about money, which is the only thing I really understand? I get apprehensive thinking that this money for this Faraday initiative would come from any other budget than the Department of Trade and Industry. One does, of course, see long-term advantage to the academic institution with the involvement in this kind of research, but the driving force is to benefit industry. Therefore, my Lord, this is an issue of where the oversight ownership would come from. I think it ought to be very much industry owned and supported, and one would hope that there was some reduction in defence research, given the

[Lord Dainton *contd.*]

change in the world, and scale of the the expenditure of the 2.2bn, to assist us. I was just anxious to log up alternatives to the funding councils and the research council as the source of funding for a Faraday Centre.

124. I accept that, but I think there is another point and that is, we want to get good young people into these subjects and, therefore, in a sense it has to have the imprimatur of the university sector very much on it?

(*Sir Ron Dearing*) Of course. One would want the Department of Trade and Industry, and perhaps Mr Waldegrave's department, to be shepherds of it, but one would want the HEIs to be deeply involved. Indeed, I have not yet seen a totally convincing argument why an HEI might not be a Faraday Centre. The problem I have about the Intermediate Institutes in relation to my principle of proximity is that it is neither close to the university nor close to the manager who is going to make the product.

Chairman] I was going to ask you whether that was what you meant.

Lord Gregson

125. You probably know that I chaired the first joint committee of the DTI and SERC for advance manufacturing technology, and the fact that the DTI actually walked away from it when the Minister changed, it did survive under the Department of Education and Science, and only yesterday it was announced that we have got the biggest slice of European money for advance manufacturing technology. We are not very skilled at extracting money from Brussels, but there is a lot of money available. I find it very strange indeed that we should finish up, after all the concentrations that took part, with three separate ministries all pushing round this one simple subject; and by so doing in fact are avoiding the possibility of maximising the amount of money from Brussels. Do you not find that strange?

(*Sir Ron Dearing*) Yes, my Lord.

Lord Porter of Luddenham] Another way of putting your proximity point is that the Intermediate Institutes instead of helping to build a bridge between the two will put an island between them, and then you have to cross two bridges.

Chairman] I have a very unruly Committee this afternoon!

Viscount Caldecote

126. I thought one proposition was that the Faraday Institute might be grafted on to an HEI?

(*Sir Ron Dearing*) Yes.

Viscount Caldecote] Professor Davies was saying that he would be unhappy about the earmarking of grants. If you were going to say that this was going to be grafted on to an HEI then I thought the implication was that there would be some transfer of funds from the engineering faculty to the Faraday Institute? Surely those funds would have to be earmarked? The idea that the DTI should be involved seems to be an extraordinary suggestion, but surely the whole idea of the OST (the Office of Science and Technology) is that all research works should be under their control?

Chairman] No, overseen.

Lord Dainton] They have control of the research councils, but not of the spend of the departments.

Viscount Caldecote

127. I am sorry, I was not suggesting that, but should it go through the DTI in any way (rather than the OST should have an oversight) is surely rather peculiar?

(*Sir Ron Dearing*) I have already conceded to Lord Gregson that the organisation of government is particular and not perhaps as Lord Gregson would have chosen it; but given that the Department of Trade and Industry have a substantial role, has a Chief Scientist, has resources and is the bridge between Government and industry, I was suggesting that the DTI should have a role with Mr Waldegrave's department. I would see it essential that those two work together on this.

Lord Walton of Detchant

128. One knows government departments do not invariably talk to one another, is it not then possible that the DTI and the Department of Education could in fact together consider a mechanism of jointly funding an initiative, if this was thought to be important, and an initiative for which different higher education institutions could apply in competition, as they used to?

(*Sir Ron Dearing*) Yes.

(*Professor Davies*) It is not normally the practice of the funding council to put very specific earmarking labels upon what are often quite small packets of money in general terms. This means that a sum of money which might be in the tens or hundreds of thousands of pounds is unlikely to be earmarked in a budget of 50 or 60 million pounds. On the other hand, because we now have new regulations about accountability, we do have the provision whereby we can give money in an unearmarked way, but then subsequently ask the question as to how the money was used, and whether it was directed largely (and I use the word advisedly) in the direction of the purpose for which it was given but, again, within the framework of institutional autonomy. If I could pick up the other point which was about the role of the DTI and DFE and the OST, it seems to me that you are more likely to get coincidence of purpose if each of the three departments has a financial stake and has some ownership of the responsibility for the outcome.

Lord Gregson] Do you realise that you are breaking the Treasury rules doing that!

Lord Dainton

129. There is no doubt the heart of the HEIs is in the right place, and they want to go ahead and do what they can in the situation. I have not the least doubt that the research councils can, within their strained budgets, take the same attitude. What worries me at the end of the day is whether the effect on the country's economy is going to be the effect which we all want on the small and medium sized enterprises. I wonder if Sir Ron or Professor Davies could tell us whether in their judgement the Faraday

[Lord Dainton *contd.*]

Institute proposals are going to engage the SMEs and are going to have the desired effect and if not, why not, and what changes should be made?

(*Sir Ron Dearing*) If I may start, my Lord Chairman. As I have said, I think there are enough a priori arguments to start modestly and developmentally. With the very limited the resources available to SMEs, particularly for high cost developments, developmental work is with advantage shared, and that suggests the availability of a body through which they can come together, and that can be the Intermediate Institute. The Faraday dimension in this is the involvement of the higher education institution, its staff and its graduate students in this work. It has the advantage of bringing some very capable people indeed into an interface with the SMEs. I think there is a prima facie case. I have to say that I have, nevertheless, a prejudice that it is better, wherever possible, for the research to take place in the company. I am on the board of a company which is rather large but, in fact, operates through a very large number of modestly sized companies. We once had a very large research laboratory employing several hundred people. Before I joined the board the company decided it was not getting good value because the research was too remote and has instead devolved the research into the work places. I have been to see some of them and I can see the interplay between researchers and managers. People are talking to people and understanding each other, and I have seen the great benefits that come from that. So if it can be done in the firm, so much the better, but there are some things which I believe need to be done collaboratively and that is where the intermediate institution, whether in an institution of higher eduction or elsewhere, *prima facie* has a role.

130. As the end of the day we want to lift up as much as we can the technological capacity of these firms and get them to use this knowledge?

(*Sir Ron Dearing*) Yes.

131. The experience has been on the initiatives, particularly in electronic areas, as government has poured more money into the business of doing research and development in those firms, so they have lost market shares. It seems as though companies use the money which they spend themselves on research and development to work for profit more than they use money coming in from government.

(*Sir Ron Dearing*) It seems that what Lord Dainton is saying suggests a certain perversity in life and it may be so. I talked about proximity and, if I may go on from that, the Parnaby graduates going into the firm seem to me a good first shot at solving the problem. I am always for selling research and development to the interface with manager wherever possible, and it is only really where it is clear that there is not feasible that I would see it done collaboratively. But if people are going into companies under a good shepherd at the Higher Education Institute so that they can pursue their aspirations for a doctorate but work at the interface, I think there is a very good chance of it succeeding. The DTI·DES has its £2 million partnership scheme in the intermediate institutions and that should be given a run, though I for my money would have put the researcher into the firm when practical.

Chairman

132. There is meant to be a pilot study.

(*Sir Ron Dearing*) Yes, indeed, five. They had 58 applications. They chose five and put £2 million aside.

133. Does it tell you anything about the Faraday centres?

(*Sir Ron Dearing*) No, it is not the same thing at all.

Lord Gregson

134. This is exactly the Japanese approach. They do not have research centres. The research is done in the company. Collaboration takes place round a table but the research is still done in the companies. Other than the Science and Technology Department of the Prime Minister's Office, which is really looking at academic research, the Committee does not control, but it does co-ordinate, the industrial based R & D effort, but MITI is an office, they do not have any research centres, the companies do the research and it is co-ordinated. Is this not a sensible way of approaching it? Is this not what you really say, Sir Ron?

(*Professor Davies*) One could build on that and the comments of Lord Dainton. I cannot believe, not having heard all the evidence, that you have not discussed the chemical industry. This is seen as being something of a success but, if I look at what I see as the difference, the size and nature of many of the large chemical conglomerates is such that they themselves are an assembly of smaller and medium sized enterprises, but of sufficient compass that they can establish what is their own Faraday centre. What I see the initiative as doing is taking a distribution of small and medium sized enterprises, which are not part of the common heritage, and achieving the same for them as perhaps the laboratory of BP at Sunbury and ICI laboratories or Unilever laboratories have done for their own industries, which are seen as being highly successful.

Baroness Perry of Southwark

135. I really want to return, Sir Ron, to the fascinating mutuality of benefit at the beginning. One part not of the duality but of the triangle of people whose benefit we must consider is the graduate students themselves and I am increasingly concerned about their motivation to spend three years of their lives on £5,000 or £6,000 a year, or whatever, being told at the end of it they are going to get a marvellous job in industry and so on. I would really like to get your reaction to the increasing number of part-time post-graduate students employed in industry who follow their PhDs on a theme which has very often been identified by the industry for which they work as something of relevance to them and which gives a great deal of mutuality of benefit. It has an effect we want for the HEI in that it becomes inevitably more closely involved with problems in industry because the supervising students working on those problems benefit from what the industry has done, so to speak, on the hoof and it has much more benefit for the

[Baroness Perry of Southwark *contd.*]

student in that they are actually paid a reasonable salary. The difficulty is it is extremely expensive for HEI and it is, on the whole, I think, for the student a very long haul without much visible at the end of it. Is there a mechanism that would formalise teaching company schemes, that would formalise that vehicle of students employed in an industry at graduate level within industrial research so that enterprises would actually spin off back into the higher education institution while benefiting the student? I do believe we are going to get more and more post-graduate students on that part-time basis.

(*Sir Ron Dearing*) I must say that seems a top of the class approach in terms of the criteria we ought to consider. How can we foster it? It is part of a wider question of how we should fund and support part-time students and I think the time has come when the Funding Council has to

revisit this fundamentally and I believe, Graeme, you have this in mind.

(*Professor Davies*) There is another element, Lady Perry. In a sense one has the feeling that the Parnaby programme is oriented towards the recognition by HEIs that they need to change the nature of some of the PhD structures and allow, more segmentation than is normally the case. That in itself is a move in the direction you seek. You may find that, despite the fact that the Parnaby students are employed in an HEI or in the industry or in an intermediate institute, essentially you have a duality of commitment that effectively makes them part-time with perhaps not the conflicting purpose of trying to deal with their day-to-day managerial supervisory activities in the company in addition to the R & D involvement with that company. We would be seeking to allow them to shed one form of activity for another but still to bring the mutuality of their commitment to bear on both the HEI and the company.

136. But still on fairly modest pay.

(*Professor Davies*) That is, one would hope, one of the anomalies that might be adjusted if these Faraday centres were brought into being, where it would be expected that the remuneration of people would be more in line with commercial support.

Chairman] That is a very happy note on which to end. Thank you very much for coming along and helping us.

Printed in the United Kingdom by HMSO

Dd 0502959 8350943 C6 12/92 203838

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HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
TAKEN BEFORE

THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

FARADAY PROGRAMME

Wednesday 4 November 1992

CONFEDERATION OF BRITISH INDUSTRY

Dr K Gray, Mr D Rose and Dr F Steele

IMPERIAL CHEMICAL INDUSTRIES PLC

Dr B W Langley, Dr N F Elmore and Dr M P McOnie

SOCIETY OF BRITISH AEROSPACE COMPANIES

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Ordered by the House of Lords *to be printed 19 May 1992*

LONDON : HMSO

£4.95 net

HL Paper 23—iii

WEDNESDAY 4 NOVEMBER 1992

Members Present:

Caldecote, V.	Kirkwood, L.
Dainton, L.	Platt of Writtle, B.
Flowers, L. (Chairman)	Porter of Luddenham, L.
Gregson, L.	Renwick, L

A memorandum from CBI will be published with the Committee's Report

Examination of witnesses

DR K GRAY, Thorn EMI, MR D ROSE, Innovation Associates, and DR F STEELE, Head of Technology Group, CBI, called in and examined.

Chairman

137. May we welcome you, representing the CBI, to the Committee and say how glad we are that you are able to join us. I am sure that you would like to make an opening statement of some kind. However, before you do so you may like to bear in mind the following thing, and perhaps you would kindly introduce yourselves for the record. The first question I should ask you, if you have not dealt with it already in your opening statement, would be: do we not already have enough bridges between industry and the university world, given all the various schemes that there are, and what is it that one hopes to achieve by setting up yet another such bridge? We all want bridges, of course, and we all want to see more innovation and we all want to see university research contributing towards industrial growth, but why yet another scheme? If I may say so, we have had very guarded replies so far from the official bodies. Perhaps we can have frank remarks from you. Perhaps you would bear those points in mind in your opening statement of anything you wish to say?

(*Mr Rose*) Thank you, my Lord Chairman. We are very pleased to have this opportunity to speak to you this afternoon. Dr Ken Gray is the technical director of Thorn EMI. Dr Fiona Steele is head of the technology group in CBI. I am a consultant specialising in innovation and business development. This meeting comes at an appropriate time for CBI, my Lord Chairman: we have been addressing questions of innovation over the last two years and we have recently prepared a new policy statement, which if I may I should like to summarise briefly before we speak about the Faraday centres. The former research and manufacturing committee is now the technology and innovation committee, and the CBI have been involved in a major initiative on innovation with the Department of Trade and Industry, which will be launched next January and previewed at our annual conference next week. Ken Gray will speak about Faraday from the large company point of view and I propose to say a few words from the small and medium sized enterprise point of view, if that sequence will be agreeable to you, my Lord Chairman. The CBI's policy has been to concentrate on the industry perspective of innovation and we have looked particularly at the technology and science issues encompassed within innovation. We define innovation—and I am aware that there are as many definitions as there are people defining it—broadly as the successful, profitable and sustained exploitation of new ideas—I emphasise "sustained". The CBI has identified five key areas of weakness within the United Kingdom which we believe must be got right for the nation to be more competitive, first, innovation and its management within companies; secondly, communication between industry and investors on innovation; thirdly, education and training and the skills needed for technological advancement and particularly management training in the broader sense; fourthly, the exploitation of science and technology—this is directly relevant to the Faraday debate—and finally, perhaps most importantly, the issue of national co-ordination and strategic direction for promoting technology and innovation. The CBI believe that it is this issue of national co-ordination and declared strategic policy that is the driver of the other four and that at the moment there are some deficiencies in these areas that need to be addressed urgently. We see four of these, my Lord Chairman, first, the creation of some agreed national objectives for creating and sustaining a more pro-industry and more pro manufacturing culture and looking some time ahead; second, having a clear understanding of our strengths and weaknesses, particularly in areas of technology and science and application; and that thirdly these should lead then to priorities for action with (?), some clear targets for expenditure allocation that remain reasonably constant over a period of time. We in the CBI believe that Government should now be taking a lead in the initiative to spearhead or create a partnership, that is, a single partnership, between academia, Government, industry and the financial community to draw up some of these national objectives and devise some clearer strategic guidelines for action by the relevant bodies. We are aware that this has a taste of national planning. Nonetheless, we do believe that it is important to attempt to plan even if on a limited scale and to see some of those plans followed through into action. We see the Faraday initiative as part of this agenda, and the debate on skills and exploitation and technology transfer, which is Faraday, we should like to see tackled within a sensible overall strategic direction for the nation. That, my Lord Chairman, concludes my comments on CBI policy. Perhaps Ken Gray would like to speak now about Faraday from the large company point of view.

138. Dr Gray?

[Chairman *contd.*]

(*Dr Gray*) My Lord Chairman, may I say a few words, particularly from the background of someone from a large company, a company whose business is basically products, not materials. I should like to make my comments not particularly towards the question of the benefits of the company for which I work, but in respect of United Kingdom manufacturing in general. I bring personal strong support for the need for Faraday centres and my comments will fit within that context. The purpose for such support is to deal with the serious situation that I believe exists where the balance of payments of manufactured goods in 1980 was 5.5 billion pounds positive and predicted in 1993 to be minus 17 billion pounds negative, a swing of 22 billion pounds over 13 years. This is a very serious situation that is reflected in the decrease in GDP that manufacturing contributes. Previous reports from the House of Lords, which I fully support, have indicated this both a general and a specific way. Every technical and scientific resource in my view therefore should be focused on this problem and no doubt the OST activities towards their White Paper next year will indeed incorporate that. My own view is that Faraday centres are but an element of this total picture. As your questions alluded to, my Lord Chairman, one needs to use the tremendous high quality academic science base in order to aid industry to recover the situation. Indeed, there is much more that I am sure we can do to improve the existing academic science orientation towards industry and towards wealth creation. However, I believe that it is not sufficient to do just that, particularly there is a need for intermediate institutes of the Faraday centre type for product companies. If I may just illustrate what I mean by that, my Lord Chairman, if you are in the business of making materials and you need a particular material that can come out of the academic science base which you can translate into a product, then you find the linkage or coupling between the industrial science and technology base and academic science and technology is very close. However, if you get to a situation where you are dealing with products where universities can contribute, say, to the material element of a complex system or product then there exists a wide separation. This gap does exist and there are many industries in this country for whom contact with the universities is weak and insufficient to give them what they are clearly looking for. From an industrial viewpoint perhaps I may tell you what one is looking for. One is looking to de-risk investment. One is looking to use those resources that one has in an organisation in order to maintain its competitive situation and to maintain its profitability and to increase it in the way that the City expects. In order to get this de-risking, my Lord Chairman, it needs to acquire technology in one form or another to benefit its future products. In this country at the moment in many areas there is no contract research organisation to which you can go that has the quality and the capability in depth for many industries. It is in this area that one would like to bridge the coupling between the present academic science and technology base to an intermediate institute technology base in order to create in these intermediary institutes an industrial product-based science and technology capability.

139. Dr Gray, perhaps I may ask you to pause there for a moment. I understand perfectly well what you say, and I am sure that my colleagues do as well. The other question, of course, is whether you would advocate taking resources from other schemes and putting them into this new one. There is a finite amount of money available. It may increase or it may not, but it is still finite.

(*Dr Gray*) Personally I am, and I think that you will find that the CBI also is supportive of the existing schemes such as CASE, LINK, Teaching Companies.

140. And work in your own laboratories?

(*Dr Gray*) The issue that we are talking about here, my Lord Chairman, is a very large one, that of recovering the manufacturing base of this country. I do not believe that the amount of money needed for intermediate institutes should be taken from those existing schemes, and new money should be found for Faraday schemes. I know that that is not a popular view, but it is a very serious issue and the amount of money involved is not significant in relation to the total industrial picture in manufacturing that we have in the country. I do not think that we should be taking it away from existing schemes. I think that one should be looking for additional money.

141. So the Department of Trade and Industry so-called pilot scheme is not of very much value?

(*Dr Gray*) No; it is a step in the right direction, but not sufficient in order to meet the need.

142. I must not hog all the questions, and I am sure that you had not finished, Dr Gray?

(*Dr Gray*) To all intents and purposes I have, in fact, my Lord Chairman.

Baroness Platt of Writtle

143. My Lord Chairman, perhaps I may follow up the last question. If you support the other schemes as you say in your evidence, would you still think that Faraday centres are a better use of new money or would new money be better placed in, say, the Teaching Company Scheme or something that already exists? Is it a good idea to put it into a new scheme and, if you did, would you rather cautiously do it on a pilot scheme first or do you think that it has such potential that you want to see a lot of money put into it?

(*Dr Steele*) My Lord Chairman, if I may come in on that, before we get down the nitty gritty of deciding whether we need more money for Faraday, additional money, I think that we should like to see a total review of all the schemes that are available—a sort of national audit, if you like—to decide which are working very well. We feel that perhaps the Teaching Company is a particularly good scheme. We would take the Faraday assessment polls into account in that in respect of the individual throughput and how that would contribute to the wealth of the nation as a whole, which is one aspect of it, but it is a very valuable aspect. We feel that we need a much greater auditing of the skills and of the resources that we do have before we could say that Faraday centres must have, say, 20 per cent of the total funding available for technology transfer. We

[Baroness Platt of Writtle *contd.*]

are not going quite as far down the road as actually saying that that there must be X per cent of new money available for this particular scheme. We want also to be absolutely sure that there is a market for it.

Chairman

144. In Germany where the Fraunhofer institutes bear some similarity to what is being proposed, they get somewhat less than 30 per cent of their income from industry. It is reasonable to suppose that Faraday centres here would find it even more difficult to get as much as that, and would probably get less?

(*Mr Rose*) Yes, probably, my Lord Chairman. Perhaps I may comment on that, particularly from the perspective of medium sized companies whom Faraday is expected to benefit, and I speak as one who has managed business development in these companies and within the Cambridge area, which is not unknown for successful innovation over the last decade. Our viewpoint is that Faraday is an excellent initiative and has certainly caught the popular imagination. We should be very much in favour of any scheme that begins to galvanise, to energise and to enthuse people. It has highlighted what we believe is a national weakness in the gap between science and its exploitation and the economic return from that. It is probably, looking at some of the more detailed papers and the working party's most recent report published, I think, a week ago, the clearest exposition that we have yet had. We should see this work as the foundation which provides the best chance for many a year of changing what in our opinion is a long and sorry history of laudable schemes and excellent initiatives, but they do not appear to have changed the course of United Kingdom plc. We do have some concerns about the Faraday proposals, my Lord Chairman. First, they concentrate on education and structures and they should be concentrating on winning technologies and their application. As Baroness Platt has mentioned, there are some excellent schemes within SERC, Teaching Company, Integrated Graduate Development and so on, which are focusing very much on the effective training of young scientists and engineers and moving the focus from academic training to applied training. We have some difficulty with the notion that Faraday should add to this as well. We believe that it should be concentrating on winning technologies and their application, with education as an extra byproduct of that, and that these should be technologies and applications that have a demand in the market place and where we have some excellence in the competitive position in the underlying science in this country. We should be concerned about adding yet another scheme to what we see as a welter of schemes. Among ourselves we have described it as a veritable spaghetti which is causing confusion, we believe quite widely. The spaghetti needs to be untangled and, as my colleague here said, we do need to review each new proposal in the light of the others and come up with a balance not just in financial terms but in terms of what these schemes actually contribute within the overall innovation mix. We liken the innovation mix to the recipe for a cake or a soufflé: every ingredient must be there in its right proportions.

145. As I understand you to be saying, this new programme should be concentrating more on the industrial end of the innovatory process rather than the educational end, and I should imagine that it follows from that that industry itself would wish to put quite a lot of money into it. Do you envisage paying for some proportion of the programme, like 75 per cent, for example?

(*Dr Gray*) The existing numbers you refer to is what is going on in Fraunhofer Institutes in today, they did not start out like that, my Lord Chairman, and to be honest I do not think one should concentrate too much on that because we are talking about today in the United Kingdom, and that was yesterday in West Germany. Today we need a resolution of this serious manufacturing problem. In order to find a solution to that we have to find a British solution to the problem. What we do not have and what the scheme in my language is attempting to do, is to have in this country contract research houses or whatever you would like to call them, intermediate institutes, whereby a company can use its small resources to go there to invest through a contract and get something out of it, say a new textile manufacturing technique and give them back the output so they will further invest in it and then make a profit.

Lord Dainton

146. Will they further invest in it? The record of our failure in exploitation surely has been a failure to invest, has it not? Your own company reminds me of magnetic resonance imerging energy, a case which we, the inventors lost the manufacture and market. You had it.

(*Dr Gray*) Well, we could have half an hour on that issue! Indeed, my own company in its EMI history puts the whole company at complete risk and got taken over because of the degree of investment that it put in, so I do not think one can criticise the company for not taking risks.

147. But equally it is not an encouragement to go down that road again, is it?

(*Dr Gray*) Oh, we continue to invest in innovation. If I may just continue, to go back to imaging, the licensing income that we receive from that is not to be ignored. It is very, very substantial, even though the manufacturing is not there today.

148. And that is not the only example. There are lots of these cases that we have lost, is that not so?

(*Dr Gray*) Yes, I am sure. The lack of investment that we have in manufacturing across industry is very, very sad.

(*Dr Steele*) My Lord Chairman, if I may come in here, that is why we feel that we ought to put the whole debate in the context of the main issues we have identified. One is the question of the climate to encourage investment.

Lord Dainton] Yes, indeed.

Viscount Caldecote

149. From a conversation that I had with a professor of production engineering in Berlin University earlier this week, my Lord Chairman, I understand that some of the Fraunhofer Institutes,

[Viscount Caldecote *contd.*]

including the one with which he is connected, do a lot of contract development work for companies?

(*Dr Gray*) Yes.

150. Would you envisage that that would make a contribution towards your problem that you mentioned—you called it de-risking? Perhaps I may more appropriately call it sharing a risk. Would you envisage that that would be a function of Faraday institutes and that industry would support that? He told me that the institute that he was involved with had 70 per cent of support from industry and around 25 per cent from government and other sources.

(*Dr Gray*) Such institutes as the one to which you refer to do not exist here, but were they to exist I am sure that if that is the best source of obtaining technology of whatever nature—and in my own definition I include production engineering in that—then that is exactly the best place to invest. You would cease perhaps to do some work inside and you would put more out.

Viscount Caldecote] And you would see that as a very good way if that institution is connected closely with a university, of feeding academic science into the development process?

Lord Gregson

151. Do not the new defence research agencies fill that role somewhat becuase they are not charged with getting civil development programmes and they have had enormous resource? Some of them are much bigger than any Faraday institute by a factor of about 20?

(*Dr Gray*) I worked in a research institute in the Ministry of Defence in Malvern for thirteen years and I am very familiar with their capabilities and what they can offer. Indeed, they must be one of the candidates for such a Faraday institute in certain sectors. However, Faraday Centres also must be organisations that understand how industry works, and that is not necessarily today how defence research agencies are. There is a lot of change that has to be gone through in order to perform the function we are looking for, a real industrially relevant, industrially capable organisation that can assist a wide segment of industry in their particular required expertise.

152. But if they do not do that then they are going to disappear anyway? That is part of the programme. They have been told: get out into industry or disappear?

(*Mr Rose*) My Lord Chairman, you asked, what is it that we hope to achieve and will industry spend money and invest as a result of this programme. Industry, despite these difficult times, will invest when it sees quality and a return. It will not invest because a scheme is laudable or elegant or because it is told to. But companies will tend to invest and commission research where they see excellence and quality in their particular field, and where they can see it leading to improved products and processes that they can sell to their customers in the reasonably short term at the moment. Now we believe that if there is a scheme that may well enhance the offerings of some existing intermediate institutes that can be seen to develop new applied technology for the future, taking it out of the universities and commercialising it over a three, four, five year time period, then we think that it would be attractive.

Chairman

153. So you will contribute after the event, but you will not launch?

(*Mr Rose*) We believe that companies will contribute now for work that will bring them a short term return, my Lord Chairman, but they are not unfortunately in a position to contribute to long term research.

Lord Gregson

154. But why should companies suddenly change their mind? Manufacturing is rapidly disappearing out of this country. We can look at the figures. You quoted the figures in your opening statement. They have failed, industry has failed, to take up the investment potential in this country. Why should they suddenly change in the middle of a downturn in activity that they now have? Can you explain why they should change?

(*Mr Rose*) What one has to hope, my Lord Chairman, and I confess that this is a hope, that we have bottomed out rather than are continuing to decline, but there are some excellent examples. If I may take just one—

155. Are we on a green shoots exercise?

(*Mr Rose*) I should never use the expression. The Rover Group, which admittedly with Japanese knowhow and technology has with British management achieved quite a remarkable turnround in terms of its—

156. Very few industries.

(*Mr Rose*) There are very few. Clearly industry would have to display leadership and acumen and it would—

157. Which it has not done in the past?

(*Mr Rose*) Which it has not done in the past, but it has—

158. But what is going to change? That is what I want to know. (*Mr Rose*) We should hope that industrialists and managers will respond to motivation and to—

Lord Gregson] But why?

Chairman

159. Please have a heart for the stenographer!

(*Dr Steele*) My Lord Chairman, I wonder whether I may perhaps address Lord Gregson's question. One of the factors that has been informing this particular study of ours is that we have over the last year gone out and talked to over 100 companies in depth about their innovation practices, which would include the exploitation of science and technology. It is, I think, fair to say that within that cadre of companies probably 10 per cent would be regarded as world class. Now one could take some comfort from the fact, even though it is a very small percentage, that those companies are actually succeeding despite the economic situation in which they find themselves at present. What is it about those particular companies,

[Chairman *contd.*]

what are they doing that offers examples of best practice from which other companies can learn? We have certainly found in those particular companies which we regard as innovative and highly competitive that there is an openness to looking outside the company as well as getting their own management structures right. I think that that is absolutely essential, my Lord Chairman. We should be the first to admit that industry has got to get it right; it has got to be able to manage itself so that it can take advantage of what is outside. I think that that has been one of the great weaknesses in the past. Those companies which are succeeding have managed the process and at the same time they are going out looking for exploitation wherever they can find it, and there are small companies amongst them. We were very encouraged and if we can use their example, with perhaps the Faraday concept as an adjunct as a mechanism to encourage people to invest in future, then there is nothing like peer example, I think, for taking you forward.

Lord Gregson

160. And this is going to reverse one hundred years of decline, yes?

(*Dr Steele*) We have to be optimistic, as David Rose says. We cannot give up, we really cannot give up.

161. We have been optimistic for over one hundred years, since Prince Albert made his famous speech in this House which created the 1851 exhibition, and we have steadily gone worse ever since, so what is going to change?

(*Dr Gray*) Perhaps I may give another different view of it, my Lord Chairman. If you take a large company like our own, we put investment in many different countries. Our business is doing all right, thank you very much. It is surviving and it is finding new business in many different areas, but it is not increasing its manufacturing in this country. Ours and other companies that are doing well—and I could give you examples—have the opportunity of investing in different areas of the world. The question behind these company options in my view is: what have we got to do to make their future investment in technology and manufacturing in this country and not elsewhere. The Germans used the local Fraunhofer institutes, as one example, to springboard themselves forward, taking those possibilities and opportunities by using these institutes as a contributing factor to growth. The question I was trying to address was that if we had such high quality contract research organisations of the proposed type of intermediate institutes, then there is a possibility for small, medium and large companies to take advantage of these and to site their manufacturing in this country.

Lord Porter of Luddenham

162. My Lord Chairman, I found what Dr Gray has had to say very helpful because I for one really had not the faintest idea what was the main purpose of the Faraday institutes. Both Dr Gray and Mr Rose have said that it is not education and training, and Dr Gray has said nearly three times precisely what it is: it is the need for contract research organisation, they will be contract research organisations, you have said this quite clearly?

(*Dr Gray*) That is correct, like the Fraunhofer institutes. They are contract research organisations in their contact with industry.

Lord Porter of Luddenham] Yes, and in their contact with the universities, which I think is not envisaged here.

Chairman] They are so far as 29 per cent of their income is concerned contract research organisations, but that is a small proportion.

Lord Porter of Luddenham

163. Dr Gray, we have had for 40 years 50 contract research organisations subsidised by the Government and called research associations. The only industry that you actually mentioned was the textile industry. We have a wool research association, we have a cotton association at Shirley and we have a British Rail association where I worked for a year. Why do we need others now? If we take your Faraday research association in textiles, what is it going to do that those three do not do already? Just to finish as one final question, where are the gaps in which we do not have contract research associations, and should we not have to do a proper experiment to set up about 20 pilot schemes because you would need one for each one of your gaps and they would be successful in some and not in others? I should like to hear your view on what putting the name Faraday to a research association will do for us.

(*Mr Rose*) My Lord Chairman, perhaps I may comment on that. We are of the opinion that adding a new name to something that already exists and adding more money and little else would achieve very little. The point, I think, is that the existing institutes, intermediate institutes, provide a mechanism that is already there that would otherwise take years to start and they are commercial and they do know how to go out and to sell.

164. They are research associations?

(*Mr Rose*) The independent research and technology organisations do have to go out and sell to survive, but they do tend to be selling what they have. They do not have the opportunity to reinvest and to create new technology from new science. Now it seems to us, my Lord Chairman, that the great benefit of the Faradays, if they are correctly organised, is that they can draw new science from the universities and develop that into processes and products and mechanisms that companies can use to make and to sell things. From our understanding of the Faraday proposals the existing research organisations are no more than one possible type of vehicle to embody the Faraday institutes and there are other research organisations and possibly some of the more applied university departments that could qualify. The important thing would be to add something new to the equation, not to augment something which already operates.

(*Dr Steele*) My Lord Chairman, perhaps I may add to Lord Porter's point. With regard to the research associations, contract research organisations, whatever you like to call them, they are a very mixed bunch. In terms of their intellectual excellence and

[Lord Porter of Luddenham *contd.*]

the work that they do, I think there are certainly some that one would think without government subsidy could not be justified commerically as being in existence at all, nor would they have a great role. One of the problems that is happening in some cases, I think, is that there has been inconsistency in the way that Government have tackled support of that movement over the years. When they were set up, if my recollection is right, it was more or less on a fifty:fifty basis. Over time, however, in fact, the Government have withdrawn funding, and for just that sort of advanced technology bringing ideas for the future which the contract research organisations are able to do. But now they are having to look very much to the short term benefit of their own particular bottom lines in a very commercial world. What you are missing perhaps is the old customer-contractor relationship where 10 per cent of funding was originally supposed to be set aside for the more speculative work. That no longer exists. If Faraday is an attempt to readdress that question then I think that we should obviously support it. I take David Rose's point that they do not necessarily have to be in contract research associations. If some particular body has excellence in a particular area that could benefit by a closer interaction between the industry it serves and the university system in terms of the enabling technologies that are coming through, then I think that we should say that there was merit in putting additional funding into that particular organisation to build on excellence; and, similarly, to come back to our main point, identifying where your national strengths and weaknesses are.

Lord Porter of Luddenham] My Lord Chairman, I think that Dr Steele's suggestion in this afternoon's discussion that we should have a review of the existing schemes is the most useful one that has been made.

Lord Gregson] Hear, hear.

Lord Porter of Luddenham

165. There are successful industries we know very well, like ICI and the pharmaceutical industries. Why do they do so well and why are research associations, as Dr Steele mentioned, some good and some bad?

A review of that I should have thought is essential before we embark on any new schemes.

(*Dr Steele*) My Lord Chairman, we should like to suggest that that should not take too long. The present situation warrants immediate action.

Lord Kirkwood

166. My Lord Chairman, I too should like to ask about the magic ingredient, why the CROs, these intermediate institutes, should be so much better when they are called Faraday centres. One of the reasons that I understood you had put forward was this quote from the working group report about the flow of appropriately qualified staff into industry who carry the unwritten part of exploitation as well as the documental part. I think that is a very important, key ingredient if that is so, and I suppose the fact that these are short term contracts encourages people to move on. To get a flow you need some pressure at both ends of the unit, a flow in and a flow out.

I can understand you can get a flow in if you offer exciting jobs and provide the right sort of salaries. What concerns me, my Lord Chairman, is to get the flow through, you have to get the flow out. Who the hell is going to empty these people in industry, particularly if you are talking about small and medium sized enterprises? Why should they employ these highly qualified characters in small companies that have very little technology in them in the first place? These are expensive luxuries as far as they are concerned, yet you are saying that it is the flow of people which is the key element, as I understand it, in these Faraday centres. That is what makes them different. I would wholly agree with you that in fact it is the knowledge that people have within them as much as the published papers which is the useful thing as far as transferring technology is concerned.

(*Dr Gray*) My Lord Chairman, there are two issues that I extract from the question. One is where these people who are coming out of these institutes are going to be employed. If I may answer that one, the requirements for any growth in manufacturing in this country that is going to occur will by itself consume those same people, particularly if they are bearers of the technology transfer in one form or another and the knowhow is there. The second point related to that is that the postgraduates who would come through this form of training would be exceptionally valuable individuals. If I take our own company research activities there is a substantial period that recruits have to go through in all but exceptional cases, and not only in facts, but also character of how a commercial operation works, what is expected from the individual, what added value we expect from them, etc, etc. If you set up the right sort of intermediate institute I suspect that these people would assimulate quickly and be in great demand.

167. I can understand that large companies will absorb these people. The prime purpose of the Faraday centres surely is to pump new technology into small and medium sized enterprises but their technical staff are not the people who are going to be employed, by SMEs; very often the culture of SMEs is wrong. If you change the culture maybe that will have an effect. Even so, however, they are often too small to employ people of this quality and qualification.

(*Dr Gray*) Their major output will be the technology in that case.

(*Mr Rose*) My Lord Chairman, perhaps I may answer Lord Kirkwood on the question of small companies and recruitment of highly qualified people. Small and medium sized businesses clearly do not recruit PhDs and MScs in droves, but there are some very good examples, for instance, in the Teaching Company Scheme where small and medium sized enterprises will use students under appropriate supervision to help them develop their businesses and provide some educational broadening in return. One possible role of Faraday centres that they could offer is to provide the infrastructure for these students in the way that small companies find difficult to provide in themselves. I am aware that Teaching Company has an initiative called teaching

[Lord Kirkwood *contd.*]

company centres to help that. Rather than create yet another scheme perhaps something could be encompassed within Faraday or some other local conglomeration. I think that it does raise an issue—and I have been trying to think of an answer to the noble Lord Gregson's question, what are we going to do to change things. We have not as yet discussed motivation and enthusiasm. I think that we should both agree that things happen when people get enthused and motivated and excited and that can come partly from seeing a policy that people can believe in and can give direction, but it can also come from having a critical mass in a local area with a centre or lead body where people can meet and convene a network, as the expression is, and learn from each other. It would seem to us that the Faraday centres or something like them could provide these focal points where people can learn from each other and exchange and encourage each other and do business with each other. We should hope that that is one mechanism that would help reverse the decline—something we all agree is required.

Lord Gregson

168. When I chaired the teaching company scheme we estimated that one in ten thousand companies were in the scheme. We also estimated we should need one in ten before we moved the country's manufacturing effort to a sustainable economic growth, which is to be debated in this House this afternoon. What is going to happen to amplify that situation by one thousand times—I mean, one thousand times! It is unbelievable, is it not?

(*Mr Rose*) It is unbelievable, my Lord Chairman. Faraday can only be one element of that. That is why Dr Steele suggests and why we ask that we take a look at the overall picture and actually grasp the magnitude of it. The nation has some very difficult decisions to make about where it allocates its resources. Fifty million or one hundred million pounds investment in Faraday is not going to reverse the decline in itself. One is much more likely talking about billions.

Viscount Caldecote

169. My Lord Chairman, may I just very briefly return to the question of research associations. The most successful research associations were those connected closely with the universities. The ones that were not successful—and they were unfortunately the majority—were not connected closely with the universities. A very good example is the British Welding Research Association, which was a great success and was very closely connected with Cambridge University. Now that has done an enormous amount of good and it has helped particularly small and medium sized enterprises in earlier days starting off on using welding techniques. Would not the Faraday concept be very close to the best of the research associations that were very closely connected to the universities?

(*Dr Steele*) My Lord Chairman, this is certainly true. What we are looking for is excellence. If you can build on where excellence exists such that it would have a cachet of prestige that would make people be interested in working there—and I think we should not forget the fact that the financial carrot is a very strong one for getting the right people into such organisations—it could have quite an important effect. Those particular organisations are well managed so they have their links to the outside world and they have a strong customer base themselves as far as small, medium and large companies are concerned. They themselves work at the leading edge of their particular technology or nearer the market. I think that it is essential that they do have that particular expertise, my Lord Chairman. As regards those that have gone the way of consultancy it is all right up to a point but unless you know what you are talking about you are not able to consult effectively for all your constituents.

Chairman

170. I am afraid that we will have to draw this to a close very soon because we have other witnesses to hear this afternoon. May we just finish on this point. Assuming that money is scarce, and I think that that is a fair assumption, considering what little can be raised, partly by stealing it from other schemes no doubt, is it better put into Faraday centres, intermediate institutes, or is it better put into centres at or closely connected with higher education institutes, that is, given the country as it now is and the scarcity of money to create any really new shiny objects?

(*Mr Rose*) My Lord Chairman, I think that we would agree with the change in flavour of the Faraday proposals from the first iteration to the most recent one, which has considerably broadened the range of institutions that could be involved; and they include now the commercial research companies like Technology Partnership and Generics Group around Cambridge. What we do believe is that an experiment should be carried out. We believe that we should be prepared to run experiments and be prepared for them to fail. Being prepared for failure is often the best way to prevent it in our opinion. Secondly, we believe that however many are done only such numbers should be done as can be done properly within the budget. It is better to do five well than ten badly. These should be seen as part of a mix of new initiatives that we should be prepared to invest in.

171. As long as the Government bears the loss if it is a failure?

(*Mr Rose*) Industry is looking to Government to bear the long term risk in these new institutions. If they develop excellence we are confident that industry will buy.

Chairman] Thank you very much. I think that we really do have to leave it there. You have done us proud, and we are very grateful to you all. Thank you.

Memoranda from ICI and SBAC will be published with the Committee's Report

Examination of witness

DR B W LANGLEY, Academic Relations Group, DR N F ELMORE, Research Collaborations, DR M P MCONIE, Planning Department, ICI; and Professor D E H BALMFORD, Chief Scientist, Westland Helicopters Ltd, (for the Society of British Aerospace Companies), called in and examined.

Chairman

172. Professor Balmford, would you like to be taken separately or would you like to join in? As you can see, we are not very industry specific.

(*Professor Balmford*) I should like to join in, if I may, my Lord Chairman.

173. Very well. One of the things in which we are interested is to see whether there is a difference in attitude or behaviour or leadership maybe between the chemical/pharmaceutical industries and the more physics based industries. You may have a view on that. Dr Langley, may I ask you to start off?

(*Dr Langley*) Thank you. Lord Dainton and his colleagues who saw me off before I nominally retired two years ago will be glad to know that I have not in fact prepared an introduction. The one I had almost prepared I have rewritten twice during the learned and most interesting discussion that we have just had. My Lord Chairman, you will have seen from our paper that we can really speak only for large industry; we can only speak for our sort of high tech industry and specifically for the chemical industry. One of our difficulties is the shortage of advanced customers with which the chemical industry can interact unless it is selling its own things directly. Until our own recent third quarter results I hope we were considered to have had a pretty good track record for the United Kingdom in innovation and we have not actually disappeared since 1851. You will have seen from our paper that we have set out our position. In a nutshell we have had and had to have for our own survival very close contact with the sharpest end of science and technology and engineering wherever they are. That is rate limiting. Where we have not done well but we might have done well for all sorts of other reasons, but these contcts are a *sine qua non*. I think that we have had a good track record in maintaining that and showing our dependence on it in a two-way process. I do not think I should like to say any more by way of introduction, my Lord Chairman. We will be happy to answer questions on our paper or to answer you specifically. In the short time available as far as the three of us looking through your questions are concerned they seem to us to get to the heart of the matter. Indeed, this has already been exposed in several key points that have been mentioned earlier. What is going to be different this time round from what has happened before if we are now up against it? And what part will Faraday centres play in this instant revival which should have happened in 1852? I am sure therefore I should welcome your questions, that is, all three of us, and Professor Balmford.

174. Professor Balmford, would you like to add anything at this point?

(*Professor Balmford*) Yes, thank you, I think so, my Lord Chairman. The aerospace industry obviously has certain parallels with what has just been said, but to some extent the gestation period of some of our products may be on average considerably longer and I think that this has an influence on the whole cycle of innovation. I think that we also represent a very successful industry and that to maintain our position we really do have to stay at the leading edge of technology and we do need access to a very substantial base of research and development. In that process we believe that the universities have a very significant part to play and that the Faraday centre does offer something that other initiatives have not yet provided. Some of those have already been touched on and we feel quite strongly about these things, my Lord Chairman.

175. Is the time scale the main difference between physics based industries and chemistry based industries?

(*Professor Balmford*) It is a long period of investment before payback. I do not know enough about the chemical industry.

(*Dr Langley*) If you follow through a new drug, a new polymer, or make some substantial change in the way you make something on a large scale in most industries it requires a long lag period. I think that one has been bemused by these quaint S shaped curves and IT. Almost everything is not IT and this is one of the most important messages in relation to most of manufacturing industry. When you are coming in with a new polymer or a new drug it is quite a long haul. Because it is a long haul I am afraid your Lordships and your other colleagues went into our defects in innovation in your, I think, quite masterly report on this and you lifted almost every stone that there was to be lifted as to why we had not got a better track record for all sorts of reasons. If you are looking at pure exploitation of science and technology apart from the contact with good work and apart from seizing the chance and apart from doing the initial work in your own laboratory it is a long cash haul to conduct an international clinical trial or to convince the market or to wait patiently for your customer to come alongside you. It is a long haul, so the question I think is the time scale.

(*Professor Balmford*) My Lord Chairman, I think that perhaps the real difference is the fact that there is not a range of products in the aerospace industry in a way. We make very large[1] things that take a very long time to manufacture and that are a very long time in service and there are not the other products being sold that will balance what is going out.

176. Your risks are not so distributed?

(*Professor Balmford*) That is right, there is not the spread. I think that is perhaps the biggest difference. The time scales may well be the same for an individual product.

Lord Dainton

177. What I seem to have heard from the chemists so far, and it seems to be generally agreed, is that the state of affairs as between industry and the

[1] *Note by the witness*: Our projects are large and expensive.

[Lord Dainton *contd.*]

universities is not bad, the linkages are good, and perhaps this is due to the similarity of the kind of activities that are carried on at the bench level before you get to manufacture, and perhaps not so close in engineering in the universities and engineering in industry—I do not know. But is it the opinion, as it were, that the situation in the chemical and pharmaceutical areas is sufficiently satisfactory that Faraday institutes/centres are not needed? And, if so, why is it that they are needed in the other areas which have been maintained? What fundamentally is the problem that calls for some improvement in the situation in the other areas? I may be wrong on both these points, my Lord Chairman.

(*Dr Langley*) My Lord Chairman, I think that there was a need. They were set up and the arguments were put forward in ACOST and the like and there seems to have been recognised a need to get people over the hump. It was thought that these places might make it much easier for small and medium sized companies—as Lord Kirkwood has said. But what should be different? The larger organisations if they had relatively few problems, at least, in the chemical industry, I do not think would make any outstanding plea for the creation of these centres. Certainly if it were to take money away from the many admirable schemes that already exist one would not give these high priority. But I understand that in the ACOST arguments there were many sorts of industries, and smaller industries, lower tech problems, I do not know what they were specifically, in which these Centres would provide something which was not immediately accessible elsewhere. We are asked somewhere what use the chemical companies would make of them if they were set up. I note in the pilot schemes that in five areas if you look at them that there is scarcely one of them in which ICI could not claim to have an interest. We said that we should take a watching brief in these things and that we should see what was going on and that if there was going to be a new injection of cash and something unusually lively we should interact with them, but I think that it would be folly to pretend that for us they would be held to be rate limiting. Although that is not to disparage the fact that there may be others for whom that is the case. There may be interactions with large companies and their customers where these might be a case also. None occurred to ourselves when we were looking through the papers.

178. Is there a paucity of small and medium sized companies in the chemical industry? Does that account for the difference?

(*Dr Langley*) I do not think that there is a paucity of small and medium sized companies, my Lord Chairman. I think that a larger proportion of the big inventions have always called for a long haul either because of the scale of production or because of the long time scale of the early stages in their work. For various sorts of reasons the chemical industry has concentrated on the biggest topics. That is, most, of the large discoveries and most of the large money has changed hands on things that people must be primarily concerned about because they are science and technology limited. These have come from large companies or, in from small companies, have been taken over—or from universities—and have been later exploited. I think that the largest reason for that is this long haul nature. The smaller chemical companies I think are such that there will indeed be areas in which, I do not think so much for product, but I should have thought for process and for the training of manpower, where these Faraday centres, like the present research associations are more useful. I believe—I do not have the statistics—that we in ICI are concerned with the paint research organistion, but this is mainly of use to the great hordes of small paint manufacturers, of which there are many, my Lord Chairman, but I do not think that this usage is a characteristic of the chemical industry, for those that are small are really very, very low tech. That is my impression anyway, my Lord Chairman.

Chairman

179. May I now bring us round to the line of questioning that we started off with our other witnesses earlier because this does involve a couple of serious questions for us. First, do we really need more bridges between industry and university or just better funded ones? Secondly, if there is not any extra money—and let me ask three questions—from Government do you think that it is worthwhile stealing from existing schemes to put into a new programme along the lines of the proposed Faraday centres, including possibly large donations from industry itself? Thirdly—and perhaps you will deal with all three questions at once - if there is any extra money, would you rather have it put into centres based on intermediate institutes or into centres based at higher education institutions? Which would be the more effective from your industrial point of view?

(*Dr Langley*) My Lord Chairman, I think that if you were looking as to what you could do with a smaller amount of money to really test the value of Faraday centres you should ask the people who argued with ACOST for them and who claimed that they would do something unique for them. I think that the main concern in large science based companies who are really very closely linked with academic science is that nothing, but nothing, must be done to clobber any part of the science base in the United Kingdom. This is for a great number of reasons. The principal reason is that if you do anything to demoralise academe it will be the last stage in dissuading the next generation of youngsters. It is our human feedstock. Therefore, if it is up to ICI, I am sure we should much prefer, all of us, a better job to be done with what was to hand. But I think that one should in fact listen to the best arguments for those who claim that these centres are going to provide something that is not provided already. I was delighted by the suggestion of an audit, my Lord Chairman, of all the schemes.

Lord Porter of Luddenham

180. We are talking of building bridges between industry and university too, are we not, my Lord Chairman? Dr Langley himself has been with the academic relations group of ICI, and ICI have always had this very strong academic reltions group going back to the 1950s when I remember Dr Cook. These are known in the universities. As a chemist perhaps I get a one sided view on this, but I am

[Lord Porter of Luddenham *contd.*]

wondering, is this the difference: is it the difference, that chemical and pharmaceutical companies are around and are visible in university all the time and we know them personally and they know us personally? Let me ask Professor Balmford this. Is there an academic relations group in Westland Helicopters?

(*Professor Balmford*)Yes, my Lord Chairman, me!

181. And are you able yourself to have contact with all the activities in the universities in your field?

(*Professor Balmford*)We have had a policy in the past to improve our connections with universities, in particular perhaps to single out those that were sympathetic to the technology which was particularly relevant to helicopters, and to appoint a senior engineer to sit on the appropriate university department's Industrial Liaison Committee.

182. But this is the only form of pool that there is, is it not?

(*Professor Balmford*) That is right, and this has—

183. So that so far as industry is going to do something, if they are going to pool they have got to go out and grab?

(*Professor Balmford*) Yes.

184. It seems to me that as far as ICI in particular is concerned every chemistry department knows half a dozen people at least in ICI, and I think that that is not an exaggeration. I doubt whether it is the same with most of the other departments?

(*Dr Langley*) My Lord Chairman, for that side, of course, it is not necessarily held that Faradays would help remove the block. The principal reason why I think the ICIs of this world would not be very enthusiastic—we should listen to the others and we should be ready to help and to see what emerges—would be that we do most of these later stages in house. We have to. We do not regard it as a penalty to have to train our people. You would have to examine quite carefully the circumstances in which ICI solved a coatings problem and in which circumstances it used the paint research association, and would a person who had come through that Association be more useful or not than a good graduate. We wanted—and I am sorry to be toffee-nosed about this but having no connections with these Associations and being once an ICI fellow myself we justed wanted people who were very sharp and we wanted a relationship with the universities to tell us about the things that we did not know and to have to look for discontinuities. As I understand it, my Lord Chairman, the great purpose of the Faradays might be to help manufacturing processes. I think that it may well be thought that within the chemical industry—I think ICI would admit—as far as many of its manufacturing processes are concerned that the technology would be all right but we have a lot to learn: we have to learn from aerospace and we have to learn from car manufacturers about manufacturing processes. It is probably in that area—and I do not know whether or not my colleagues may have a view on that—that we might have more to learn from these sorts of places, not our hard core main line inventive research.

Chairman

185. I should like to hear from Professor Balmford his answers to my questions about intermediate institutes versus higher education institutions and as to whether there was a need for further bridges, new kinds of bridges?

(*Professor Balmford*) My Lord Chairman, we in the aerospace industry certainly believe that there is a need for better bridges. If money is fixed then it should certainly go to those areas where it could most usefully be used. We do believe with regard to the Faraday centre because of the staff flow situation and the co-location of core staff and the inflow from industry side and the higher education institute that the transfer of technology and the understanding of the industrial problems will more naturally happen than with previous links. As I have said, we have tried—and this is speaking parochially within my own company, my Lord Chairman, but I am sure that it is true of some others—to establish strong links with the universities in the past and we have had to work very hard to keep them going. Some are very successful. However, there is a tendency for things not to happen in an automatic fashion which perhaps would be more facilitated by the presence of a Faraday centre with an interaction and spin off that would be to the benefit of all of us in using similar technologies which must be much greater than individual companies attempting to establish their own relationships in the universities. That will happen anyway, but I think that there are greater benefits from the Faraday concept. Therefore, my Lord Chairman, I think that it is worth giving it a try, but subject to detailed discussion on the way that it is implemented because I do not believe that the proposals at the moment about the host centre are necessarily either the only ones or the better ones. If a university has an industrially oriented arm I think that it could then act as the host. If an industry has a separate research centre organisation, then it could act as a host. I am wary of this fourth organisation to act as the host institute.

Chairman] I have been concerned to balance the views of our witnesses, but I fear that I have not been equally balancing the questions of my colleagues.

Lord Renwick

186. My Lord Chairman, I wonder whether I may perhaps follow Professor Balmford's comment there by asking him this. Can he give any particular technology where he thinks that the Faraday institute centre could help his industry and whether that would be more likely to conflict and be in competition with what is happening in the universities now or perhaps even the aeronautics programme in the Commission, whether that is pre-competitive or post-competitive or how it ties in?

(*Professor Balmford*) With regard to the noble Lord's latter point, my Lord Chairman, I think that we have to be careful here. We have some fairly strong views in the aerospace industry about the value of the national programme before we start talking about international programmes. We believe in both and we are prepared very much to take a leading part in international programmes, but we have indeed to do that from the strength of a national

[Lord Renwick *contd.*]

base in research and development. As far as the noble Lord's first point is concerned, as to whether I can think of a technology that would benefit from this approach, certainly, say, advanced control technology would benefit the rotary wing industry, fixed wing industry, both civil and military, and possibly other non-defence industries. This is where I see perhaps that the generic technologies could spin off into quite a range of sectors. If I may be a little more parochial, we were talking about small companies and in relation to the aerospace industry most of these are, if you like, doing jobs for the main, large companies. In the past they have been more subcontracting companies, but more and more they have been asked to share the risk. It is to that extent, and to be competitive in order to get the work in the first place, that they have to think about raising the level of their technology. I believe that this would be easier if they were partners inside a Faraday type approach than would be the case in the present situation with the existing schemes.

Lord Howie of Troon

187. My Lord Chairman, I have been looking at technology policies for about 25 or 30 years, as most of us have been, and it must have struck most of us that over and over again we deal with structures and propose yet more structures to deal with technological or industrial problems. Are the witnesses quite sure that we need yet another structure in the form of the Farady programme? If they are not—and they may be—would they think that the same amount of money should be sunk directly into research in various selected points in industry?

(*Dr Elmore* My Lord Chairman, perhaps I may respond to that. Purely from the ICI point of view I think that the schemes that exist already—CASE, co-operatives, LINK and all those—are extremely good and I think that we are grateful for the words of Lord Porter, who has said some very kind words about ICI and our involvement. We do take it very seriously, my Lord Chairman, and we have been working quite hard at the academic interface for about 40 years. I think that it is difficult for us to envisage how we would use a Faraday centre. What we should perhaps like to suggest is this. We have tried similar organisations: we have a joint laboratory in molecular biology at Leicester University, which has been running since 1978 where we have supported up to 12 people within the university environment and learnt a lot from it, although that is coming towards a close now. We have looked at the MRC collaborative centre at Mill Hill, which is a sort of pseudo-Faraday, I should say, where it was envisaged that one could do contract work in that centre using the expertise of the people in Mill Hill, and we did not get involved with it. If there is, indeed, a limited amount of money, my Lord Chairman, what we should like to suggest is two approaches, which perhaps do involve moving the goal posts a little. The first is that we feel that the maintenance grants of postgraduate students are far too small; therefore, could we use funds to make them more attractive, not to go overboard, but to make them even the sort of grants on which people can actually live. We all suffered when we did our PhD financially and we think that everyone should suffer a little while they do, but not to that extent! Can we therefore use limited funds to raise the grants for PhD students? The other thing is this, that perhaps it is a Faraday centre with a difference. There is undoubtedly an acute shortage of good people in analytical chemistry. That also stretches over into environmental technology, and we know that those two are related. Would it perhaps be possible to consider from our selfish point of view that there should be created a centre for analytical chemistry to solve that problem, bearing in mind, my Lord Chairman, that chemistry and the pharmaceutical industry are very successful. That perhaps would be very helpful. My last word in this little context, my Lord Chairman, is that my senior colleague pointed out when we were thinking about this that the very successful pharmaceutical industry does not have a research association.

Chairman

188. Dr Elmore, what you have said in all respects is very interesting. Are you going so far as to say therefore that you would rather see money put into the support of young research workers and PhD students—post-doctor students, I suppose, as well?—rather than its being put into a new scheme of institutes, assuming that it was not very much extra?

(*Dr Langley*) I am sure, my Lord Chairman, if it was an either/or that that would be the view of the pharmaceutical and chemical manufacturers, but I do not think that the arguments for Faraday were brought forward by people in those industries or for those sorts of industry.

189. No, I understand that, but I just wanted to ask, because Dr Elmore was talking about PhD students having a hard time and, yes, I know that they do. No matter for the moment; what is important is whether we are getting the scientific manpower at that level that the country needs and that industry can use because, if we are not, then paying them more might help. Can industry take more if there were more?

(*Dr Elmore*) My Lord Chairman, we believe that the pool of good people would be greater. One could argue that anyone who is turned off from doing a PhD because the maintenance grant is pathetic is not a committed scientist anyway, but who knows? For undergraduates who run up an overdraft—and I have seen my own daughters do that—to continue on a grant that is a pittance I think is a great shame. Therefore, if we can attract or retain within the university system more people of a quality that we should ultimately want to recruit, that, I should say, is a better way of spending the money.

Lord Dainton

190. Would industry contribute to the cost of this in order to do the topping up?

(*Dr Elmore*) Well, my Lord Chairman, we do already in respect of CASE studentships, and maybe we could do more. One of our problems, I think, is that we have been so supportive of CASE and co-operatives that we have got in right up to our necks. We have 280 CASE students and some of those are in

[Lord Dainton *contd.*]

businesses that are going through rather a rough time. However, I think that we should be prepared to pull further stops out.

Chairman] You used to have a marvellous fellowships scheme that you have dropped now.

Lord Dainton] It has changed.

Baroness Platt of Writtle

191. My Lord Chairman, if I may just follow that up, the whole point of the Faraday programme was to encourage innovation and the exploitation of new technology. Now if you put the money into studentships it is not necessarily the case that what they might want to study either would be exploited or would lead to innovation, is it?

(*Dr Langley*) That is where we get our innovation, my Lord Chairman. If you take an industry like agrochemicals or pharmaceuticals, something like that, you need the people who are trained in competition with other people doing similar things around the world who really are, in the nature of the industry, as sharp as you can be. Then they are dealing with folk who are looking for an application. Quite frequently the application, be it to kill a bluebottle but not to upset the Friends of the Earth or some other, requires extraordinarily subtle entomology, subtle biology and the sort of people who we trained in these wasy. We had a collaboration of this sort with the Imperial College at Silwell park as our Lord Chairman may recall.

192. Yes, but what exactly—

(*Dr Langley*) Our sort of people are to hand, and it is a question of our meshing into this academic interface. As to Faraday, there have been SERC units of entomological chemistry within the existing schemes where people are applying themselves, in this field. The existing schemes will do for our sort of science, but it is held that there are large areas of engineering, and the concerns of small, lower tech firms, where as regards this sort of thing there is not an existing mechanism that makes it so easy.

193. I should say that I worked in the aircraft industry so obviously I should be aware of that, but what I was really concerned about was, when you choose your students do you, in fact, in any way lay down the research that they do so that you know that it will be useful to you?

(*Dr Langley*) Well, I have to say, it depends on what really is "useful". If you have 289 CASE students they are working on overlap topics, these are topics of joint interest to ourselves and to other persons.

194. Yes, you have seen to that?

(*Dr Langley*) Lord Porter will find somewhere a photon that will split something unbelievably unspeakable and he and his man will convince us that splitting such a thing will be a very good training for the person. That is point one. If what is split is of some interest to us, fair enough. However, it is a very loose sort of arrangement. Our collaborations extend from that sort of touch fingers relationship right over to the Leicester laboratories, the main purpose of which in the early days was training our people in biotechnology. Long before other industries discovered it we had the first research lab of our own on recombinant DNA work; we had this only because we sent some people to Edinburgh University who were interested. We had to explore the basic idea of whether it would work and whether it was safe. That sort of thing is perfectly all right at one extreme, but we go right over to relying on universities and university hospitals for clinical trials for applied things, so there is a very broad spectrum of things. I think that we are saying that in our understanding—that is, our industry, the ICI—(and I am sorrier to be holier than thou) Faradays are not on the top of the pile, but the great and the good have got together in secret caves and decided and listened to other people's pleas that there is a case for these in some areas. We have heard from the previous witnesses. I am sure that there are many different ploys, and since there is a limited pot I think that the concept of Lord Porter of an audit to look at the relative merits and the expectations is best. Because there is undoubtedly a glamour about a new scheme, my Lord Chairman, and there is always a measure of arm waving and people might join in this. When Faradays were selected and why they were not put in higher education institutes to start with by my reasoning of the approach, was that they wanted somewhere with a good commercial track record. Now Lord Flowers would say terrible things if he thought that Imperial College's hard-nosed brothers had not got a very good commercial track record—it is almost too good a commercial track record—but the point was that these people were doing the sort of work that is very unlikely to attract the PhD student working in these sorts of Faraday areas. If you look at the sorts of ploys which are on the original Faradays you could indeed just get some money for them, but I think that the aim is to look for some areas where folk would be got over the hump in these lower technology areas and where you cannot just go to Imperial College and get first class entomologists and bring them into your own lab to discover an insecticide but where there is something more seemingly lowly and where they have to be attracted and where the idea of working in conjunction with and closer to the business in a small firm might spur them to do something which they would not do otherwise. I do not think that the large sized chemical based companies have let the world's populations down as regards their track records. In most places—and there are many reasons for this—including the States, apart from things like computer programming and diagnostic work and some other such things, there has not been nearly enough scientific injection into the lowly, ordinary things.

Chairman] I am afraid that we must begin to wind this up now as time is getting on.

Lord Howie of Troon

195. I want to ask a very brief question, my Lord Chairman, which is this. I thought that I heard Dr Langley say that the Faraday programme was not at the top of the pile. I was just wondering where it was on the pile.

(*Dr Langley*) From our point of view you would have to say that it would be pretty low on the pile, but I think that that is due to the nature of our selection criteria. There are those who argue, knowing how

[Lord Howie of Troon *contd.*]

tough it is, that this will provide a spur to innovation. I think that they should be given a modest amount of money and nailed to the mast and let us see what they have done with this modest amount of money by comparison with what is done in other things.

(*Dr McOnie*) My Lord Chairman, I think that it would be important for some of our smaller customer industries perhaps to have access to generic technologies. Indeed, one of the suppositions has been that it must be a higher education institute or an RTO that could be one of the intermediary institutes. Industry itself has laboratories that could possibly qualify in this respect. For example, my Lord Chairman, we have our own group of environmental laboratories which does contract work within ICI and contract work in environmental technology outside ICI, and that would provide the type of model.

Lord Dainton

196. My Lord Chairman, I think that this has all been very illuminating as far as I have been concerned. I get a very clear sense that the problem is not with the big firms in any discipline but that it is also the case that it is in the small and medium sized firms and that there there is a great difference between the various sectors of manufacturing industry. The question I am interested to know is this: if you were to choose Faraday's programme in, shall we say, part of industry where the small and medium sized enterprises do not have the kind of relationships that they ought to have with the universities, would you see that as a remedial step to come to a situation like that which exists in the chemical industry or would those be permanent features of the landscape? Are they, in fact, something that you do in order to try to improve the situation and then, if it is successful, do without them, or do we always have to have them and, if so, would they move around from sector to sector?

(*Dr Langley*) We have, in fact, just finished putting together our vast reply to Mr Waldegrave's science and technology white paper. One of the questions there is one of the things that your Lordships asked in regard to innovation: what are the hallmarks for this. I think that the answer to that would be that if they work they would take off, otherwise they would shrivel. This occurred to me during the questions previously, my Lord Chairman. I think that one of the most interesting things that might be helpful to future Faraday centres is to look very carefully at what is happening in the contract research organisations and these sorts of places. I was stunned to learn when I went to a Faraday seminar in Glasgow the other week that there is claimed to be more research going on in these centres than the whole of the higher education system. I found it stunning that there is such a large amount of work. If you are trying to get most benefit for your money, as the noble Lord the Lord Chairman has said, I think that you should determine quite carefully what they are doing and what would be different because of this, what has prevented them in the past. I am sure that they would all have been delighted to get a PhD student; in fact, my Lord Chairman, I am sure that there are CASE students within these places now although I do not know that for actual fact. What might be different for a few more pounds in a different scheme than has possibly been able to happen already? Why have not the textile industry, for example, taken note of this. What you might properly ask is, why have not ICI used them—I do not know whether they have or not—in relation to dyeing processes? I think that there would be a rich harvest from examining this.

Chairman

197. Thank you very much. Professor Balmford, are there any final words that you would like offer?

(*Professor Balmford*) My Lord Chairman, perhaps a slight defence of the Faraday concept in relation to some of the things that are not quite so important to the chemical and pharmaceutical industries. The issue of co-location of staff working together: here I see a situation where the core staff and the seconded higher education institute staff and industry staff (I do not see why industry should be excluded) should not get a PhD by working inside a Faraday centre in connection with the university. This is good for a career prospect in industry where people often feel a PhD is not being used or they do not see the point of pushing to get one outside the basic work requirements. I think that it would be good for staff recruitment and for staff retention of very high calibre people. The culture of the Faraday centre I think has to be such that people are fighting to get into it, that is, people of very high calibre. That to me is one of the very essential differences that it may create. Many universities as far as I understand it have to look far and wide to get a student to do a postgraduate degree. Very often people are not coming forward.

198. Not in the universities with which I am associated!

(*Professor Balmford*) I should expect them to be fighting to get in. If I may come back here to a point that was raised earlier, I should hope that they would be adequately rewarded as well. They would not, however, be fighting to get in on that basis; they would be fighting to get in because it is very much a career enhancing activity where not only do they do basic research but they get they insight into business requirements, and so do the people coming from the higher education institutes outside rather than directly recruited into the centres. For those sorts of reasons, my Lord Chairman, I think that this would have an advantage over existing schemes.

Chairman] Thank you all very much indeed. I think that we will leave it on that optimistic note. Thank you for coming and thank you for being so helpful and co-operative.

Printed in the United Kingdom by HMSO

Dd 0502959 8350943 C6 12/92 205135

HOUSE OF LORDS SESSION 1992-93

MINUTES OF EVIDENCE
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THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

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Wednesday 18 November 1992

COMMITTEE OF VICE-CHANCELLORS AND PRINCIPALS

Dr K J R Edwards, Professor B F Pender and Professor G G Roberts

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Dr B G Smith, OBE, Mr M J Rowan and Mr [illegible]

Ordered by the House of Lords to be printed [illegible]

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Ordered by the House of Lords *to be printed 19 May 1992*

LONDON : HMSO

£4·95 net

HL Paper 23—iv

18 NOVEMBER 1992

Present:

Dainton, L.
Flowers, L. (Chairman)
Kirkwood, L.
Nicol, B.
Perry of Southwark, B.
Porter of Luddenham, L.
Renwick, L.
Walton of Detchant, L.
Whaddon, L.

A Memorandum from CVCP will be published with the Committee's Report

Examination of witnesses

DR K J R EDWARDS, Vice-Chancellor, University of Leicester and Vice-Chairman, Committee of Vice-Chancellors and Principals, PROFESSOR B E FENDER, Vice-Chancellor, University of Keele, and PROFESSOR G G ROBERTS, FEng, FRS, Vice-Chancellor, University of Sheffield, Committee of Vice-Chancellors and Principals, called in and examined.

Chairman

199. May I welcome all of you. Some of us know you quite well, others have heard of you, but you are all very welcome. We look forward to an enjoyable bout of discussion with you about the proposed Faraday programme. In doing so may I ask whether there are any words you would like to say just to open things. Perhaps, in doing that, you would bear in mind that one of the questions that we shall have high on our agenda is this. Given the fact that many universities have been successful in forging links with industry already by a variety of means, some of them entirely of their own making, some aided and abetted by research councils, government departments and so on, given all that, do we really need any more bridges between universities and industry of a new kind, a new scheme of things, or would it be enough to strengthen what we already have? Perhaps in your opening remarks you would try to deal with that question, which is really the key question of our enquiry.

(*Dr Edwards*) My Lord Chairman, may I say right at the beginning just to clarify one matter that the document that was submitted to you was prepared by the old CVCP and I should therefore say that we are here representing the old CVCP. I have no doubt that the new universities would share some of the points that we have made, but they have not really been involved at this stage in this discussion. May I then begin to talk round the document a little by saying that we entirely accept the importance of developing good links between universities and industry and, as you kindly said, my Lord Chairman, we have done a good deal, particularly in the last decade or so, to improve that. We think that there are a lot of good schemes—the CASE studentships, teaching company schemes, the LINK scheme and various others that have been mentioned to you, I know, in evidence from other people—which are working very well. I think that if we had to identify one area where we do feel that there is a gap, it links with small and medium sized entreprises. We should like to see structures in place that could make it easier for those companies to form good working relationships in research and technology with universities. Having said that, my Lord Chairman, I think that our short answer is that we do not believe that there is a place for yet another set of structures. I think we feel that there could be a great deal of development on the existing structures. There might be something to be said for having them seen as part of a coherent overall programme, but in short I think we feel that the proposed Faraday centres would not help that; they would create yet another set of structures apparently on top of the existing ones. There is just one general point that I should make, if I may, my Lord Chairman. It is that as part of the working party's proposals there was mention that technology transfer and links are not a linear process but unidirectional, and we entirely accept that. I think our view is that the proposed Faraday centres would not help that because they would present yet another blockage in the chain that would not assist the kind of iterative exchanges that I think do need to take place. I think therefore, my Lord Chairman, that our short answer is that, yes, we want to press ahead with developments that we have put in place in the last decade or so particularly and we do recognise that there are problems about making links with small and medium-sized enterprises; but we do not believe that the proposed Faraday centres would actually help. However, we do accept that there is plenty of scope for development of the existing mechanisms.

200. Thank you, that is a very clear exposition of your basic attitudes to all of this. On the other hand it is said by many outside the universities that the links between universities and industry are highly deficient and why do not universities pull finger.

(*Dr Edwards*) In fact, I think that is an unfair criticism now. It may well have been a fair criticism 15 years ago, say, but I think now that universities are putting a great deal of effort into developing links, and I think that we do have some very good links. However, I accept that largely they are with the larger companies where they are very successful.

201. Clearly Prince Charles' working party did not think so or they would not have proposed yet another link?

(*Dr Edwards*) I do not accept the general criticism that they make except in the area that there is deficiency with regard to small companies. I believe that there is a need for new mechanisms and better funding of those mechanisms in order to achieve those things.

Lord Dainton

202. If you accept that there is a need for a new mechanism for small and medium sized enterprises have you given thought to it, can you make suggestions as to how that can be done?

(*Dr Edwards*) It is probably felt, though I must admit that I personally do not have that direct information, that the small and medium sized companies do have links already with many of the research and technology organisations. I believe that there is potential there for developing that. I do not know whether Professor Fender would like to add anything to that.

(*Professor Fender*) Yes, my Lord Chairman, I think there is some scope in going in that direction. Of course, the research associations cover a very wide span in both scale and quality of research. But in a way we are not talking about the direct links between a small and medium sized company and a university. That may be not an equal partnership. One is often talking about a generic body of research which would be helpful to a whole cluster of small and medium sized companies. In so far as some of the research associations, or perhaps many of them, have links with those companies and carry out research on a contract basis and provide consultancies for those club members, then I think that we probably could strengthen our links with some of the research associations and a bit of pump priming to make that partnership work would seem to me to be desirable. Otherwise, of course, we are going to end up with a system in which we are taking away from some successful schemes like the LINK programme, as it is now becoming, the teaching company scheme and so on. We are then simply going to be pinching money from those schemes and giving it to yet another scheme and we will end up with more unfunded schemes. Apart from that one rather narrow point about linking clusters of small firms into universities through research associations I think that we should be concentrating on our existing mechanisms.

Lord Porter of Luddenham

203. My Lord Chairman, I think that is a very interesting point that Professor Fender has just made. After all, the research associations were set up with this purpose in mind, were they not, that smaller companies could go in? I for one find it very difficult to see what is wrong with that. Obviously it can be improved. Is there perhaps not enough contact between research associations and universities? I gather from what you have just been saying that you feel that this is the way forward?

(*Professor Fender*) Yes, I think the links with the research associations are not as strong as they might be and I think there is not a mechanism which easily brings them together. When I did the last review of the teaching company scheme there, of course, there is a mechanism to bring the DTI mainly and the SERC—those are the principal sponsors in this case—together into a coherent scheme. One could envisage a mechanism by which the DTI and the science funded programmes were brought together with the specific purpose of encouraging their interaction, as I said, for the generic research of small companies—with the universities making some use of the research associations. Although I believe that it would be possible also to envisage a university itself perhaps in conjunction with a science park also providing that kind of interaction.

Lord Porter of Luddenham] You could probably give us some good examples of such collaboration, for example, the Shirley Institute with Manchester University perhaps or, thinking of Professor Gareth Roberts, the Wool Institute perhaps? Well, of course, yours would be steel, would it not?

Lord Dainton] That is at Sheffield, is it not?

Lord Porter of Luddenham

204. And what about the steel, for example?

(*Professor Roberts*) Perhaps I may answer Lord Porter's question and also Lord Dainton's, my Lord Chairman. I am fortunately based like Lord Kirkwood in a large city based university, a large civic university. I believe there that partnerships with research associations are good, for example, the glass research association is actually on the campus. I believe that the club attitude, especially when it comes to small companies, could be very advantageous. We have just recently started a major metals processing initiative in Sheffield where several companies, about 15 in all, are looking now to the universities in Sheffield for partnership. The environmental field is another one where more co-operation is essential. I do believe that there are now mechanisms and a different attitude in civic universities generally towards helping their regions. I believe that the teaching company scheme that was referred to just now is an excellent scheme. If that can be broadened in possible some way I think there is a lot of mileage.

Baroness Perry of Southwark

205. Links with industry, which you have been using in a rather generic sense, take many forms. One of the criticisms in the working party report was about technology transfer, that is, research that has happened in the university without perhaps a predetermined link with any industry, simply staying as an academic exercise and not being turned into a commercial enterprise. Do you think the existing schemes as they now are would allow for a development of better technology transfer?

(*Professor Roberts*) If I put my Thorn EMI hat on—I was research director of Thorn EMI until a couple of years ago—I believe the linkages we have at present between industry and university are very strong. The main problem, I think, is that in industry itself there is a huge gap, an unfunded alpha gap really, between projects for which researchers in industry would generally like support but whose companies do not support them. I believe that we can in fact help them achieve some of their goals. There are some very good examples of LINK programmes. If I may quote one very good example, it was one where Thorn EMI took the lead and Philips were involved. This was for developing room temperature infra red detectors. Four universities were involved in partnership—a superb programme that has worked really excellently. The problem though is that it was a very focused programme aimed at night vision devices to operate at room temperature. If only we could broaden LINK schemes so research themes as well as research projects could be supported, I am

[Baroness Perry of Southwark *contd.*]

certain that we could have all the benefits of the proposed Faraday type institutes but without introducing any particular new structure. We should be building on existing partnerships and existing strengths. I am sure that is the way forward to try to broaden objectives. The OST and the DTI presumably would be the main departments looking after this with SERC, or whoever, very much in support.

Lord Walton of Detchant

206. My Lord Chairman, may I just say that while there are clearly areas of excellent and outstanding collaboration there are nevertheless, I think, certain universities that seem almost unaware of the existence of some of the research associations involved in research and development not very far away from themselves. Would there not be a case for suggesting that the new and old universities might try to develop much more formally a kind of relationship/liaison arrangement with the organisations of this nature which exist in their respective areas

(*Dr Edwards*) My Lord Chairman, I think that there certainly is a case and I think that there is a very strong case for universities that are very close together pooling their thoughts on this and trying to work out some common procedure. It is certainly something we try to do in Leicester and Leicestershire with Loughborough, ourselves and De Montfort University. Much of the research that goes on in universities will actually not necessarily be relevant to local activities, the historical pattern of what has happened and what is good, so I think we must not believe that we can solve all our problems locally.

Lord Dainton

207. May not the area of interest change over time and should it not therefore follow as a corollary that the initiative should lie with the university to build on its strengths in relation to the region? A propos all this may I mention that your memorandum of evidence to us was in the form of a memorandum written in July. Has the Committee of Vice-Chancellors and Principals taken the matter further? Does it intend to do anything collectively? Has it encouraged its members to do so and has it also, which seems tome very important at the present time, proffered its own advice along these lines to those who are promoting the Faraday centre notion or to the OST?

(*Dr Edwards*) We have certainly proffered our thoughts to the OST with respect to the developments in the white paper on many matters, including these in particular. If I may return to the original point of Lord Dainton, my Lord Chairman, I am sure that over the long term we should be trying to develop influences locally that do lead to the creation of research institutes that are related to industrial technology and that are centred around the excellencies that universities may have locally.

Chairman

208. Has the CVCP in its old or new manifestations thought of having a joint committee with research associations and suchlike bodies?

(*Dr Edwards*) I think that the short answer to that, my Lord Chairman, is no, but it is certainly something that we ought to follow up.

Lord Dainton

209. There used to be the old universities and industry committee jointly with the CBI which once upon a time I chaired in alternation with Lord Denning Pearson and that, it seemed to me, was fine up to a point, but one never had involved in this the people who needed the help because they did not know it, and this is many of the small manufacturing enterprises. How do you get over that locally?

(*Dr Edwards*) Perhaps I can ask Professor Fender to answer that—he has more experience of this than I have actually.

(*Professor Fender*) Perhaps I may give a recent example, my Lord Chairman, and I think that one needs to look at this question of industrial interaction against the rising curve which I think is best illustrated by the amount of research contract money which is placed in universities; and it is still strongly rising despite the recession. In my own particular case I do have a research association on the doorstep. We have recently taken an initiative to go into partnership with them to develop a research project and we have stimulated that by taking the two most senikor people at the advanced materials centre in ICI. We have done that on an absolutely fifty/fifty basis: we have cut the salaries down the middle and we have set up a research unit in materials which will be supported by both university and the research association. It is a developing situation. I believe that the awareness now is very strong in all universities, old or new. As far as the technology audit is concerned which is currently going on, sometimes these have been done by the BTG (that is where I go in a moment or two)—and they are doing quite a lot of these technology audits. Most universities have greatly professionalised their industrial relations organisations. I think therefore that I am rather optimistic about the momentum for industrial interaction, but that is not to say that there is not a need to focus some government pump priming on the successful schemes.

Chairman] I think that we are drifting a little far from the topic of Faraday centres.

Lord Dainton

210. This is an important point. I take the momentum on the university side, you have all expressed it very eloquently, but the problem is with the small firms—how do you get them in. Would you recommend to the DTI that insetead of supporting Faraday centres or whoever is going to do that they took some initiative to encourage the small manufacturing enterprises into co-operation with you and put a little bit of money where their mouth is?

[Lord Dainton *contd.*]

(*Professor Fender*) Either it is a university centred club or using existing clubs which might be with the research associations: it is one or other.

211. It needs a little lubrication in the form of knowledge, does it not?

(*Professor Fender*) Yes.

(*Professor Roberts*) Pardon me for mentioning Sheffield again, but that is where I know most about: the lower Don valley in Sheffield is an area of great dereliction and it has about 150 small companies, most of them materials or metals oriented. Last year we started a crusade with our research students and undergraduates where they went into these companies to carry out technical audits. This has been a superb experience to watch and encourage. If the DTI could give some sort of pump priming initiative support on a regional basis for this kind of it would be a marvellous shot in the arm for small companies. It would have a dramatic effect on these companies, these bright young people going in with their stimulating ideas. You do not necessarily have to have a huge Faraday institute structureto start these linkages.

Chairman] This has been very helpful, but I think we really must now talk more about the Faraday proposals.

Lord Kirkwood

212. The way that the discussion has gone, my Lord Chairman, I understand from the opening remarks made by Dr Edwards that his concern about Faraday centres was if they were based on commercial research organisations and not if they were based on universities. That was the original CEST model, was it not?

(*Dr Edwards*) Yes.

213. It is that you are concerned about?

(*Dr Edwards*) I think that there are two things, my Lord Chairman. One is that we certainly are concerned about that. The other is that we feel that a single solution of this kind, whether it is a Faraday centre or whatever, wherever it is based, is not necessarily the answer to all problems, but we do believe very strongly that the benefits that would arise from an institute being based in or very near to a university or group of universities to allow a very free movement of students and staff into and out of the institutes, which would allow the possibility, for example, of making joint appointments of staff, would be enormous, whatever the nature of the institutes and however they might be funded.

Chairman

214. Sir Ron Dearing used the word propinquity; he said that he had a rather open mind about the whole thing at the moment except that there had to be continuity.

(*Dr Edwards*) My Lord Chairman, I think we should accept that as very important.

Baroness Nicol

215. The only thing that worries me about this regionalisation that is being proposed, my Lord Chairman, is that if you put it alongside the Government's policy which is growing that students should live as near as possible to their homes you are going to develop, I think, regions with very strong biases in one direction and the choices for students in the country generally might well be reduced. It is something to be approached with caution, I think. I do not know whether you have felt this pressure on students?

(*Dr Edwards*) My Lord Chairman, perhaps I may answer that first. We have little evidence at the moment in our intake that students are coming from the local scene and the geographical situation is still unchanged.

(*Professor Roberts*) Except in Glasgow, my Lord Chairman!

(*Dr Edwards*) Except in Glasgow. In any case, however, even if it were to happen that would be, I expect, at an undergraduate level. I do not imagine this being a major issue at postgraduate level. I think students would then move to universities, even if they tended to go locally in the undergraduate years, where they felt the subject matter was interesting and relevant to their aims.

216. If the bias of university was all in one direction would they not be brainwashed?

(*Dr Edwards*) I suppose that there is a slight danger—

217. Not a very serious one!

(*Dr Edwards*)—but quite honestly I do not think that—

(*Professor Fender*) It is difficult to brainwash students!

Lord Renwick

218. My Lord Chairman, I should like to go back to Dr Edwards' introduction and take on board his comments that in your opinion a new structure is probably unnecessary but new mechanisms may well be. That brings us to funding. We have received evidence from another association which says: "There is every reason to believe that the existence of Faraday Centres would free academic institutions to carry out their true task of academic research unconstrained by the need to seek industrial collaboration to obtain funding." I am not quite sure which academic institution they are referring to there, and perhaps you could comment on that. In the light of the fact that over the last ten years universities have had I believe enormous value from their association with local industries, as we have just been hearing—I am sorry, I should know what academic institutions they were, but it did seem rather strange. You obviously do not feel that the existence of Faraday centres would allow that to happen?

(*Dr Edwards*) If the Faraday centres were funded by genuine additional new money I should still think that is not actually a sensible way of spending that additional new money because I think that it will reduce the links between academia and industry and create another barrier that has to be overcome. If Faraday centres are funded by a transferance of money from existing forms of support then I should think that is even more disastrous.

Baroness Perry of Southwark

219. May I press a little on that, my Lord Chairman. If there were to be some new money, if we dreamed that there might be some new money, and you are making a very strong case for it to be applied to existing schemes to enhance them, where would you like to see it go, what enhancement of existing schemes would fulfil the aims of the Faraday centres without creating a new and additional mechanism?

(*Professor Roberts*) Perhaps I may come back to the idea of the LINK type scheme. LINK at present is very project oriented and I think that is what Faraday is all about. If I may perhaps give an example to the committee, you asked whether the CVCP had addressed the Faraday centre notion last July. It is such an unwieldy body in some senses now that it is not entirely appropriate that it should. However, I know that the more strategically minded vice-chancellors have done so and maybe some good has come out of this already because it has forced vice-chancellors to say: well, if we did have a Faraday institution how could we benefit from it. In Sheffield we have a health and safety executive. We also have a social and applied psychology Research Council unit and excellent social science and engineering departments. We have started a real dialogue between them, not based round specific projects yet, but a portfolio of subjects to do with risk and hazard and building on the expertise. I believe that this is the way forward. If one could find a LINK type mechanism for supporting industry plus universities plus research associations working in partnership and building on their collective strengths, I think you would have a large number of excellent bids forging links that I think have never been thought of before. Therefore, I should have thought that Dr Malpas and his committee could quite easily take on board responsibility for a different type of LINK programme. I see that the Faraday principle could easily be accommodated within a wider LINK programme of this kind.

Chairman

220. You have been very explicit about any extra money not going into Faraday centres but going into things you prefer and thank you for being so explicit. But if you are overruled and there is extra money and it is going to go into Faraday centres then may we talk a little about how that money is to be spent? How do you see, for instance, Faraday centres being staffed? Do you think Faraday centres are as conceived or could be made suitable for doctoral research? Your written submission suggests that that might not be all that easy. Would you care to discuss that a little bit?

(*Dr Edwards*) My Lord Chairman, I think that we should start with a very strong feeling that they ought to be located in or very near universities and this, I think, would create the potential for having joint appointments or the staff being seconded for short periods and moving in and out; and I think that that would affect the staffing policy obviously. On the research student side I think the point there that is being made—perhaps it could have been made a little more explicitly—is that there should be good links between the research students and the relevant university departments and that would be facilitated enormously if the Faraday centres to be created were very near a university or universities.

(*Professor Fender*) My Lord Chairman, I do not want to introduce a new point but just to reinforce that. I think that there is scope to take projects, as Professor Roberts has suggested, and turn them more into programmes, in other words, a portfolio of projects that provide a better base for an on going collaboration. I believe that research students would in certain circumstances, depending on the quality of the institutions involved, benefit from having an opportunity to distribute their time between an external organisation and university. I think therefore that both those points are important ones. However, the money, in the sense of talking about funding, needs to be used in a way which does foster partnership and I think that joint appointments are one way of explicitly saying that it is a partnership. For example, the pilot schemes that are going on at the moment, although the universities bid very strongly for those and, as you know (you probably have the statistics) 58 applied for this pilot studentship scheme and 15 were shortlisted, shows a great will on the university side.

221. But they are not pilot schemes for Faraday centres?

(*Professor Fender*) They are not pilot schemes for Faraday, but in terms of concentrating on the people resource, that is, the training of the students, they could be seen to be a pilot for that aspect.

(*Professor Roberts*) My Lord Chairman, I am a great supporter of CASE studentships and there is a real shortage of studentships at the moment.

(*Professor Fender*) There are very good, qualified people who want to do work with industry and there are not the CASE studentships to go for.

222. Perhaps we may just look at another side of this multifaceted coin. One of the main objectives of all of this kind of thing is to persuade industry to spend more on R and D. British industry spends much less than industries in other competitive countries. This scheme therefore, or any scheme, might be useful if by putting in some government money, more money, matching funds or better, came from industry, and a real commitment came from industry as well. Do you see the Faraday centres as being a vehicle for that kind of thing? If so, do you consider them a better or worse vehicle than other schemes from that point of view?

(*Professor Roberts*) My Lord Chairman, again, if I may, speaking with my Thorn EMI research director hat on, emphasise that the gearing possible by supporting work in universities is enormous. For example, if you sponsor a research student you immediately tap into the supervisor and the huge network nationally and internationally which that person has. I just cannot understand why industrial labs do not invest more in universities. Our problem perhaps is that we academics have not marketed ourselves sufficiently; I do not know. But it does seem to me that industry is more at fault here. The more astute people do recognise the value of investing in research. We looked recently at the investment that industry already makes. It is interesting that in the areas of medicine physical sciences then engineering, industry contributes roughly £30 million in each. That is the amount of support that the universities receive from industry. By comparison the R&D

[Chairman *contd.*]

budgets of companies in industry is enormous. I am sure that there is a selling job to be done to the managing directors and chief executives of British industry.

Chairman] It is, if I may say so, a task that would be particularly well carried out by yourself and one or two other vice-chancellors with close connections with industry also.

Lord Dainton] Is not the difficulty really—again, I return to this problem—that everyone is concerned about the small and medium sized enterprises and they on the whole neither have the resources given the problem at the present time of short termism in the City or the ability therefore to invest in these things without having a very long payback time, which they do not want to undertake at the moment?

Lord Walton of Detchant

223. My Lord Chairman, I can see the force of the argument: you are suggesting that if there are to be Faraday centres or something like them you wish to see them associated closely with the universities to create a partnership with industry for the reasons that you have set out clearly in your paper. The question I should like to ask you relates to a kind of indirect analogy. One of the problems, for instance, that the MRC found with its clinical research centre, which it is now in the process of closing, was the lack of association with the university which made it difficult, for example, to obtain things like doctoral postgraduate studentships. If something like a Faraday centre is created do you think that this would make a contribution in the longer term to the concerns that many young scientists have about their career structure in a diminishing market for scientists where all too many of our graduates in physics and in other sciences are going out into the financial field rather than carrying on in science? Attempts have obviously been made in the past by schemes like the new blood lectureships to try to create a better career structure. Do you think that the development of this kind of institute attached to university in partnership with industry will create a better career structure for scientists?

(*Dr Edwards*) If I may perhaps start, my Lord Chairman, one of the problems about attracting students into research and research degrees is the fact that the personal grants they receive are very low, but it is much more than that: it is the prospect of employment. I think there are problems on both sides. The academic world is being squeezed and jobs are not very plentiful. I feel also that in industry there is perhaps not a good enough career structure for scientists and engineers very often.

Chairman] We must now draw this part of the proceedings to an end, but Lord Porter has a quick point before we do so.

Lord Porter of Luddenham

224. My Lord Chairman, thank you. I want to bring up a point where you do differ completely from CEST. You have been very clear that your first priority for a Faraday centre of this kind would be that it should be associated with the university. CEST say no, and they gave one or two reasons. The principal reason was that they believe that small and medium sized companies are uncomfortable talking to university professors, whom they find very hard to understand, from something said a couple of days ago, and they will approach an independent organisation which is not an academic institution more readily. Do you think that there is any truth in that?

(*Dr Edwards*) My Lord Chairman, I think that there may well be some truth in that, but I think the answer is not to set up a Faraday centre but to develop schemes or clubs for research associations using the context that they do have with the research and technology organisations.

(*Professor Roberts*) You can also form managing director clubs based in a university to try to provide a user friendly face.

225. But it is true, is it not, that it is lack of pull by business as well as perhaps lack of push by universities that makes this gap? The case has been made that one of the reasons is that they do not find the universities very easy to approach.

(*Professor Roberts*) It is also worth mentioning perhaps, my Lord Chairman, that the way one progressed in the university to become a Fellow of the Royal Society was through engaging in large international projects or programmes with a large national dimension. Fewer brownie points were earned perhaps for linking in with smaller companies and local companies. Those attitudes have I think now changed. The regional office to which I have referred in Sheffield has certainly has transformed the situtation. We now have a nice shop window and a much more user friendly link with the local industries. With regard to the concern that was expressed about students staying at home, when it comes to postgraduate students—I am not sure what the figures are—a large number of postgraduates, probably the majority, do tend to go to an institution other than their home based institution.

(*Professor Fender*) If I may just come in very quickly, my Lord Chairman, there may be some barriers still to overcome, but the barrier to which the noble Lord Lord Porter referred has not stopped the teaching company being successful and that has a high proportion of small companies involved.

Chairman

226. And a final quickie from me, if I may: in the light of all you have said and all that has been proposed do you consider that university industrial relations and schemes to encourage them and so forth ought to be the business primarily of the DTI or primarly now of the OST?

(*Dr Edwards*) I have to say, my Lord Chairman—it may be that this is a slick answer—that I think both have to be involved because the DTI can do much more on the industrial side, of course, than the OST can; and the OST will handle the support of science activities in the universities very largely. Professor Roberts is more intimately concerned with these matters than I am.

(*Professor Roberts*) My Lord Chairman, one of the faults of government has been that there has not been enough togetherness between different government departments. I do believe that this will improve when

[Chairman *contd.*]

the white paper is published and that there will then be encouragement for the Chief Scientists to form a much stronger club within government, so that collectively the Department of Health, of Transport and others provide more strategic direction to whoever it is, the DTI or SERC. Such change, I think, automatically encourage the formation of the type of institutes and the type of collaborations referred to in these documents. I am sure much more strategic thinking of that kind would be helpful.

227. Thank you all three very much. It has been helpful. You have been very frank with us, and that is also helpful.

(*Professor Roberts*) My Lord Chairman, may I add just one other comment about the Fraunhofer institutes. We have not said much about them this morning. I will be very brief. In a former existence I believe that all three of us were very active researchers in different fields. However, not one of us has ever been to a Fraunhofer institute. We have though all been to a Max Planck Institute in Germany. I think that says a great deal; that is we do not see them possibly as being the research oriented groups that one might be led to believe by reading the papers.

Chairman] That is a very good parting shot. Thank you very much.

A Memorandum from AIRTO will be printed with the Committee's Report

Examination of witnesses

DR B G SMITH, OBE, President of AIRTO, Chairman of Smith System Engineering Ltd, MR M J ROUSE, Member of the AIRTO Executive Committee, Managing Director of WRc plc, and MR J A BENNETT, Secretary General of AIRTO, called in and examined.

Chairman

228. Thank you very much for joining us. We are looking forward to your oral evidence. You have given us a policy document, which is very helpful. The first question that we have come round to putting to all our witnesses goes something like this: we already have a large number of schemes/links/bridges between universities and industry in this country, some say more than any other country—and I think you have said that. Why therefore is it necessary to create a new scheme, a new set of links, according to slightly different rules from the ones that already exist? If there is going to be any extra money, which is better, to put it into a new scheme or to back the schemes we have, some of which seem to work better than they have so far been credited with. That is the first question I should be grateful if you would address. You may very well want to make some introductory remarks of your own. I should merely ask you to bear in mind that that is the first question in doing so.

(*Dr Smith*) My Lord Chairman, may I first introduce us and then address your question afterwards. First of all, here today we are representing AIRTO, the Association of Independent Research and Technology Organisations. That is the trade association in the United Kingdom which represents industrial contract research companies, so-called research and technology organisations. We have some 36 member companies in AIRTO. Between them they have some 10,000 or more employees and a turnover of between £300 and £400 million. Those statistics give you some idea of what AIRTO is about. I am the president of AIRTO. I am also the chairman of an independent research and technology company. My colleague, Michael Rouse, is a member of the executive committee of AIRTO. He is the managing director of WRc plc, the water research company, which is an independent research and technology company. As you may know, WRc is one of the five companies participating in the DTI postgraduate training partnerships. John Bennett is the secretary general of AIRTO but also in the past has been the chief executive of a research and technology organisation. To come now to your question, my Lord Chairman, I think that if one looks at the characteristics of what is proposed for the Faraday centres they have two main pillars. One is an educational pillar and the other is the principle of untargeted funding to enable them to maintain their technology base. If one looks at how these two things are involved in technology transfer, which we understand is what the game is all about, bridging the gap between academia and manufacturing industry, there are two mechanisms of technology transfer, both of which take place within people. One is the actual physical movement of people who have acquired skills and who then go out into manufacturing industry carrying their skills with them. That is one very powerful method of technology transfer. A second method is that which is employed in the normal business operation of a contract research organisation where individuals within the organisation itself work for a number of different customers in different sectors of industry and transfer technology horizontally between different sectors of industry. The educational aspect proposed for Faradays is clearly associated with the technology transfer of people through and out of the institution, the Faraday centre. The untargeted funding aspect is associated with the accumulation of expertise within the Faraday centre which the people working within the centre themselves then apply to customers in many different parts of industry. The characteristic of the proposed Faraday centres is that they would be very efficient organs for carrying out these functions, more efficient than organisations that exist at the moment.

229. More efficient, for example, than LINK schemes or CASE studentships, to mention just two?

(*Dr Smith*) Yes, my Lord Chairman, we believe so. Let us just look at them separately. CASE studentships: in a sense the training aspect of the Faradays would have CASE-like characteristics.

[Chairman *contd.*]

They would go considerably beyond what the CASE system does, of course, but they would have CASE-like characteristics. Indeed, one could imagine that CASE students could form part of the Faraday. As far as LINK is concerned that is a rather different case. LINK is one of the many DTI schemes which have their merits but which are based primarily on a subsidy of some sort to eas the progress of something that might in an ideal world have happened automatically. In the Faradays by use of the untargeted funding mechanism we are trying to do something which would not necessarily have happened automatically.

230. Do I understand—and I do not want to hog all the questions; I am sure my colleagues will start butting in at any moment—from what you are saying that the great benefit from the Faraday proposal from your point of view is the element of untargeted funding?

(*Dr Smith*) We believe that that is a very important element. I think I said at the outset that there are the two pillars. One is the educational one and the other is the untargeted funding one. We should treat them with equal importance. If one speaks to people in the Fraunhofer organisation I think that they would answer in exactly the same way.

231. If I may persist with this just for a moment, because it is important to try to find out exactly what attracts you, the educational element is taken care of if it can be taken care of by such things as CASE studentships and by all sorts of informal arrangements that universities have with local industry already?

(*Dr Smith*) Yes, my Lord Chairman.

232. So, all right, the Faraday centres would have that as an element also, but it exists already. What remains therefore is the untargeted funding. I am not absolutely clear that even that is new because there are arrangements between universities and industry with agreement to collaborate on certain projects or groups of project, programmes which they have somehow arranged themselves and they have arranged in such a way that there is some free money, some untargeted funds, provided by industry perhaps, by a research council perhaps.

(*Mr Rouse*) My Lord Chairman, I wonder whether I might add something else. It seems to me that what Faraday has to offer which is really what Fraunhofer is offering is the ability to have the intermediate institutes, whatever you are going to call them, having intimate knowledge of the industries that they are serving and having very good knowledge of the universities and having good links with them now, and being able to focus better so that there is much more likely to be transfer of people with successful projects at the end of it, which is partly training, partly technology movement. I think that we are talking about the process here of getting good people into manufacturing industry through the academic route of science and technology. If you look at the German scene with Fraunhofer it puts a lot of very good technical and scientific people at the head of the industry, and I think that Fraunhofer is quite a big component in that.

233. Fraunhofer institutes are sited at universities, not at intermediate institutes.

(*Mr Rouse*) That is true, my Lord Chairman, but they do actually operate very closely with industry and they are a separate body in their own right. Indeed, if you take AIRTO being the trade association for the United Kingdom and if you take the trade association for Europe, EACRO, Fraunhofer is one of the members of that. In that sense therefore they are behaving like intermediate institutes.

Lord Porter of Luddenham

234. The question that is bugging me all the time in this, my Lord Chairman is, why are you not supporting your own 36 companies as the answer to these problems? Why are they not filling this gap? Why are they not—and some of the research associations used to do this—the intermediate bodies that you are thinking about? We have those intermediate bodies between universities and industry and now we are going to put yet another one so that there will be three bridges. Why can you not do the job?

(*Dr Smith*) My Lord Chairman, the existing RTOs do do the job to some extent and are exceedingly successful in doing it. Indeed, their primary business is providing contract research services to manufacturing industry. Also many of them are closely involved with the universities in the training activity.

235. So what is the problem, that you do not have untargeted funding? Can you just tell us about this £300/£400 million, roughly where it comes from and how much of that comes from industry?

(*Dr Smith*) On the statistics I will pass this over to Mr Bennett.

(*Mr Bennett*) My Lord Chairman, 80 per cent of this money comes from industry, 10 per cent from United Kingdom Government sources and 5 per cent form the European Commission sources.

236. So is that not enough from government sources? Do you need more money for untargeted funding? What is the problem of building yourselves up into intermediate organisations of the kind one wants?

(*Dr Smith*) My Lord Chairman, it is necessary to maintain the technology base of RTOs and in order to do that RTOs use a certain amount of their profit for ploughing back in, a few per cent usually. They also glean expertise from carrying out contracts for their customers whether they be industrial customers or government customers which they can then use in the future for some other customer. However, the general view is that that is an insufficient source of expertise to maintain the technology base in the long term. If I may come back to the Lord Chairman's point on untargeted funding we do believe that the untargeted funding element of the proposal is very important in that respect.

237. I am sorry, but just for clarification, what do you mean by untargeted funding? What is missing from your own RTOs that would turn them into having sufficient untargeted funding—more government money, is it as simple as that?

[Lord Porter of Luddenham *contd.*]

(*Dr Smith*) Not necessarily more government money but government money with different conditions associated with it. Funding which comes from the DTI at the moment is earmarked for particular projects. The money that the RTOs spend from their own budgets out of their own pockets for maintaining their own technology base is untargeted in a sense because clearly they spend it on what they want to. The meaning of the untargeted funding that we speak of here is government funding that is not earmarked for specific projects.

238. I fully understand, but why is it necessary to set up a different set of organisations to have untargeted funding? If money is coming into the same kitty why does it not come to you?

(*Mr Rouse*) Indeed, I do not think that we are talking about additional institutions, my Lord Chairman. I think that we are talking about a process here rather than an institutional body. We are talking about the process of improving the movement of people and technology. In the case of my own particular company we receive no untargeted funding at all. Everything we do untargeted comes from our profits. But I believe much more strongly that the basis for any untargeted funding should be success. If you take the Fraunhofer institutes they do not get it unless they are successful, and the poor ones go to the wall, and that is how it should be.

Chairman] I think that your attitude is very clear.

Lord Walton of Detchant

239. My Lord Chairman, perhaps I may ask you four brief and rather precise questions. This is to clarify my mind about your organisation. With regard to the 36 companies, is their number increasing or decreasing? Are new ones being established and have any closed? Secondly, in relation to the recruitment of scientists to the staff of your companies are you in a position, any of you or all of you, to offer tenured posts to young scientists of quality and are you able to recruit people of high quality and what proportion of those are physicists and engineers? Lastly, do many or indeed all of your organisations have links with universities? They all do? Yes, thank you.

(*Mr Bennett*) My Lord Chairman, I will provide the facts. You asked about the numbers, my Lord Chairman. There have been amalgamations in RTOs and two have gone out of business in the last three years due to the economic recession. Do you want me to deal with recruitment?

(*Dr Smith*) Perhaps I may say something about recruitment, my Lord Chairman. You made a point about tenured posts, I think.

240. Yes?

(*Dr Smith*) RTOs are commercial organisations and they have contracts of employment with their staff.

241. Exactly, yes.

(*Dr Smith*) So they are not tenured posts in the sense of the universities. You asked also about our ability to recruit staff.

242. But it is a career structure with a certain degree of security, an element of security?

(*Dr Smith*) Yes, indeed, as would be normal in any other commercial business. You asked about our ability to recruit staff of the right quality. Recruitment is always a difficulty, but I should think generally that by assiduous activity RTOs are able to recruit the staff that they need.

(*Mr Rouse*) My Lord Chairman, we are recruiting constantly even now, though not as such a high level as we were. Of the recruitment over half would be engineers, physicists and mathematicians.

Lord Renwick

243. The submission that the AIRTO gave us last July, I see, mentioned the reason to believe that "the existence of the Faraday centres would free institutions to carry out their true task of academic research unconstrained by the needs to seek industrial collaboration to obtain funding". I should be very grateful if they could describe which academic institutions they mean—presumably it is universities. I believe that most people believe that universities have had enormous benefits from industrial collaboration, but perhaps there are ideas on true academic research which would interest us?

(*Dr Smith*) My Lord Chairman, I think that universities have a particular purpose. That purpose can be enhanced by the contacts that many have developed with industry. The point that we have in mind here, I think, is that we are concerned that universities might be pressed into becoming more contract research organisation oriented than they would wish to be for purely financial reasons. If they wish to carry out contract research in order to provide intimacy with industry for the feedback that that would give them to the selection of their research programmes and to improve the teaching of their research students, that we should see as a very good thing. However, if they are forced into being contract research organisations purely for the purpose of obtaining funds, then that we should see perhaps as unfortunate. The point that we make in our paper, I think, is that if the relationship between universities and the RTOs were formalised in the way that is proposed in the Faraday programme that would actually free up universities outside the programme perhaps and allow them to behave in a way that we should think more satisfactory.

Baroness Perry of Southwark

244. My Lord Chairman, I find that argument a little hard to follow. You suggest, I think, that the purpose of this untargeted money would be to anticipate market needs—I think that is the phrase you used in your letter. Can we just describe how you would see it working? The university would have some money from government to perform some untargeted academic research, yet this would be anticipating market needs. How then would the transfer of what the university had done in its research to any kind of value and use to British industry take place?

(*Dr Smith*) My Lord Chairman, I think that there is a closer intimacy between the university activity and the manufacturing activity which goes on in a Faraday centre than is implied in the question. One is

[Baroness Perry of Southwark *contd.*]

considering, I think, research and the development of technology which is going on in the Faraday centre which has close university involvement, has close manufacturing involvement. The generation of the new ideas, the new technology, much of that is actually happening in the Faraday centre itself. It is happening as part of the or in close association with the carrying out of contracts for industry. The management of the Faraday centre would be such as to steer the activity very much towards what the market does need or will need. In connection with what the market will need as perceived by the managers of the Faraday centre from their understanding of industrial demand and the way in which industrial demand is likely to go, so they would use the untargeted funding to develop the skills that they believe are not necessarily needed today but will be needed tomorrow.

245. Is that not targeted in a different sort of way? I think that most academics would understand that would be research that was still governed and targeted by the needs of the industry with whom they were working. It might be in a looser sort of club formation within the Faraday centre context, but it would not be free academic research in the sense that they would be told to go away and do whatever they felt like?

(*Dr Smith*) The noble Lady is entirely right, my Lord Chairman, the excess of any money would be targeted, but it would be targeted by the managers of the Faraday centre in anticipation of what they thought their market would want tomorrow.

246. But is that not what already happens within AIRTO?

(*Dr Smith*) As far as the money that AIRTO companies themselves spend on their own research programmes that is exactly what happens. But with regard to funding that comes from Government, that the companies are not free to use in the way we described.

(*Mr Rouse*) Perhaps I may add something, my Lord Chairman, that I think is terribly important. I come back to the process again. I think it is wrong to assume that universities do one thing only and AIRTO members only do another. There is in fact an awful lot of overlap. It is how we can get the best integration of that to make it work. If you take Fraunhofer, I know that they are located in universities, but quite a lot of work is done in industry. If you take the trial that we are doing with Imperial College some of the students will spend more time with us the project than at the University and the benefit of that is achieve better integration than existed before. Also the students to work with others within our organisation who are living a wholly commercial life so I think that they become very much more commercial and very much more focused on the needs of industry. This is very helpful.

247. In the new universities the concept of part time students who are employed within your industries who are working for their doctoral theses on topics that have been identified by their employers in industry create that model without any additional government funding whatsoever?

(*Mr Rouse*) I should come back to the knowledge that is needed of those industries and the focusing that can be applied with that knowledge. To my mind that is where there is a need for support of the process. There is the management effort and the selling to be done. It is a selling process at the end of the day to get it right, to get industry involved and to get industry really to want to take it up, and they take not only the technology but also the people because the best transfer is on the hoof.

Chairman

248. May we be just a little clearer on one small point. If there were a fixed sum of money coming from government to do the things about which we are talking are you saying that you would rather a proportion of that be spent on untargeted activities, that is to say, activities targeted by the management of the institutions themselves? What you are really asking for in backing the Faraday centre proposal is that some of the government money should be freed?

(*Dr Smith*) That is true, my Lord Chairman.

249. And if it were freed, if it could be agreed that there could be a 10 or 20 per cent contribution, free money, not extra, but out of what is already given. Would you then say that you did not mind what route it came through, that it did not have to be Faraday centres, it could be something else? Is it the free money that you are really after?

(*Dr Smith*) As far as that aspect is concerned, my Lord Chairman, that is true.

250. Thank you, that clarifies things quite a bit.

(*Mr Rouse*) My Lord Chairman, it could well be that you need to have something called Faraday. One of the problems is that we need to give the general public very much more publicity on the need for industry.

251. That is a different point.

(*Mr Rouse*) I think that it is an important point, my Lord Chairman. I think that it could be built on existing RTOs because they are doing that job in that context.

Lord Kirkwood

252. My Lord Chairman, there are two points that I should like to ask. First, would the panel of witnesses agree that the culture of the RTOs and IROs is essentially a firefighting one and that the problems that they tackle are by and large technical ones thrown up overnight by industry and require rapid solutions, and that sustained long term research is not the main preoccupation of these organisations? Novel ideas are not initiated and developed at IROs and perhaps therefore this is the wrong soil to plant the seed of a Faraday centre; the culture is wrong. Maybe the solution to this is therefore that it is a necessary condition that only those RTOs that are close to universities, old and new, are the ones that might successfully develop into Faraday centres where you can get the right sort of informal contacts between staff and research staff and managing staff between both institutions. I am sure that we are all aware that it is the informal contacts in coffee room where the real problems

[Lord Kirkwood *contd.*]

come out and some of the bright solutions are generated; in other words, proximity to a university could be an essential part of the success of such a Faraday centre if it were to be centred within an IRO?

(*Mr Rouse*) My Lord Chairman, our experience in the trial so far is that that is not the case. If I may start from your premise to begin with certainly my own organisation is not in firefighting. We have had programmes that have been tackling some major longer term things for the water industry. There is always an element where the problems are more immediate, but you have to find a temporary solution and then you are looking for some longer term technology that will give you a better so you are covering the whole spectrum. The beauty is that you get better feedback and better definition of what you are trying to do. The experience, if I may just come on to the ideas, that we have had with these trials is that with the various groups from Imperial College together with ourselves—and it involves five Imperial College separate departments which I do not think have worked quite in that way before, mechanical, civil engineering, chemical engineering, there is a management unit and the centre for analytical research for the environment, and they are all working together on this. The brainstorming that has taken place within those departments with our own people, I should not like to say who threw up most ideas, but I know that a lot of them came from our people as well as from the universities.

Chairman] For the record I have to declare that both Lord Porter and I are rather closely connected with Imperial College.

Lord Kirkwood

253. It seems to me you are saying we do not need Faraday centres, it is working as it is now?

(*Mr Rouse*) No, my Lord Chairman, this is the trial.

Lord Kirkwood] The trial, oh, I beg your pardon.

Lord Whaddon

254. Dr Smith, you do not appear to suggest untargeted funds for any of your own people. Does this mean that you think that independent organisations are not able to use untargeted money effectively and, if they were, how would their efficacy be measured?

(*Dr Smith*) My Lord Chairman, I am sorry if I gave that impression. I think that RTOs would be very pleased to receive untargeted funding right now.

255. In that case why do we need Faraday?

(*Dr Smith*) Faraday is a package which includes a number of elements. Although the individual elements could perhaps be provided separately it is a good proposition for stitching them all together in an effective way.

Lord Porter of Luddenham

256. I must say, Dr Smith, that we have discussed two, three or four of these elements, but each one has more or less disappeared—when we have looked at the education one, when we have looked at untargeted funding and so on. It seems it has been possible to replace each of these by other means. To say it is a package, therefore, it is a package of nothing when you look at what is in the package.

(*Dr Smith*) It is a package of things which all could be done individually by other means.

257. Right.

(*Dr Smith*) I suppose in some sense that must be true.

Chairman] Perhaps it makes it easier to deal with them all in a package than separately through different mechanisms. I think one could argue like that, and I think that is perhaps what you are saying.

Lord Renwick

258. My Lord Chairman, Mr Rouse and others have said that there is a lot of overlap between the RTOs and the universities. I come from less than an academic university world than the RTO world, which I know a little about, and I do understand that that overlap sometimes comes from a duplication of the sources or abilities with a much lower base of overheads on the university side than for RTOs in many cases. I do not know whether that comes into your thinking. Universities have said to us that another structure is probably unnecessary but mechanisms, especially to bring small and medium sized enterprises into the benefits of science and technology, are something—is that what you are really saying, that the Faraday centres you see as a mechanism rather than as a structure?

(*Mr Rouse*) My Lord Chairman, I believe that there is a large element of that. It is the process which is important. If you look at the German process it does seem to work very well.

Lord Walton of Detchant

259. My Lord Chairman, perhaps I may follow up that point. It has been suggested to us from various sources, I think, that it is more likely that the small and medium sized enterprises will come to a research and technology organisation than to a university if they seek advice. Do you believe that that is so and, if so, why?

(*Mr Rouse*) I think generally yes, my Lord Chairman. I think they will come partly because historically they have done so; that is one thing, but I think that it is much more than that. I think that they feel they are going somewhere where people understand their problems and where they have a good understanding of their industry, their needs and their requirements. This has been built up over many, many years and there is a lot of mutual confidence and respect across those boundaries. I think that there are two other elements as well, my Lord Chairman. They know that an RTO to survive has to deliver to price and cost. I think that also an RTO has to be able to work in confidence very often. Some of the work that we are doing for industry now we actually partition off within the building because they need to have confidentiality, but this is much further towards the product end than at a University. That is not what we are talking about in Faraday. Nevertheless, that is the case. I think that often they feel that because university departments' main purpose is education obviously they need to be leaky.

Chairman

260. It may help our witnesses, I think, if I explain where our concern really lies. This has come to the front from other enquiries that we have held. The British Government spend on civil research and development and its support rather less than competitor countries do, but British industry spends much less on civil research and development than competitor countries do. I think therefore we are a little puzzled to hear people from industry saying that what they want is extra money from government to do the things that they want to do. Why don't you pay for it yourselves?, as they would in other countries. I think that this is where our basic unhappiness with all this comes from, let me come clean with this, and it has arisen over quite a large number of enquiries that we have done in the last 14 years. You might like to comment on that in the context of what we are supposed to be talking about.

(*Dr Smith*) My Lord Chairman, if I may answer that first, it is certainly a very good question, but it is one that you should address primariy to manufacturing industry. If you address that question to the contract research sector we will say that we are investing as much as we can in the expertise that we need to do our job, so please do not ask that question of us because we are already doing it.

Lord Porter of Luddenham

261. Would you not indeed say that you are a shining example compared with the Fraunhofer institutes: they get 27 per cent from industry directly, you get 80 per cent?

(*Mr Rouse*) Yes.

262. Why destroy something that is so successful, or even compete with it?

(*Dr Smith*) If I may just answer that, my Lord Chairman, I believe that we could be even better than we are.

(*Mr Rouse*) I do not think that we are destroying it; I think that we are adding to it. If I may come to your point, my Lord Chairman, my feeling is that the reason that industry is spending so little is that there are so few people leading those companies who have the technology base. They are accountants or lawyers. If you look at the German scene they are often technologists. Therefore, they are much more comfortable investing in research and development. I think that what we have to do is to get that process working so that we get good people through to running our industry who are technologists. I believe that the Faraday concept could help that.

263. I am sorry, my Lord Chairman, but we have turned the thing on its head. My point was that you are being successful; you are attracting 80 per cent of your funding from industry and it is a lot of money, £400 million. The Fraunhofer institutes are not and they are even going down in the amount that they already get, which is only 27 per cent.

(*Dr Smith*) But I believe that we have a strategic concern and that is that in fact the technology base of the sector is running down. We do not feel that the amount of our own funds that are being ploughed back into our own facilities are enough in the long term.

264. So that if you were to receive untargeted money would that help to stimulate more private money?

(*Dr Smith*) It would do, my Lord Chairman, yes.

Chairman

265. I think we have given it a very good run around. Are there any quick points that anyone would like to make either among our witnesses or my colleagues at the table?

(*Mr Bennett*) My Lord Chairman, perhaps I may come in on a point that Lord Kirkwood made in his opening remarks. He talked about the culture of the RTOs as one of firefighting and not one of long term research. I think that that has perhaps happened, but it was not always true. If one goes back into the history of the RTOs they produced at least one Nobel laureate and a number of fellows of the Royal Society. I think that this is really a function of the decrease in funding that used to be available from government for untargeted research that is no longer available. If industry is now supporting the RTOs to the extent of 80 per cent of their income and, as you have said already, industry tends to be run by accountants and some of these have a fairly short time horizon, they are going to demand firefighting services rather than longer term services. I believe that we do need more untargeted research so that we can build up our stock of technology that we can use for firefighting and for other purposes.

Lord Kirkwood

266. So your option would be for untargeted money rather than for Faraday centres?

(*Mr Bennett*) Another thing that attracts me very much, if I may, my Lord Chairman, about the Faraday centres that perhaps has not really come out in today's discussion. I think it is a way of merging two very important cultures both of which I believe are necessary for the survival of the United Kingdom industry. I think that the Faraday centre can get the best of the scientific advice and technology knowledge that it requires, but as it is based in an organisation that has to earn its living by totally commercial activities I think the postgraduate product of the Faraday centre will be versed in both good technology and good commercial practice. If we cast our minds back to the first Zuckerman lecture recently where the German minister of science was asked why good people go into engineering in Germany, he turned round and said, look at the chief executive of Siemens, the chief executive of Mercedes, the chief executive of Bosch—they are all technical people. I should hope myself that the Faraday centres would be a training ground for future chief executives of important industrial companies. I think that we have the right ingredients for it.

Chairman

267. The German ambassador makes a real contribution to the life of this country, and I am glad that he does. You do raise one point that I think I have to take you up on before you depart. That is to do with who should run the Faraday centre scheme—not the individual centres, but the scheme as a whole, creating centres and so on. It could be CEST. They

[Chairman *contd.*]

thought of it, or did not think of it, but backed it. It could be the DTI. It could be the new Office of Science and Technology, I suppose, or it could be you. Maybe it could be others—the research council. Who do you think should be in charge of the programme, setting up and maintaining the system of centres?

(*Dr Smith*) There are two jobs that need to be done at different levels, I think, my Lord Chairman. One is the strategic oversight that needs to be given to the whole activity, indeed, a Faraday programme in the bigger context of the United Kingdom science and technology policy. That is one job. A second job that needs to be done if government funds are being disbursed is the actual disbursement of the funds—the secretarial with a capital 'S' job. As far as the strategic oversight is concerned AIRTO believes that no satisfactory body exists at the moment which is the reason why we have been proposing this idea of an IRTC, an industrial research and technology council, which would do for that side of government funding of science and technology what the academic research councils do for the HEIs. We should see that that body would involve government and industry and academia. As far as the lower level activity is concerned of the handling of the disbursement of the funds, that could be handled by a government department or, indeed, it could be handled by a contractor if that is the way that government wanted to handle it. If one looks at what AIRTO might do I think AIRTO's primary role, given that it is a trade organisation with no pretensions to be anything more than that, is to have an important role as the co-ordinator of a network of intermediate institutions to provide geographical coverage throughout the country.

268. Thank you very much, that has been very clear. You have all been most helpful. Thank you for coming.

(*Dr Smith*) My Lord Chairman, thank you for giving us the opportunity to give evidence.

Printed in the United Kingdom by HMSO
Dd 0502959 C6 1/93 206639 PP

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FARADAY PROGRAMME

Tuesday 8 December 1992

The Rt Hon Michael Heseltine, MP

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TUESDAY 8 DECEMBER 1992

Present:

Dainton, L.
Flowers, L. (Chairman)
Gregson, L.
Kirkwood, L.
Perry of Southwark, B.
Platt of Writtle, B.
Porter of Luddenham, L.
Renwick, L.
Tombs, L.
Walton of Detchant, L.
Whaddon, L.

Examination of witnesses

THE RT HON MICHAEL HESELTINE, Member of Parliament, President of the Board of Trade and Secretary of State for Trade and Industry, MR EDWARD LEIGH, Member of Parliament, Under-Secretary of State for Trade and Industry (Minister of Technology), DR G ROBINSON, Chief Adviser on Science and Technology, and DR A KEDDIE, Head of Innovation Unit, Department of Trade and Industry, called in and examined.

Chairman

269. President, Minister, Gentlemen, you are very welcome. We are very grateful to you for coming. I think, Mr Heseltine, that it is your first visit to this particular select committee?

(*Mr Heseltine*) My Lord Chairman, I have visited other of your Lordships' committees but I think it is the first time on this one.

270. You are all the more welcome for that. It has been agreed with you, I think, President, that we will first of all talk about the proposed Faraday programme because that is what our enquiry is about, but then, if you care to engage in a little conversation with us about innovation in manufacturing industry on which a couple of years ago we published a report, we should be grateful.

(*Mr Heseltine*) I shall be very pleased to take part in such a dialogue, my Lord Chairman.

271. I will sort it into the two halves, if I may. No doubt, President, you would like to make some introductory remarks and introduce your colleagues. However, may I ask you to bear one particular problem in mind; it turns out to be the problem with which we are really trying to grapple. We are all agreed that innovation is important. We are all agreed that better links between universities and industry are highly desirable and, of course, we are very interested in what you are going to do to stimulate that. What we are not convinced about at the moment, however, to be frank about it, given all the schemes that already exist for encouraging those links, is whether there is a place for yet another programme and yet another scheme called Faraday centres. What could the Faraday centres provide that the others would not? Would it be preferable if there is any fresh money going to back the older schemes better rather than create a new one? If you could deal with that in your introductory remarks we should be very grateful, President.

(*Mr Heseltine*) My Lord Chairman, it is a great pleasure to be here. As my colleagues are very clearly labelled I think that it is not necessary for me to introduce them to you. However, I should like to address head on, the first question that you put to me. When I arrived at the Department of Trade and Industry, which was more or less coincidental with the arrival of Dr Robinson, we discussed the commitment to Faraday type activities and we very rapidly came to two conclusions. First of all, within the Faraday concept we concluded that there was a philosophy that we thought was very important; and, that having been said, it was not something that should be applied as a limited add-on to the many schemes and centres of activity currently in existence. It was much wider and instead therefore of pursuing another initiative, we should actually step back and examine the philosophy of Faradays across the horizon of the research and development activities, not just of our department, but even more widely than that. I think therefore in a sense, as I understood your opening question, my Lord Chairman, because it had an implication in it and, indeed, a very explicit statement, that I agree with your judgment. I do not think that there is a case for trying to set up a new organisation called Faraday Centres. It is not my intention to proceed with that specific initiative. I think that there are much wider opportunities, and those are where we are focusing our attention.

272. That is very clear, President, thank you very much. I am just wondering whether we should turn to the other subject immediately! However, rather than our doing that, I wonder whether you could perhaps say in a little more detail what you have in mind to do?

(*Mr Heseltine*) I can in a way that I hope is helpful, my Lord Chairman, but I am conscious also that it is not as helpful as I should like to be or hope one day to be able to be. We do have a wide ranging review under my colleague, the Chancellor of the Duchy, into government research and development and we, who are the possessors of only a limited research and development budget within the Department of Trade and Industry, have asked William Waldegrave whether we can help in any way with the review that he is conducting. He has been very helpful and Dr Robinson is now in constant touch with the work that is going on there in the preparation of the White Paper. It is there really that we see the answers to the sort of questions that your Lordships will want to put and the ones that we are putting. What we are at the moment doing is trying to put our proposals and our

[Chairman *contd.*]

ideas into that review. It will not surprise your Lordships where the Department of Trade and Industry's approach to these matters will be: it will be about wealth creation and the exploitation of scarce scientific resources. There are many other issues to be balanced against the views of my department, but there is no doubt at all where my department's approach to these matters lies. That is the work that Dr Robinson on the department's behalf is now conducting.

Baroness Perry of Southwark

273. One of the questions that have obviously occurred to us as we have looked across the scene in the last few weeks has been the relationship between your own department and OST and the other government departments that fund research very substantially. Evidence that we received from the Committee of Vice Chancellors and Principals suggested that the Government Chief Scientist might perhaps chair a sort of club with someone from your own department and other representative departments. How would you describe the relationship between yourself and OST in future in respect of scientific innovation? Could you set a map for us?

(*Mr Heseltine*) Yes, my Lord Chairman. At this moment the dialogue that is going on is exploratory. The OST is responsible for drawing together the views of governments and presenting this in a White Paper. They will be consulting very widely; certainly they are consulting us very widely. As your Lordships know, before the White Paper can be published it will have to secure collective assent from one's colleagues in Government. So we are obviously trying to play our part in influencing the drafting. As a member of the Cabinet, I will in the end be involved in the collective judgment of the draft when it is put before colleagues. As far as the relationship between the two departments is concerned, it is exemplary. Mr Waldegrave and myself had a lengthy meeting with our officials in order to go over the ground. Dr Robinson is in fairly frequent contact and you might like to ask him for more specific details of that. However, as someone who is interested in this subject I have kept pretty closely in touch and my total satisfaction is based on the fact that at this moment I believe that we are at the centre of a process. The process, as I say, will represent the views of other departments besides my own. We will be in there with a view to maximising the exploitation of the science base.

274. Perhaps I may ask just one supplementary, my Lord Chairman. May I press you on whether you would see OST as having a co-ordinating role that would include the co-ordination of your own department?

(*Mr Heseltine*) Yes, I have for a long time, and I once wrote a memorandum inside Government in 1984 saying that as you are dealing with the allocation of scarce resources you have to try to have a common set of standards by which to judge the product. It was not enough, I argued, to have a pot of money Government Department by Government Department, which Departments then sought to use as they themselves thought right. You had to be able to have common standards, measurement of output, to see whether the priorities that determine the size of the pot were in fact being applied. Otherwise you could just roll forward last year's programmes with a bit of bidding and a bit of special pleading and all that sort of thing. I have therefore always believed that there was a need for this external discipline that can only lead to some central point in government, the custodians of the discipline, and it is now the OST. That is fine by me, it seems to be essential that it should be, and it does mean that they will be expecting me departmentally to account for the money that I have. My only concern is that I should account for it to the same disciplines as other people. It may help your Lordships if I explain how I first got into this matter because it reveals the practical background. I was Defence Secretary. It is well known that the Defence Secretary has creditors in every direction, broadly called the civil science base, who are trying always to move research and development resources out of the Ministry of Defence into every other department aided and abetted by the Treasury. In order to try to stop the defence budgets going up they try to get it out of the Treasury, so it is a very formidable alliance that you face against you if you are Defence Secretary. I argued that it was very desirable that there should therefore be some measurement as to what they would do with the money that was more effective than what I was doing with the money. That was the point at which the conversation failed to make progress.

Chairman] Lord Walton, would you like to come in on SMEs?

Lord Walton of Detchant

275. Yes, I should, my Lord Chairman. We have had a lot of evidence to suggest that we have not been good in this country at exploiting the results of our inventions in a commercial sense. There have been many instances where major inventions have been developed and they have not been effectively marketed and have then been taken on by other countries. I remember, looking back to my days on the Medical Research Council, that the National Research and Development Corporation (the NRDC was supposed to have exactly that function of exploitation). The evidence that we have received suggests that the link between universities doing basic research in the physical sciences and large industrial companies has improved. But where we seem to have a problem is with the small and medium sized enterprises. When we took evidence from the Association of Independent Research and Technology Organisations, of which there are 36 throughout the country, they said that the small and medium sized enterprises tend to go to them rather than to the universities when they want some research done. The question we wish to put to you is whether you see a means of overcoming this problem because there are so many things in universities that could help these small enterprises if appropriate links could be created and established more firmly. We wonder whether a variation on the LINK scheme might be devised to meet this problem.

[Lord Walton of Detchant *contd.*]

(*Mr Heseltine*) My Lord Chairman, I am not against special schemes if there is a special requirement, but I have a caveat, and that is that it is quite easy to set up a special scheme that is usually fairly small, and you believe that you have addressed the issue, whereas what you have done in fact is to put a fairly small scheme into a very large horizon. What we really ought to be concentrating on is changing the culture across the whole interface of the wealth creating process. One of the things that we are doing in the Department now is to try to analyse the horizon in each of the particular fields in which we are interested, to see how we can interface, comprehensively with the various objectives that we have. Your Lordships may have noticed an announcement that we made just last week about the one stop shops. That is, to take those advisory bodies that interface with the private sector from the public sector that are disparate and widely spread and not co-located and to try to bring them all into one common point, co-located, each town and city with its own point; and not only just co-locate, but then to go into a proactive role where you actually approach companies, instead of waiting for those companies who happen to approach you, in order to make available to them—you could say sell to them—the services of Government or the CBIs or the chambers of commerce or TECs or the enterprise agencies, all of which are partners of ours in this initiative. It would be sensible, indeed, it would be unthinkable not to, to have as part of our one stop shops the best access to databases that we can design in order that, when we activate the customers to come in, we are able to expose to them the range of opportunities and access points to whatever database we are talking about—it might be export advice, it might be scientific and technological advice, it might be access to research teams in universities. What we want in the round, is to have this advice available in each town and city in one place, and then to go and try to get the industrial and commercial companies in particularly the small and medium-sized ones, to make this idea available to them.

Lord Gregson

276. Secretary of State, quite a number of your precedessors in office have made the comment about the need to change the culture in order to reverse our decline in manufacturing industry. This problem of failing to exploit the inventions that we invented in this country was very well explained in this House over 150 years ago by Prince Albert, the prince consort at the time, and it has been repeated almost every 25 years—Playfair, Balfour and so on—from that point of view. We have not solved the problem and we are going further and further down the slippery slope in a very catastrophic way in my opinion. What can Government do, or what can anybody do, really to reverse this decline, this abject failure to exploit our own inventions, or anybody else's inventions, if it comes to that? The Japanese exploit everybody else's inventions; we do not exploit any.

(*Mr Heseltine*) My Lord Chairman, we have talked personally about these matters over the years and I am not anxious to dissociate myself with the concern that you express, but I do not think that it is wholly a black and white situation. I think, for example—and I hope that our Japanese friends would not be offended—that we have exploited the Japanese automobile industry rather well by actually attracting inward investment in this country on a scale that is going to close and reverse the trade deficit and turn it into a trade surplus within a matter of years. We have a surplus today on television manufacture. It is virtually exclusively Japanese manufacture in this country. It has of course a very, very important consequence managerially to the suppliers to that industry that are British companies, not just because they sell products but because the management ethos of those inward investment plants is hugely beneficial. There are other things of which I think it is too easy to lose sight, and it is very relevant to the point that we are making here. Although if you look at Britain's share of world trade for the last 40 years, there has been a very significant and persistent downward drift. The last two or three years of the 1980s saw that trend halted and marginally reversed. If you look at the balance of trade deficit, in fact we have a surplus with the rest of the world on capital goods—not understood by many people. Where the deficit is significant and of concern is in fields such as food imports, building materials, consumer goods, but in a lot of the top end high technology we have world beating companies with world beating products. The point is that it can be done. It is not an impossible task. It is not that we have been all wrong. It is just that at the margin we have to change the percentages.

277. May I just reiterate that I said British industry has failed. I agree about inward investment. That is the best thing that has happened to Britain since North Sea oil in effect, but British industry is failing miserably to pick up this impetus on the whole?

(*Mr Heseltine*) I think that there are interesting changes and interesting exceptions. In the chemical field we have world class players, and in pharmaceuticals, which I include in that, we have world class players.

278. Pharmaceuticals heavily supported by the Government, of course?

(*Mr Heseltine*) Not supported in the sense that it is subsidised; supported in the sense that it is a market that is closely regulated, that is perfectly true, but then many of our competitors have enjoyed not dissimilar arrangements with their domestic governments where they have done well. For example, nobody would question that the consumer world of Japanese industry has enjoyed huge—what word shall I use?—support.

279. And how it has paid off!

(*Mr Heseltine*) Oh, yes, and I understand that. But again it is not just domestic support. It is ruthlessly competitive processes that work in the domestic market, particularly Japanese industry. So there are things about this country's manufacturing economy that are excellent, world class—not quite enough, and that is the issue. Can we address the issue? Yes, we can and we must. I happen to believe that privatisation addresses a 40-year gap in Britain's ability to compete abroad. It is quite extraordinary to

[Lord Gregson *contd.*]

see huge parts of the manufacturing base that have been denied access to the world markets now going out and winning dramatic contracts. British Gas, for example, the British Airports Authority, British Airways, all these huge companies, which by definition were not allowed to operate or to invest overseas, are now going and doing it. The water industry is now beginning to move into the international world. If one thinks that these are some of the biggest players in the domestic economy with all the consequences that international competitiveness would have on the supplying industries, if they are successful, and that we cut these people off for 40 years from the opportunity to play in that field, it is really a reprehensible political position to have adopted. You can go on and on and on. There are endless things. It is quite wrong to look at the manufacturing base as just a reflection of innovation. Innovation is important, but there is a whole range of things—the educational system, training, tax incentives, regulation, all of these things are part of the overall ethos of success. It is an agenda that is very long, and my department is playing its part in addressing it.

Chairman] President, you are echoing the report that we issued two years ago, if I may say so. I am glad to hear you doing so.

Lord Gregson

280. It will not be easy, will it, because of where we have dropped out of manufacturing sectors, and that list is growing more radiply than the inward investment programme is putting them back?

(*Mr Heseltine*) Again I do not dissent from the point that there is a validity, but it is not a total validity. If I may make a very obvious point, if you have a company that is doing well, and most companies have a range of successes within their portfolio, the simplest way to do better is to back the successful parts of your business, not to say, how can we sort out the weak parts. The simplest way is to back success and to get rid of the weak parts. It could well be that that approach is just as valid as saying, look, we have some gaps in our portfolio, let us now put in huge resources to try to fill those gaps. I am afraid, my Lord Chairman, I am not one of those who think that there are generalisations that apply to these matters. You have to play the thousand organ stops.

Lord Whaddon

281. Secretary of State, you talk of the need to back winners and of the success of the chemical industry. It certainly is true that the chemical industry was a great winner and a great earner for Britain over several decades, but is it not a fact that the balance has been drifting against us in the past decade or so and have not a number of major companies been shifting their research effort out of the country as they felt that the climate was less favourable to them here as opposed, say, to America? If that is so, what are you doing about it?

(*Mr Heseltine*) My Lord Chairman, I should need advice on the specific question. I certainly will take it and I think that your Lordships may be aware that we have set up in the last few months sectoral responsibility divisions within the Department of Trade and Industry to give us precisely this insight into what is happening sector by sector where we sponsor. I believe that it is important for Government to know when these trends are taking place and to ask qusetions, not to go in and try and run or subsidise the company, but to know what is happening with a view to talking to the managers. We have created the infrastructure with which to do that and we are now beginning to engage in dialogue with the various sectoral companies with a view to doing precisely this sort of analysis and having it in front of them and us.

Lord Tombs

282. My Lord Chairman, I wonder whether I could confuse the President by asking three questions. First, I wonder what the Government really have in mind in terms of improving Department of Trade and Industry activity in the regions and nationally to promote what we call innovative support mechanisms. I much prefer the term product development mechanisms. I do not think that innovation is magic. What we are looking for is products that will sell in the market, so I prefer product development, and I shall use that term. I wonder therefore whether the department have looked through the list of imports and categorised areas where we used to be strong and are no longer strong and asked their regions to look for centres where that might be remedied. Secondly, my Lord Chairman, I should ask whether the department have considered whether launch aid should be more widely available in sectors other than aerospace. I do not particularly think that it is very successful in aerospace because it is too expensive for aerospace to use by and large, but there must be other areas of capital goods where the Government could take a proactive role. Some examples of that might be the construction of demonstrators that would hearten industry and allow technologies to be developed. Finally, I wonder how the President sees the role of the Department of Trade and Industry in influencing other departments, purchasing departments, whether they believe that those departments are sufficiently convinced of the need for private development. I have in mind here, for example, not just defence—the obvious candidate—but the National Health Service where we have a very large tied market and a great prospect for development products that could be launched on the world. I am sorry to ask three questions, President, but I am sure that you are up to it.

(*Mr Heseltine*) No, they are very interesting questions. On the issue of influencing other departments, my Lord Chairman, I think that that is important. If I may start with the last question first, we see ourselves there absolutely to help British business to win. That requires first of all an expertise in our department that enables us to distinguish between special pleading and a genuine case that deserves support so that we are not just seen as a "whingers' charter". If companies come to us or, indeed, if we work it out for ourselves that there are areas of government that could be more helpfully

[Lord Tombs *contd.*]

opened up, subject to the European legal constraints in which we have to operate, then we should listen to that case and we should talk to the people about the opportunities that flow from it. My experience so far is that my colleagues in other departments are only too happy to listen to such arguments providing that they are carefully and coherently put forward. As far as launch aid is concerned there are, of course, tightening regimes in Europe as a result of the activities of the Commission and particularly the activities of Sir Leon Brittan to constrain the amount of launch aid. There are industries with which you, my Lord Chairman, are very familiar where there is a regular recourse to launch aid because, I suppose, of the difficulties in the interface between defence and civil fields making it very difficult to see exactly what a free market amounts to in such circumstances. With the huge American defence and space programmes there is a balancing factor to be recognised if Europe is to survive in this field, so there are launch aid schemes, and my department is the custodian of those in the aeroengine and airframe industry. We have a certain number of specific programmes with which your Lordships will be very familiar—EUREKA, LINK and special schemes for small businesses. There is also regional selective assistance which helps attract both United Kingdom companies and those from overseas. Therefore, we have a whole range of programmes. In some now we are looking, as part of the review on research programmes, to see whether we can perhaps address one issue to which I have referred already, that is, the multiplicity of small schemes. We have to see whether we have not just dealt with a little problem and designed a particular scheme, but whether we might not perhaps be rather more flexible overall. That applies not only to my Department, but it applies more widely across Whitehall also. All this is being looked at in the research and development review. As regards innovation, my Lord Chairman, I should see that as a very important part of my departmental responsibility. We have an Innovation Unit which includes secondees from the private sector and they are constantly looking to see what can be done. There is obviously a very long agenda of what could be done. From the point of view of the small firms, I believe that one of the most important things is the consequence of their major customers interfacing down through the industrial chain. It is a very well known and a very impressive consequence that has flowed from it. I believe that our responsibility is to be fully aware of what opportunities exist and, when we have decided that they are worth pursuing, then to pursue them as effectively as we can within the financial constraints.

283. My Lord Chairman, I presented two particular points. One was the question of whether the Department has examined the import substitution possibility list, the areas where we were once great and where regions might in fact rekindle some interest. Secondly, there was the question of demonstrators. I do take the point about launch aid in general. It is a very blunt weapon and Europe does have a lot to say about it. But there are cases where funding of demonstrators could be of enormous help to industry and where the knowledge such a listening ear was available would be a great help.

(*Mr Heseltine*) My Lord Chairman, on the question of import substitution, this is one of the areas that I had in mind when I gave a fairly cautious reply because of the legal constraints. We can encourage inward investment but it is quite difficult in terms of competition policy and European policy to persuade companies that are buying in a free European market that they should stop buying foreign goods, which probably are European, in order to buy British goods because that is not what the single market is supposed to be all about. I think therefore that we have to recognise the changing culture. Perhaps the most important thing that we should see as the positive way forward, is to be sure that other people are allowing access to their market as effectively as we allow them access to ours. On the issue of demonstrators, my Lord Chairman, I am not sure whether the noble Lord had in mind the specific company that obviously the noble Lord is associated with.

284. No, certainly not!

(*Mr Heseltine*) Or whether it was generally throughout industry.

285. There are two points. First, I think that there is a misunderstanding about import substitution. What I was really speaking of, my Lord Chairman, was the areas where we were once great and are no longer—we have left voids in the economy—and whether your regions could seek the former areas of expertise and seek to encourage them. I was not talking about preferential taxes or preferential purchasing or anything of that sort but trying to make things grow where they have been allowed to die. Secondly, on demonstrators I certainly was not thinking about Rolls-Royce. I retired from there two months ago so I have not thought about it for two months. I was thinking about such things as the French substitution of a fibre optics network throughout France or of central heating schemes, for example. There is a whole raft of things of that sort that we are not very good at doing. The technology sometimes exists and cries out for a demonstration to prove it and there is a belief that Government are not interested in such things.

(*Mr Heseltine*) I think that probably this is well within the remit of the review. I think that what has happened, as a generalisation, is that as we have taken our research programmes further and further away from the market place, so people of course have got used to the psychology that it was a non-market approach and therefore the bids tended to move further and further away from the market place. Whereas of course, if you start talking about demonstrators you are right back in the interface of the market place and you are almost talking about prototypes before you know where you are. One of the arguments that I think we shall be advancing within the review that is taking place is to recognise that exploitation means practical decisions and not just fine praise.

Chairman

286. Do you think that the move away from the market in research and development has gone too far?

(*Mr Heseltine*) I personally think that we have not recognised the way that the real world operates and that it has gone too far.

287. That is a very welcome thought. President, those of us who read the Financial Times will know, or think that they know, that your department is coming back on your research budget.

(*Mr Heseltine*) I have seen some reflections of that. I am at the moment in the midst of sorting out my particular programmes, but I think that even the journalistic comments reflect that it is a very small sum of money that we are talking about. My department's overall budget is not increasing; it is marginally lower than last year, and I made that quite clear. I have got to decide what I do in the framework of the resources that I have available. However, my Lord Chairman, I have also clearly said that I think that the influence of the Department of Trade and Industry in these fields is much more important outside than inside the department, because our budget, whatever happens, is always going to be a very small part of the field.

288. But it is an encouraging part of the field? Your job is encouragement in a way?

(*Mr Heseltine*) Certainly it is a part of the field, but I have got to weigh responsibilities, for example, between the support of small businesses and the setting up of the one stop shop initiative and the European programmes that I have to fund. There is a whole range of issues that have to be balanced. In the constraints of a public expenditure round which has been a tough one I have got to take difficult decisions.

Lord Porter of Luddenham

289. I wonder whether I may just come back to the beginning. We were talking about the Faraday programme and you expeditiously disposed of this in your first sentence, President. What you said I am sure has been the view of many people whom we have seen. In spite of that, the Faraday programme was set up with the specific worry in mind that we hear interminably that the Brits are very good at doing research and extremely bad at exploiting and transferring it. I wanted to ask you whether, despite the fact that the Faraday programme might not be the way, this is in your view one of our big problems and, if so, one that you feel responsible for in the Board of Trade and, if so, doing something about it? If it is not the Faraday programme is it just a matter of going on with the ones that we have and improving on them? Do you believe this story that we hear over and over again that we are particularly bad compared with the Germans and the French and the Japanese at transferring technology from academia to industry?

(*Mr Heseltine*) My Lord Chairman, broadly speaking the differential performance between the British and the French economies is measured in statistics of a half to one per cent a year, so there are no absolutes in this business. It is not that we are very bad and they are very good. It is not that it is innovation or research or education or tax levels. It is that across a very wide range of activities each year in aggregate we have lost out by about a half per cent and at the end of one year, two years, you do not notice it. At the end of 40 years you have a general economy double the size of ours and, of course, it is a compounding process that we are describing. I have never myself subscribed to the view that there is a short agenda list of items—"If only we had put those right all would be well". It is not like that. It is, as I think we referred to earlier, a cultural phenomenon about the pursuit of excellence across the whole horizon all the time. If we are going to reverse the decline we have to address all these issues and everybody involved in the pursuit of these responsibilities has got to improve their performance. If we all do it right across the field we might close the gap between the Germans and ourselves by that one per cent a year.

290. But, President, would you put the one I mentioned, technology transfer, and alleged lack of liaison between universities and industry and so on very high on the list?

(*Mr Heseltine*) At the top of my list would be macroeconomic management and the stability of a low inflation, high growth economy. That is what I should put at the top of my list. Second would come the education system. After you have done that there is a whole range of things that add their own ingredients but none of those ingredients is overwhelming in significance. They are all important and all of them have got to be got right but none of them is of critical significance. If you take the Chinese economy they are growing at 10 per cent a year—a phenomenonal potential—but no one would suggest that it is being driven by the transfer of technology from the higher education institutions to the manufacturing base. It is being driven by Hong Kong entrepreneurs coming in from Hong Kong and investing in south China.

Lord Gregson

291. If you take North Sea oil and gas out of the equation the economy does not look quite so rosy against France—I mean, that is not going to last for ever. It is quite a substantial lump?

(*Mr Heseltine*) It is important, but I do not think that we should take the good news and eliminate it from the equation or to make ourselves look more depressed than we are.

292. As long as when we fall off the end of the cliff, which in the past—

(*Mr Heseltine*) But the trick is to see that this is a bonus and to exploit it to the full. I think that that is happening. We have had a very substantial investment on the basis of it. We have some first class companies that are now operating—British Gas and British Petroleum, which I visited the other day, where it is obviously the case. But then I think if you start following the logic of what I said about those privatised industries, there is a huge potential of world class companies that we are just beginning to see operating in the financial field that we have not seen before. I think perhaps I have not dealt with Lords Tombs' point, my Lord Chairman. There must be fields of activity in this country that we could ask searching questions about, at the very least, and that is where we could do better, and I think that some of

[Lord Gregson *contd.*]

the big fields that I mentioned are such. It would not worry me, however, if the answer came out, "No, we'll never get those back" provided that we could actually build on the others sufficiently to close the gap.

Lord Walton of Detchant

293. My Lord Chairman, may I follow up that point? Lord Tombs mentioned the National Health Service, and there was a time, for instance, when all the CT scanners in the world were made in Britain by EMI; now none are made here; they are all manufactured in the United States, Japan or Germany. There are very many other examples where industry has apparently failed to exploit inventions. I think that one of the problems about the Faraday centres—and, as Lord Porter said, you dealt with those very rapidly—is that they deal essentially with the physical sciences and engineering. There are now grave concerns that British expertise which is substantial in the field of biotechnology may also be in danger of lacking exploitation to the extent that British science and British inventive genius should make possible. What I should like to know, Secretary of State, is whether you feel that your department has a role to play in helping exploitation of this type of work in the future?

(*Mr Heseltine*) I think that we have, my Lord Chairman, and I think that it would flow from our sponsorship responsibilities in the pharmaceutical and chemical industries and engineering widely. In the dialogue that we are now engaged in, with the companies of these particular sectors, it will obviously mean that we focus on particular markets, potential markets, that questions will be asked and research will be done and analyses will be produced as to what tomorrow's opportunities are. To the extent that we are rightly undertaking the analysis of the research, I think that that is a Department of Trade and Industry responsibility. To the extent that we discuss these things with the companies concerned, I think that that is our responsibility. In the end we have to say: well, if the companies do not do it, we cannot do it for them.

Baroness Platt of Writtle

294. My Lord Chairman, this is changing the subject a bit towards fiscal incentives. In our report on innovation in manufacturing industry we recommended a number of fiscal incentives and one of them was 150 per cent tax exemption for new industrial research and development expenditure and discretion for companies to choose for themselves the rate of depreciation against tax for plant and machinery. I personally welcome the fact that in the autumn budget statement there is to be a 40 per cent allowance this year and then, I think, it falls to 25 per cent, but it is only a temporary one and it does not allow complete discretion. It does seem to me that probably to large firms this is not so applicable but if small firms decide to apply the new technology and put in the new high tech machinery that has a major effect on their budget and they are taking a risk but it is their own money with which they are taking a risk. It is important that they get the maximum help in the first year, it seems to me, and then the Inland Revenue should, if they have made a wise decision, get the pickings in the years to come, but it will not be obviously the first financial year. How do you feel about the scope of fiscal incentives of that sort?

(*Mr Heseltine*) I think that I was persuaded by the argument when Nigel Lawson was Chancellor, of going for lower tax rates and fiscal neutrality. I think that people today, in looking for enhanced capital allowances, have forgotten the fact that they got a very significant tax reduction in order to pave the way to lower the capital allowances. The Chancellor has of course given a temporary support to this method in the Autumn Statement. In respect of the obvious inventions, while I should always draw the Chancellor's attention to any argument that I think has some validity, in the end it is the Chancellor who has to decide on the fiscal incentives for the economy at large. I think that there are probably lots of ways in which small companies could be encouraged into new technology by consultancies which my department provides, and we are looking again as to how we can provide them more effectively, and by the support of the large companies that purchase from the small companies, and again I refer to the experience of the Japanese family businesses that have a very close relationship with the large companies and I think often do receive maybe second-hand equiment but significantly better than they themselves would ever be able to afford as that is discarded by the large company. Therefore, I think that is a need for a constant consideration of these issues, but what I cannot do is to give the impression that the Government is going to introduce tax changes which is not in my responsibility.

Chairman

295. I should be happy to accept what you have just said if it were not for one thing. The one thing is that if you compare the research and development expenditures in different countries the British civil industries' R and D in this country is significantly less than in our competitor countries. British industry really does not go in for research and development to the extent that other countries do. There is therefore that problem of trying to change that particular industrial practice. Does not the Department of Trade and Industry have a job particularly in trying to stimulate that by schemes, fiscal schemes among others, that might encourage it?

(*Mr Heseltine*) Yes, but the decision to adopt the fiscal measure will be the Chancellor's. I cannot just stand apart from the Chancellor and support figures or proposals that he himself is not then going to adopt because we have a collective responsibility. However, in a departmental role I certainly will constantly be in touch with the Chancellor about what is on offer by way of incentives and it is for him to make up his mind as to which he will or will not adopt. My Lord Chairman, I noticed that you used the word civil R and D. This was the debate, of course, to which I referred earlier on, the implication being that somehow defence research and development has no commercial interest. The fact is that some of our largest defence companies are our largest export companies and there is a very direct relationship between the research spent on defence

[Chairman *contd.*]

programmes and the export markets. This is one of the arguments that I was referring to in 1984 when the civil argument was to take the defence budget away because somehow it was going to be better exploited in the civil field. I never saw any argument to support that view.

296. I accept that completely. I was comparing civil research and development in this country with civil research and development in other countries.

(*Mr Heseltine*) Ah, yes, but, you see, if you aggregate—well, one of the most obvious examples is the Japanese one where they have a bigger civil programme but a small defence programme and therefore if you just take the civil you get unfavourable comparisons, but if you take the civil and defence you get a more favourable comparison.

Baroness Perry of Southwark

297. President, if we may turn to a different kind of incentive, you mentioned earlier that you believe that the education system was the country's second priority. Your department invests in the Teaching Company Scheme which at least in the view of many of us in higher education gives very good value for money in terms of changing the attitudes towards innovation and entrepreneurism. Is it your view within your department that you are getting value for money from the Teaching Company Scheme and are you intending to expand it, to contract it or to keep it steady?

(*Mr Heseltine*) If I may rely on my memory, on the figures on the public expenditure forecast that I have, I have not queried it. I have queried it to say, what is this for and what are we doing with this money, but I do not think that I have changed it. It is not a very large sum of money from what I remember. I should have to say that the real thrust of educational standards can only be addressed by the Department of Education. That is where the vast influence on standards will be achieved, not through anything provided through my Department. It might be perfectly valid in its own sense, but the standards that we must be consulted about are those that flow from the education system.

298. Nevertheless, the Teaching Company Scheme does provide an opportunity for graduates across a range of subjects to spend time studying problems of industry and learning how to be entrepreneurial. That is a very direct form of technology transfer at the individual level which I should urge you to study more closely.

(*Mr Leigh*) Yes, the Teaching Company Scheme has been very successful. We are looking at all our schemes very carefully. If you look at each of them individually, they certainly all have a very important part to play, but there has been criticism of the Department's schemes that there are too many of them and difficult for business to understand. That is why we are undertaking parallel to the White Paper that is being prepared by the Chancellor of the Duchy, our own review of all our schemes, including the Teaching Company Scheme. This will be carried out within the overall funding that the President has managed to secure from the Chancellor, to ensure that all our schemes are effective and are easily understood by business. This is where I think that they fit into the kind of Faraday principle that the President of the Board of Trade has been referring to earlier this afternoon. Although, as we have heard, he has dismissed the concept of Faraday centres as bricks and mortar, we believe that the Faraday principle should go right the way through all our schemes. This is where schemes, like the Teaching Company Scheme have been so successful in promoting two-way technology transfer between higher education institutes and industry. That is why we are concentrating on the overriding arch of the Faraday principle to simplify and to make our schemes more effective. That will apply to the Teaching Company Scheme as well as to other schemes.

Baroness Platt of Writtle

299. And I hope, my Lord Chairman, that the President will go on interfering in the schools in the way that the Department of Trade and Industry has in the past because I think that it has enhanced an entrepreneurial system that the Department of Education and Science did not promote in the way that it should have done. I hope that the DTI goes on making interventions of that sort because that is what we need as far as young people are concerned.

(*Mr Heseltine*) I should have to say that our intervention is suitably modest, but any support my officials can give is readily available. I should be pleased if we saw an increase in the expenditure in the autumn statement.

Lord Renwick

300. I think that for the most part Mr Leigh has answered my question, but is there anything more that you would like to say about important philosophies that were identified within the Faraday concept and how you would like to take advantage of them?

(*Mr Heseltine*) In a sense, my Lord Chairman, we have been discussing the philosophy and the manifestations of it during the course of this session. In its simplest, it is common sense. There are talents and there are ideas and there are people who ought to be exploiting them in order to create the wealth from which so many other things then flow. That is really what it is about. The task of my department is to facilitate that process as much as possible. Perhaps I may ask Dr Robinson to come in here because he is at the coalface as far as the Chancellor of the Duchy's department is concerned in our relationship with it.

(*Dr Robinson*) Perhaps I may add a few words of background to the thinking that the President has alluded to. I think there is no doubt that it will be recognised that the science and technology base has an important role to play in wealth creation. Too often one has felt in the past that there was too much of an "us and them" debate, between the science base and industry, with various accusations perhaps based on ignorance, about exactly what was going on in the two communities. Starting with the Faraday proposals that we received earlier this year and then looking at the Fraunhofer institutes in Germany which have triggered some of the ideas, it became

[Lord Renwick *contd.*]

quite clear that at the heart of all these ideas was the attempt to create an environment where academics and industrialists could come together on mutual interests more. Whether it was because you had a Teaching Company Scheme, or a graduate or academic would go and spend time in a small company; whether it was because you had a PhD student at the centre or a CASE scholarship; or whether it was because you had the ability to have small companies able to have access to research in universities you kept coming across the same question: "how can you encourage academics and industrialists to share a common purpose, given that they do at bottom have different objectives?" We have been looking at the whole range of DTI schemes, as the President has alluded to, and trying to find out what are the common principles where we can gain maximum impact because, of course, we are working with a limited budget. At the same time, with the review that OST and the Chancellor of the Duchy of Lancaster are doing, there is the chance to take some of these common principles and base ideas and say, to what extent should they be within the remit of the science base through the Research Councils. This morning, I was at a very good meeting of the AFRC where they were discussing what was their role and remit for wealth creation and exploitation of the science base. One is trying to get this basic thinking into the system against which the Department of Trade and Industry can then say: "*here* is where we can apply maximum value added"; and many of the things that people say are good ideas, are built into the fabric of the system, not plastered on top by piecemeal methods, which to some extent is where we are today. We have learnt an awful lot from the tremendous range of activities—the Teaching Company Scheme, CASE students, LINK—and I think we now know enough so that we ought to be putting some of them into the base system. I think that is what the President alluded to in the Faraday principle, that we are now trying to encompass this with a lot of support, I should say, from our friends in OST. I hope that helps clarify some of the thinking you were trying to get at.

Chairman] We must, I think, try to wind up fairly soon, but Lord Gregson has one point.

Lord Gregson

301. I happen to be a director of a German company and we made application to the EC for a support fund. I have to say that we get considerably more help from the German Government in framing our proposition and in putting it to Europe—in fact, they put it on our behalf. Now it may be just a quirk of fate that the Commissioner involved is a German so that to some extent there is a certain liaison between them, but in my experience the Germans certainly get more help in putting programmes to the EC than exists in this country.

(*Mr Heseltine*) That is a serious charge. I can only respond locally as I believe it merits by saying, show me if we have failed. I cannot know what happens to your company projects in Germany. If it is my Department that is failing to give support to any company, I hope that I will be the first to know about it and not the last. I cannot say fairer than that. It is certainly not our policy or our intention that such should be the case, although I think that it is fair to say that we sometimes do take a fairly critical view. Just becuase it is a European programme does not mean to say it is automatically desirable. We have a difficult situation at the moment with High Definition Television where the advice available to me—and I have checked it carefully - is that this is not a technology that we should be investing money in and it is going to be outdated. It already has been overtaken effectively and in the course of two, three, four, five years' time the market will have moved on to digital and that if we start trying to pursue the MAC system, we are merely taking a journey down a cul-de-sac. It is very uncomfortable, and Edward Leigh and Neil Hamilton had to face the serried ranks of 11 Community countries, all of whom think that we are wrong, but on all the advice that has been given to me, we are right. Sometimes you have to say so.

Lord Dainton

302. My Lord Chairman, I am still slightly suffering the effects of the trauma of having attended a meeting convened by the European Parliament on its energy and research committee to discuss the fourth framework programme where I was representing this committee. I came away from it rather anxious in some ways that the fourth framework programme despite all its fine words and its division into categories and so forth was rather imprecise and very difficult to focus; and in particular their claim that they were going to focus on generic technologies, which is a great point that they were making seems to me to be words in some cases lacking clear definition so that one did not know quite where one was. I wonder whether you share my lack of sanguinity, if I may put it that way, about the outcome of the negotiations for the fourth framework programme or, indeed, that it will lead to the kind of results that were avowedly the purpose for which it was set up. I realise that this is rather a leading question, but it does give us a source of considerable concern, I think, particularly in view of the fact that of course there is the question of attribution which may affect British scientists if that goes ahead. That is rather a long question, but I am sure you know what I mean.

(*Mr Heseltine*) I have a different word for attribution, but it is the same point, and I just wanted to be sure that I have got it right.

Lord Tombs

303. Rude?

(*Mr Heseltine*) No! I think that I start where you start. I think that there are very powerful reasons why we should have European programmes because there are so many programmes now beyond the reach of a medium sized economy and there are programmes where we should be ill-advised to compete with each of the countries of the Community—we should simply be reinventing the wheel in many cases. I have always believed that the negotiation that I conducted to create the European Space Agency in 1973 was a very sensible, practical way of moving forward. I think that Britain has

[Lord Tombs *contd.*]

gained and that other countries have gained from that degree of co-ordination. However, I have to say, that just because it can be right in principle and theory, it does not always mean to say it is right in practice. I think it is encumbent upon us, particularly those who think that there is merit in much that Europe does, to be very critical of the detail of these programmes. It is not in any way my intention that we should simply say: "well, this is a European programme and it is beyond our control". If it is beyond our control, whose control is it within is a very important question. Your Lordship's question flows from exactly what I was saying about High Definition Television. It is the same issues that are at stake. We are cautious about these generalised approvals for programmes without the details and without the implications. We are particularly aware of what you describe as attribution and I call under the less charming concept of EUROPES, but it has the same point, that it comes off my budget.

Lord Dainton

304. The next question, of course, is how this committee—a question that we must address ourselves, but with your help—can be effective if in fact this first meeting is to be followed by others. I got the very clear impression for what it is worth that in a sense what we were saying has been the thinking is not something to which the other parliamentary committees on science and technology give a great deal of thought. Maybe that was because the power had shifted somewhat from them to other bodies. Is that the point as you perceive it? Is there anything that we can do?

(*Mr Heseltine*) The issue that you raise I think is of great importance, not the least from Europe's point of view. There is no point in spending money on general programmes simply to be able to say, we have a European programme. That will become discredited and it will stop the process and national parliaments will get increasingly indignant about it and the industries will not gain from it. What is essential—it is a very difficult thing to say, but it has to be said—is that if you are dealing with research programmes there is no area where you need a greater degree of self-discipline and there are few areas where it is easier to compound yesterday's inadequate result by saying, "Well, just another heave". If you throw that into the melting pot of European politics it is very easy for people to say, "We are only here once every six months to look at these things, and anyway it sounds as though it will be all right and it is not that much"—or, worse, "someone else is paying", and it is usually Britain that finds itself in that club. It is therefore very important that these issues should be ventilated and exposed, and committees such as your Lordships' committee can play an important role in doing that, as can my Department. I think that Britain is characterised, not always to our credit, but it ought to be to our credit, with being the one who asks the detailed questions, whereas there are people who think that as long as it is European it has per se to be good. It is not always the case.

Chairman

305. Are there any final quick questions from my colleagues? Secretary of State, are there any other remarks that any of your team would like to make that have been left unsaid? Perhaps not?

(*Mr Heseltine*) Perhaps we think that we have said enough!

Chairman] Secretary of State, thank you very much. We are very grateful to you.

WRITTEN EVIDENCE

Evidence from AEA Technology

1. Almost anything that reduces the fragmentation of British science will do it good. Fraunhofer-type centres could work well if they have *serious* support (i.e. commitment of sensible start-up funds, assurance of reasonable life-expectancy, and an intention to give real technology transfer (i.e. *not* just seats in an industry office with all control with the university).

2. (a) The main change is that university departments *with* Faraday centres will gain and those without *may* lose (though not much if they are among the strong departments).

(b) Unless the IRO's get *some* funds, I expect there *will* be a simple loss in what they put out as university contracts at present.

(a) is basically good, (b) could be harmful.

3. If the pot of money remains the same size, there can be no alternatives. However, given the disastrously low proportion of LINK funds already spent, there is money available, but there may not be the will to spend it.

4. Probably yes. There is a very basic problem which needs resolving (which also arises with CASE, though it is usually resolved at a local level for each student): is the intention:

(a) merely to have university-supervised students sitting in an industrial building in the hope that the commercial environment rubs off (almost by accident perhaps?) or

(b) to have the student as closely associated with commercial projects as is acceptable (both academicly and also to the customer, since there would be all sorts of problems with students working *directly* on projects; "slave labour" is a no-no) and hence with much of the supervision from IRO staff?

I don't see how (a) can succeed; (b) can certaily work for good IRO's but it does need spelling out.

5. If the DTI wanted the scheme to be a success, then yes, it should have been more generous (and better planned).

If the DTI merely wanted an election gesture, they have spent too much.

6. (a) Timing (good students apply in December/January);

(b) funding;

(c) just how the DTI envisages the IRO will gain—the 58 applicants this time presumably all did so either;

(i) to formalise existing arrangements; or

(ii) in the (political) spirit which may have been intended, i.e. to make a point about their position in UK science.

(d) some thought is needed about the European context. It would be silly to simply duplicate a centre which exists in the EEC without seeing if there's a better route.

Evidence from the Advisory Board for the Research Councils (ABRC)

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

1. I recently visited Germany to examine the Fraunhofer system, and to try to establish whether the setting up of such institutes would provide an efficient and effective mechanism for enhancing interaction between industry and the science base. I was accompanied by Sir Mark Richmond (Chairman of SERC), Dr. Geoff Robinson (the newly appointed DTI Chief Adviser), Professor Ian Shanks (Chief Scientist, Thorn EMI and member of ABRC) and Mr. John Vereker (Deputy Permanent Secretary of the Department for Education). The group met officials of the Federal Research Ministry (the BMFT), visited three Fraunhofer Institutes (production technology, laser technology and solid-state technology, respectively), and visited officials of the Fraunhofer Gesellschaft—the central administration of the Fraunhofer system. We therefore viewed first-hand the Fraunhofer system in practice.

Background

2. The Fraunhofer Gesellschaft was set up in 1949, but it was only in the mid-to-late 1950s that the first institutes orientated towards contract research were set up; the numbers of institutes slowly increased as institutes that no-one else wanted to run were taken over. Initially, 60 per cent of the effort was related to defence research. From 1968, the institutes have been allowed to carry out non-commissioned as well as commissioned research; there are 37 institutes in the old FRG, and 9 embryonic institutes in the former GDR. The total turnover is about 800 mDM, and in the system in total, there are about 2,000 permanent staff

(largely technicians and administrators), 2,000 researchers on short-term contracts, and 2,000 researchers on unlimited contracts.

3. The Federal Government's aim is for each institute to obtain 80 per cent of its running costs from contract research; in practice, generally about 29 per cent comes from industrial contracts (although BMFT would like this to increase to 30-33 per cent), and 35 per cent from contracts with the Federal Government and Lander. The attached diagram shows the percentage funding received from industry by each institute, and it is clear that only a handful of institutes earn more than half their income from the private sector. In addition, the capital costs of the institutes are covered by funds from the Federal Government and the Lander. Overall, most resources for these institutes are drawn from public funds.

4. As large companies have their own in-house research facilities, it is intended that SMEs should be the main industrial customers of Fraunhofer Institutes. In practice, large companies make good use of the institutes and the state of the art equipment therein since this, in effect, reduces their long-term commitment to research and provides a cheaper alternative to setting up in-house research facilities. We noted with interest the proposed use by Siemens of a new suite of high-quality clean rooms for the fabrication of microelectronic systems in one of the Fraunhofer Institutes that we visited. The Fraunhofer system effectively subsidises industrial research. According to the Fraunhofer Gesellschaft, this degree of Government intervention to strengthen contract research is justified because:

(i) knowledge is the single most important factor for economic growth in highly industrialized countries, and knowledge will be economically effective only if it is transferred into applications;

(ii) SMEs cannot afford all the in-house R&D capacity they need to remain or become competitive;

(iii) large firms will be aiming for a lean in-house R&D capacity, which will be concentrated on their core activities;

(iv) the life-cycles of products are decreasing, while their complexity is increasing; and

(v) the number of science-based products is increasing.

5. The Fraunhofer Gesellschaft told us that there are four conditions which have to be met when setting up a new institute:

(a) the institute's research area must be of interest to industry, and industry must be willing and able to participate in contract research;

(b) the research area and associated technologies must be viewed as strategically important by the government;

(c) the institute site must be adjacent to a university with technological leanings; and

(d) there *must* be a person to head the institute with scientific and entrepreneurial skills—able to attract high-quality staff and students, and to build up good links with industry.

It was strongly emphasised that whenever an institute was to be set up, the Gesellschaft always had a person or small group of people in mind, who were known for their enterprise, and who would therefore provide a suitable foundation for the institute. Most heads of institutes were also professors at the local university.

6. Once set up, the embryonic institute is allowed about 3–4 years to build up its private sector contracts. It is then subject to review to see whether there is a big enough market for its services. If so, it will become a fully fledged Fraunhofer Institute, and will thereafter be examined annually against criteria of revenue (overall, from industry, and from SMEs), of level of innovation (contract volume, combined contracts, patents and licences) and of staff (movements, scientific honours and publications).

7. Because doctoral students in a Fraunhofer Institute have to perform contract research, as well as carry out the individual research project required by the accrediting university, the doctorate takes rather longer to complete than in a University—about five years on average. Significantly, in Germany, students take their first degree at 28 or 29, and they are consequently rather more experienced and mature when embarking on their doctoral training than their UK counterparts. Such maturity better equips them to deal with managing the contract research required as part of their training. This industrially relevant experience should increase the employability of the researchers; the aim is to encourage them to follow a career in industry after about five years in the institute.

Impressions

8. The Fraunhofer system developed during a period of rapid industrial growth in Germany. But with much public funding currently being directed towards regenerating the former GDR, and with industry becoming more reluctant to invest because of the slowing down of the economy, and also less willing to recruit the highly qualified but relatively expensive 34 year old doctorates from Fraunhofer Institutes, the future of the system is looking much less secure than it was.

9. We found no evidence that the quality of the work carried out was ever assessed, or that any contracts had been refused on the grounds that the work required was too undemanding. Moreover, we learned that no institutes had been shut down, that the system took decades rather than years to reach maturity, and that the throughput of researchers, mainly from University to Fraunhofer Institute to industry, was not very high.

The staff are on public service contracts (many of them indefinite), consequently it is not easy to encourage them to leave and there is some danger of fossilisation.

10. In no way should the Fraunhofer system be regarded as a quick fix, nor should it be regarded as a means of creating or leading an industry. The system is primarily a service by which techniques are perfected, expertises developed, and advanced and enabling technologies developed and brought to the attention of industry. The most successful institutes seemed to be those that had strong links with very technologically orientated universities; the university had access to the institute's state of the art equipment for its own research purposes, and provided the basic underpinning research for the institute as well as a supply of the best young researchers.

11. As mentioned above, the maturity of the doctoral students in Germany is, we feel, an important factor in the students' ability to cope with the demands of contract research. In the UK, the doctoral students are much younger, and are therefore not as well equipped to meet these demands.

12. Based on their recent experience in setting up institutes in the former GDR, the Fraunhofer Gesellschaft strongly advised against setting up Fraunhofer Institutes around already existing institutions, because the prevailing culture of the existing institution would not match the aims of such an institute, and would be hard to change. The key point here is that the appropriate scientific and entrepreneurial environment needs to be there from the start, and comes, not from bricks and mortar, but from identifying a core of high-quality people with the relevant skills, who will form the basis for the institute. This emplasis is lacking in the ACOST and CEST proposals, and, in the light of German experience, we should be cautious about attempting to build on our system of Government laboratories or industrial research and technology organisations.

13. To sum up, our reactions to the Fraunhofer system were rather mixed. The extent of public funding for these institutes, the limited movement of staff from these institutes, the comparative maturity of the doctoral students, the doubts expressed about the sustainability of such a system in a harsher economic climate and so on do not lead us to conclue that the wholesale transplantation fo the system to the UK would be successful.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

14. According to ACOST, the proposed Faraday Centres should be formed from existing institutions, and CEST too suggest that contract research organisations (eg AIRTO members, PA Technology, AEA Technology etc.) would be potential candidates to host Faraday Centres, although they do not rule out the creation of a new organisations as well. The funding of a future Faraday Programme has yet to be decided, but if, as suggested, the centres are built on already existing contract research institutions, then funds would clearly not be drawn away from these institutions. Any new organisations set up would, however, be in direct competition with the established institutions, and funds would be drawn away from them—unless there is an unfulfilled demand for contract research. The merits of such an outcome would depend on the extent to which existing institutions, especially those in receipt of public funds, are performing a useful function effectively and efficiently.

(iii) Are there alternatives?

15. The first question to be addressed is what sort of gap, if any, exists between the science base and industry. In both Germany and the UK, the chemical and pharmaceutical industries have very close links with the science base. There is therefore little need to set up intermediate institutes in these areas; indeed, in Germany, the Fraunhofer Institutes are largely physics-based, which reflects the fact that, as in the UK, the links between physics-based industries and the science base are not so close, probably in part for cultural reasons, but also because the gap between laboratory science and useful products or processes is wider in this sector.

16. There is also a need in the UK to persuade academics that intellectually demanding work of the highest quality is needed to apply existing knowledge to the solution of technological problems—it is not only required in the generation of new understanding. Furthermore, there is a need to persuade British industry to take more advantage of the science base in resolving technological problems, and in providing new advances.

17. With these points in mind, our perception of the most valuable part of the Fraunhofer system is the location in one place of highly-skilled, entrepreneurial scientists who have close ties both with the universities and industry, together with state of the art equipment. The Fraunhofer Institutes that we visited were extremely well equipped in technological areas, beyond the scope of provision in UK HEIs, and generally unavailable in all but the largest industrial research laboratories. We consider that identification of these highly talented individuals, together with appropriate funding (which should be made on a competitive basis) for the provision of state of the art equipment, would provide a more fruitful basis for enhancing interaction between industry and the science base, than attempting to set up a fully-fledged Fraunhofer-like system from existing contract research organizations in the UK.

(iv) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

18. The pilot scheme of postgraduate training in industrial research organizations, which was announced in February this year by the then Secretaries of State for Trade and Industry and for Education and Science, should not be seen as the DTI's response to the proposals for a Faraday Programme put forward by the Prince of Wales's Working Group on Innovation. The aim of the pilot scheme, which is to start in September this year, is to enable postgraduate students to work for their higher degrees in industrial research organizations (IROs) rather than in the conventional academic setting of an HEI, which is a rather limited objective in comparison with that of the proposed Faraday Programme. There are five partnerships between IROs and HEIs in the pilot scheme, and it is hoped that the scheme will increase the flow of people from academia to industry and increase the industrial relevance of postgraduate research. In doing so, the scheme embraces one important element of the Faraday programme, but as explained in the press release of the February announcement of this initiative, "the proposed Faraday programme goes further and needs detailed consideration".

(v) Should DTI's response have been more generous?

19. Since the postgraduate training partnerships scheme is only a pilot scheme, it is justifiably small scale.

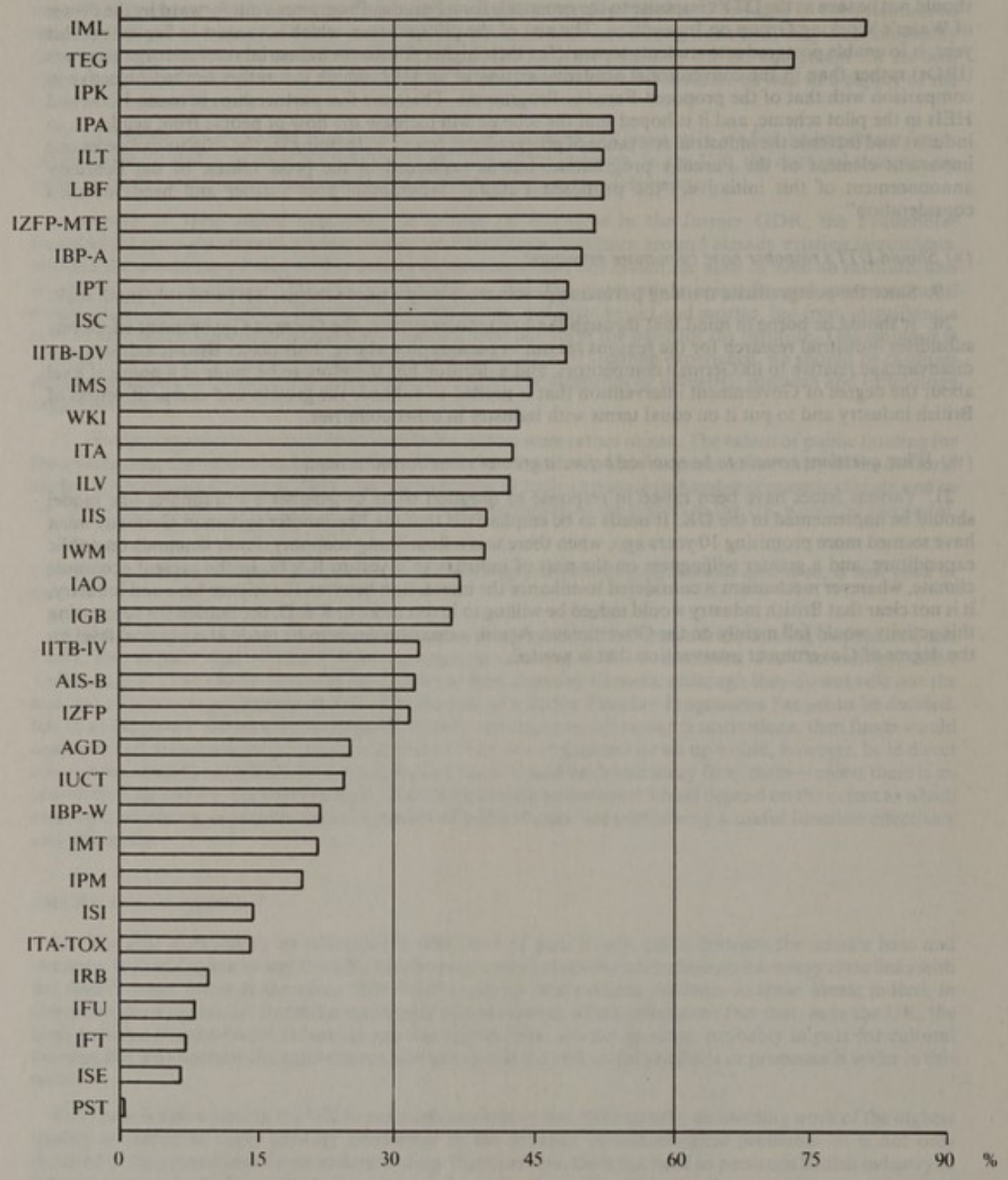
20. It should be borne in mind that through the Fraunhofer system, the German Government effectively subsidises industrial research for the reasons set out in paragraph 4 above. This places British industry at a disadvantage relative to its German competitors, and a decision has therefore to be made at a political level about the degree of Government intervention that is needed to enhance the growth and competitiveness of British industry and to put it on equal terms with industry in other countries.

(vi) What questions remain to be resolved before a greater commitment is made?

21. Various issues have been raised in response to question (i) as to whether a Fraunhofer-like model should be implemented in the UK. It needs to be emphasized that the Fraunhofer system in Germany must have seemed more promising 10 years ago, when there was a flourishing economy, fewer demands on public expenditure, and a greater willingness on the part of industry to invest in R & D. In the present economic climate, whatever mechanism is considered to enhance the interaction between the science base and industry, it is not clear that British industry would indeed be willing to invest more in R & D; the burden for supporting this activity would fall mainly on the Government. Again, a decision needs to be made at a political level on the degree of Government intervention that is needed.

ANNEX A

Income from Industry as a Percentage of Running Costs, 1990



Evidence from the Agricultural and Food Research Council (AFRC)

1. Technology transfer and postgraduate training are cental to AFRC's mission of research in support of industry, the environment and the consumer.

2. AFRC very much welcomes the excellent work by Sir John Fairclough's Working Group on Innovation and by CEST on ways of increasing the flow of ideas and skilled people between industry, intermediate institutions and higher education.

3. In these studies much has been made of the Fraunhofer experience in Germany in the search for an improved innovation framework for the United Kingdom. There are benefits and dangers in this approach. The network of FhG institutes is part of an integrated system of education, training, technology transfer and industrial development which has been built up in Germany in a purposeful manner over the past 45 years. The commitment of local industry is crucial to success. The dangers are in too literal a transplant of this one element of the German experience into the rather different British environment.

4. A striking feature of the FhG network is that it is largely driven by industrial funding and priorities. Is British industry willing or able to invest enough in in-house R&D skills to engage in dialogue with scientists and engineers in higher education or intermediate institutes *via* joint projects and sponsored research in science and engineering? The Faraday concept is only likely to make an impact on the lack of UK competitiveness if it stimulates industry to come closer to the research skills of HEIs and institutes. That is the challenge.

5. Government has responded quickly with the DTI/SERC postgraduate training partnership which breaths some life into the concept of Faraday Centres. This only a small step, however, towards full development of the idea. The studentships seem little different from CASE awards although the concentration on selected centres should beneficial. More debate on objectives and mechanisms is needed; the Faraday concept should be set against the need for a balanced and properly funded national strategy for higher education, training and technology transfer.

6. All of AFRC's seven research institutes are part of the national science base but display to varying degree the characteristics of intermediate institutes. They are big enough to achieve critical mass (the range is £7–£16M a year); have a "mixed economy" comprising AFRC Science Budget programmes, Government commissions (mainly from MAFF) and contract R&D (£2–4M a year); have strong international links and work collaboratively with HEIs; and are much involved in postgraduate training (typically each has 30–150 PhD students). The AFRC has spent £50M in the past five years restructuring its institute base to provide up-to-date facilities and an internationally competitive skill base. For example, the AFRC Institute of Food Research, which has strong interaction with the food industry and consumers, has the suitable multi-disciplinary skill base and first class facilities appropriate for hosting a Faraday Centre.

7. As for resources, AFRC believes that potential intermediate institutes already exist in large numbers, embedded within HEIs, institutes and research associations; no completely new institutions are needed. A Faraday Programme would provide Government with an opportunity to increase its funding for research infrastructure and training relevant to industry. It would also strengthen technology transfer from the science base to industry, a flow that has been weakened by the withdrawal of public funding from near-market research. The science base is already over-stretched and would be damaged if funds were simply transferred from high quality basic and strategic research to fund a Faraday Programme.

Evidence from the Association of the British Pharmaceutical Industry (ABPI)

The Association welcomes an opportunity to provide the Select Committee with its views on the proposal to establish in the United Kingdom a number of "Faraday Centres", modelled on the German Fraunhofer Institutes.

The Association of British Pharmaceutical Industry (ABPI) is the trade association representing the great majority of pharmaceutical companies in the United Kingdom discovering, developing and manufacturing prescription medicines. ABPI member companies supply more than 90 per cent of the medicines used in the National Health Service annually.

The pharmaceutical industry has consistently been one of the most successful sectors of industry in the UK over the last 40 years. As the Select Committee will be aware it is also considered to be one of the most innovative in the UK. Four of the 10 top-selling medicines in the world are the discoveries of UK-based companies.

In 1991 the industry contributed over £1.2 billion to the UK's balance of trade and its combined exports exceeded £2.5 billion. This outstanding record is based on the industry's significant investment in research and development and on its close relationship with the country's centres of academic excellence. The continuing success of the pharmaceutical industry stems from the recognition that research, both basic and applied, is crucial to its continuity and growth. This recognition has resulted in an investment in R&D which has increased consistently over the years and in 1991 amounted to over £1.2 billion, representing approximately 18 per cent of sales. This figure is much higher than most comparable sectors of manufacturing industry.

The willingness of multinational pharmaceutical companies to go on increasing their investment in research in the United Kingdom has, in the past, been largely dependent on the high quality of the research carried out in its universities, medical schools and institutes and on the availability of well-trained, innovative scientists emerging from British universities and polytechnics. The pharmaceutical industry is concerned that under-funding of civil science and a lack of proper focus of such funding will undermine the quality of the UK Science Base with serious long-term national implications. The Association therefore welcomes any initiative that will maintain the quality and numbers of well trained researchers in academia and industry. We do have some concerns however over certain aspects of the proposed Faraday Programme and the DTI initiative and therefore welcome the current inquiry by the Select Committee. At the centre of our concern is whether either scheme has any relevance to the pharmaceutical industry.

The pharmaceutical industry is internationally-based and parent companies or subsidiaries of those operating in the UK will have had personal experience of the Fraunhofer Gessellschaft concept through liaison with such bodies as the Max Planck and Basle Institutes. The ABPI noted with interest the publication of CEST's report "Attitudes to Innovation in Germany and Britain". Representatives from several of our member companies participated in the discussions on innovation organised by HRH The Prince of Wales.

The pharmaceutical industry was following closely the work of Sir John Fairclough and the evolution of the concept of the Intermediate Research Institute, and therefore noted with some surprise the announcement by the DTI in February that it was to establish a pilot programme in this area.

Despite some difficulties in acquiring relevant information from the DTI on its proposals and their applicability to the pharmaceutical industry, some of our members have identified a number of positive elements in the scheme. We will therefore continue to monitor developments as the DTI's response is developed further and possibly amended to incorporate the pharmaceutical industry.

We have a number of specific comments to make on the items raised by the Select Committee:-

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

It is the experience of the pharmaceutical industry that the main objective of the Fraunhofer Institutes is to take on board problems and ideas for development from industry, under contract, and to apply a multidisciplinary problem-solving approach in order to try and reach a solution. This approach introduces problems of funding for the Institutes as financial injections from industry are project-based, sporadic in nature, and will only come if the Institute in question has a great deal of credibility in its own right. This credibility can only be acquired through significant government or industry funding otherwise a decent research base cannot be built up. This is the basis on which universities are chosen for collaborative and contract research, but for a custom-built institute credibility takes time and resources to create. The basic problem that all Fraunhofer Institutes are now facing as they move more and more to being contract houses is how to keep going at a high level of activity between the injections of project funds.

We consider that it is unlikely that the Fraunhofer Institute model could be introduced as it stands directly into the UK. As the concept appears to be defined at present the pharmaceutical industry will be excluded from participation. Even if the proposals were amended to incorporate the pharmaceutical industry we consider that the industry would be unlikely to support Faraday Centres to any great degree because of its significant present committment to the support of research in HEIs. Direct support of individual departments in HEIs ie. funding in support of LINK schemes, support of Research Council initiatives including co-operative awards and postgraduate support work etc are likely to remain the industry's preferred options to support research and stimulate innovation.

As we have indicated the fundamental question of relevance to the pharmaceutical industry's involvement is what should be considered an Intermediate Research Institute.

It has been suggested that contract toxicology and development organisations such as Life Sciences and the Huntingdon Research Centre could be considered as Contract Research Organisations of relevance to proposal. We consider that such organisations, which carry out, for example, toxicology testing and clinical trials cannot be compared to the Fraunhofer Institutes. Their involvement in basic research and innovation is very limited.

There does exist in the UK a number of contract research/consultancy organisations such as PA Technology Ltd which could possibly be considered as relevant Control Research Organisations as they do carry out some research activities, albeit of a very limited nature.

We would like to suggest that institutes such as the National Heart and Lung Institute, the Imperial Cancer Research Fund Laboratories, the Oxford Centre for Molecular Sciences, the Strangeways Laboratory and the Kennedy Institute of Rheumatology, where industry, medical charities and the government can fund appropriate work, should, be considered as the basis of Faraday Centres of relevance and interest to the pharmaceutical industry. Unfortunately such institutes are at present restricted to the study of very specific therapeutic areas. We believe that the establishment of similar centres in other fields such as neurosciences, where discovery is critical, could play an important role in stimulating further innovation.

The Collaborative Research Centres of the Medical Research Council could be potential interfaces between Higher Education Institutes and industry. In these interdisciplinary research centres groups with different but

complementary interests covering a wide range of disciplines could be brought together under one roof. The Select Committee may wish to consider their relevance to the Faraday Programme.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

It is the clear view of the ABPI that the establishment of Faraday Centres should not under any circumstances take funds away from existing institutions and collaborative programmes. Both the proposal to establish Faraday Centres and the DTI's pilot scheme should clearly be considered as new initiatives requiring new money.

(iii) Are there alternatives?

As indicated in (i) we consider that in view of the specific requirements of the pharmaceutical industry and the close liaison that has already been established with HEIs the interest in the Faraday Centre proposal may be somewhat limited. As it is presently envisaged however the proposal may have no relevance to the pharmaceutical industry, but we appreciate that for other industrial sectors the situation may be different. We feel that it is important for the Select Committee to appreciate that "industry" should not be considered as a single entity. Industry is a group of sectors each with differing needs and approaches to innovation. We accept that for some sectors there may be difficulties in the successful exploitation of technology and the proposed Faraday Programme, in providing an additional resource, may offer further stimulus for innovation.

We would suggest however that available funding from the government would be better directed in the first instance to ensuring that the present serious decline in the infrastructure of HEIs is prevented from worsening.

Despite a number of initial difficulties and problems of bureaucracy, programmes such as the LINK Scheme are beginning to prove an effective form of collaboration between industry and HEIs. We suggest that further support of the LINK scheme with research carried out at recognised centres of excellence could be considered an alternative to the current proposals.

(iv) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

It is somewhat unfortunate that the DTI felt it necessary to respond to the Working Group's draft report before there had been an adequate review by interested parties of the Group's proposals. The current DTI pilot scheme has in many ways confused the broader issue. Nevertheless there are some positive aspects of the scheme and there should be careful monitoring of its progress. As indicated we feel that there would be major difficulties in applying the Fraunhofer concept directly to the UK. The DTI scheme is seen as a useful addition to its current initiatives for supporting innovation, but is hopefully only the first stage of a much broader and adequately financed programme.

It appears that the DTI's proposals are of no relevance to the pharmaceutical industry, which has been excluded from participating. Interested pharmaceutical companies have been informed that they do not comply with the DTI's definition of an industrial research organisation for the purposes of the scheme.

(v) Should DTI's response have been more generous?

A figure of £2 million has to be considered somewhat limited and a more realistic level of support may be necessary to give adequate stimulus to the DTI's proposals. However we do accept that this cautious approach is based on the experimental nature of the present pilot scheme. As a minimum requirement the DTI should ensure that sufficient funding is made available for the full three year period of the postgraduate award as well as for a review of the benefits gained at the end. In comparison with other available awards the individual maintenance grants being offered by DTI are quite generous and should attract graduates of suitable quality.

(vi) What questions remain to be resolved before a greater commitment is made?

The cost implications and possible benefits of establishing new purpose-built institues similar to the Fraunhofer Institutes would need to be carefully addressed before any such initiative was considered. We do not believe however that this approach, ie the building of new centres would be worthwhile. We note that the DTI does not intend to replicate the Fraunhofer concept in the UK, and is unlikely to initiate any building programme.

The DTI response, although limited in its scope will still need to be assessed. The establishment of a Steering Committee, similar to that for the LINK Scheme could be considered. If the DTI intends that its scheme is extended to include sectors such as the pharmaceutical industry then it is essential that consideration is given to redefining what is meant by an intermediate research organisation. We consider that there are few organisations in the UK of relevance to the pharmaceutical industry that are actually eligible to participate in the present initiative.

Any scheme that encourages liaison and collaboration between discovery research scientists working in academia and industry must be welcomed, but needs to be carefully constructed.

Letter to the Clerk from the Association of Independent Research & Technology Organisations (AIRTO)

Thank you for your letter of 16 June 1992 regarding the enquiry by the House of Lords Science and Technology Committee into the proposal for the Faraday Programme. You may be aware that AIRTO has prepared a response to the proposals of the Working Group on Innovation and CEST. I enclose 10 copies of this AIRTO Policy Paper and should be pleased to supply additional copies if that would assist the members of the Committee (*not published*).

You raised a number of specific questions in your letter which are addressed implicitly in our Policy Paper but I shall offer explicit answers here.

(i) The Faraday version is right for Britain. It would not be appropriate to copy the Fraunhofer concept slavishly because conditions are different in the UK. However, it is important that all the critical elements of the German experience are recognised and addressed. In particular, this requires:

— post-graduate education within Intermediate Institutions; and

— untargeted funding to allow research to anticipate market needs.

(ii) There is no reason why the funds for the proposed Faraday Centres should be drawn away from existing institutions. Indeed, there is every reason to believe (as is borne out by the German experience) that the existence of Faraday Centres would free academic institutions to carry out their true task of academic research, unconstrained by the needs to seek industrial collaboration to obtain funding.

(iii) No better scheme has, to my knowledge, been proposed. The implicit alternative, which is to maintain the current position, is unlikely to lead to improved innovation within UK industry.

(iv) Yes.

(v) As I understand it, DTI's response has to date been restricted to the establishment of the Pilot Scheme. There would be merit in increasing the scope of that scheme by supporting more partnerships than the five that it selected from the much larger number of applications. It is not known if its response to the Faraday proposal would be sufficiently generous.

(vi) There are two levels of question to be resolved. At a higher level, there is a significant issue concerned with the strategic direction and management of the Faraday Programme. This relates closely to the second recommendation of the Working Group on Innovation and is addressed in the AIRTO Policy Paper which advocates the establishment of an Industrial Research and Technology Council. At a lower level, there are many detailed and generally uncontroversial points such as: will Faraday Centres be permitted to involve only one HEI? and what fraction of their time will the students spend in the Centre?

I trust that these comments and the enclosed Policy Paper will be of value to the Committee. In the course of preparing the Paper the views of all the members of AIRTO and other Research and Technology Organisations in several European countries which have "Fraunhofer" schemes were sought. The issues have also been explored with Government officials in both the UK and those other countries. I should be pleased to present oral evidence to the Committee on the views of the RTOs and experiences elsewhere, if the Committee should wish it.

Evidence from B H R Group Ltd.

OBSERVATIONS IN RELATION TO INTERMEDIATE INSTITUTES

From an Industrial perspective actions which:

(i) increase the flow of industrially trained and commercially aware engineers and scientists into UK Industry.

(ii) Increase the capability and the gross amount of industrially relevant R & D in support of UK industry.

(iii) Increase the investment by Government and Industry in underlying generic technologies.

(iv) Create incentives for Intermediate Institutes (RTOs) to achieve (i), (ii), (iii).

(v) Improve the interface between High Educational Institutes, Intermediate Institutes (RTOs) and Industry.

are to be welcomed.

The Faraday initiative helps to achieve all the above, as Intermediate Institutes (RTOs) provide a powerful contribution to industrial innovation through four main services to industry—contract research, collaborative research, technological consultancy and technology transfer/technology diffusion. They are able to transfer technology horizontally betwen customers in different industrial sectors. The UK has a strong RTO community and the Faraday initaitive will build on that strong foundation.

The Prince of Wales Working Group make two main recommendations (i) enhanced status and role and capability of technology development and transfer organisations and (ii) greater strategic direction in support of innovation. We welcome both these recommendations. It suggests the Faraday concept for the first and the formation of an Industrial Research and Technology Council for the second (see AIRTO report for details).

In general we would like to see the Faraday initiative enhanced by:

(i) making the strategic direction of the Faraday programme a function of an Industrial Research and Technology Council

(ii) ensuring that Faraday Programme hosts are truly commercially orientated and entrepreneurial

(iii) providing incentive, but untargeted funding to support the renewal of strategic technologies at the Intermediate Institutes (RTOs) in partnership with Higher Educational Institutes.

(iv) Faraday Programme Centres to operate as a network.

COMMENTS ON THE DETAILED QUESTIONS POSED IN THE LETTER FROM THE CHIEF CLERK TO THE SELECT COMMITTEE:

(i) Yes, the Faraday concept is right for the UK. The UK has a strong independent R & D sector which currently produce a limited number of PhDs in a manner similar to the Fraunhofer concept. With support from Government, the Intermediate Institutes (RTOs) can provide the base for the Faraday initiative.

(ii) The German experience suggests that this will not be the case but would release significantly larger sums from Industry.

(iii) Not that we are aware of. All of the concepts we have discussed rely on building on the capabilities of the Intermediate Institutes (RTOs).

(iv) Yes, the pilot studies were rushed through and were not thought out. Existing experience with postgraduate training in Intermediate Institutes (RTOs) was not taken account of. The scope of the pilot studies means they will not be too relevant to the full Faraday.

(v) Yes, the setting up costs are considerable and were not fully taken into account for the pilot studies. The lack of funding to support on-going training and support beyond year two of the pilot has caused unnecessary difficulties.

(vi) Who will give strategic direction to the Faraday Centres?—we suggest an Industrial Research and Technology Council. It is important that industry is involved at the strategic level and with the management of the individual Faraday Centres. This initiative is a three-way partnership. There are a number of detailed items to be resolved such as:

- Can a number of Intermediate Institutes (RTOs) and Higher Educational Institutes come together to form a Faraday Centre or just one Higher Educational Institute and one Intermediate Institute (RTO)?

  We would like more flexibility, especially if the first Faraday Centres are to be based on generic technologies.

- How closely will the Faraday Centre be integrated within the Intermedate Institute (RTO)?

  Our view is that it should be compeletely integrated.

- The remuneration package for the students must be attractive to attract the best students and those with some industrial experience who wish to return to complete a PhD.

  The level of 'untargeted' funding should be linked to the industrial income achieved by the Intermediate Institues (RTOs).

- It is our view that two levels of Faraday Centres are required. At the first level is the generic technology based Faraday Centre and at the second are sectoral Faraday Centres serving as delivery mechanisms for specific industries.

Evidence from BP

We understand from the CBI you are seeking views on the proposed Faraday Programme. Although we would clearly welcome any Government initiative which would demonstably bring Universities and Industry closer together we have doubts about the appropriateness of the present proposal for the UK (Q1). The CEST proposal provides a possible framework but it has both strength and weaknesses.

The strengths of the Fraunhofer Institutes (FhG) in Germany are;

- the flow of students through the FhG act as a powerful technology transfer mechanism
- the use of public funding to provide 'new technological capacities' which industry draws-on through contract R&D
- the catalyst role of the FhG as part of the industrial infrastructure of the nation plays an important role in focussing technology and influencing public decision making.

The weakness of the proposal is that it does not provide recommendations which properly address all of the differences between UK and German circumstances.

- The proposal recommends that members of the Association of Independent Research Technology Organisations (AIRTO) and ex-government laboratories encourage students to study for higher degrees while doing research at their facilities. However, many FhGs are on campus and share University facilities; this proximity lies at the heart of the University/Intermediate links in Germany. The recommendation to award degrees to workers at the UK intermediaries would only go a fraction of the way towards creating a system as effective as the FhG.
- The proposal makes no clear recommendation as to how the UK institutions would achieve long term public funding to create new technological capacities. Although variable, the FhG has a direct public funding commitment. To operate in the same manner, a UK institute would require a similar mechanism rather than an amalgam of existing publicly funded collaborative efforts such as LINK. The private and public funding commitment to the FhG is a product of the government/industry/bank/shareholder infrastructure in Germany which acts as a stabilising influence in the long term. If the UK institutions are to be successful in providing benefits to industry in the same way as the FhG, long term financial support would be required.
- The FhG has a very wide range of research fields which support the needs of Germany's competitive manufacturing industries; its wide scope is a key factor in determining its important position in the German infrastructure. On the other hand, the UK's current intermediates are more selective. For example, the UK's chemical industry is not as well catered for by the UK intermediates (in terms of experience and know-how) as the German Chemical Industry is by the FhG. The technology/industry base of the UK institutions would have to be broader if they are aiming to emulate the "catalytic" role of FhG.

In summary, and in answer to question 1, we do not see Faraday Institutes as a universal solution. They could be an expensive mistake particularly if funds are drawn from what little monies there are available for enquiry led research (Q2).

You ask whether there are alternatives (Q3). We in the Oil/Chemical Industry have successfully worked alongside University Departments for many years. However, we recognise that our approach may not be appropriate for other industry sectors. Rather than impose a single 'solution' on Industry it would be far better for Government to encourage a plurality of substantive proposals from Industry and Universities on how best to improve the transfer of knowledge and expertise which provides the building blocks of technology which Industry needs. Provided that there are mechanisms for Government to be satisfied that public monies are being used to good effect in backing such proposals then there is no requirement for Government to be over prescriptive about the details of technology transfer schemes. Such details are best worked out by Universities and Industry in the light of the particular circumstances and needs. Certainly any initiative encumbered by rules and bureaucracy will probably impede progress and tie up funds and effort better used elsewhere.

In our view the DTI was right to seek further views of the CEST proposal. However, they should not have proceeded with the pilot scheme (Q4, Q5). This was done in great haste and with little or no consultation. The funds could have been better used to provide for more CASE Awards to Universities departments. CASE Awards are a proven mechanism for industry to work alongside Universities and are increasingly in short supply.

In conclusion, the Faraday Programme provides possible ways of improving the transfer of knowledge and expertise between UK Universities and Industry by changing to the role of intermediate organisations. However, whilst the recommendations made are feasible, they do not necessarily offer a solution for the UK as they do not take full account of the underlying structural reasons for the success of the Fraunhofer Gesellschaft.

Letter to the Clerk from the Managing Director of British Textile Technology Group (BTTG)

I write in reply to your letter of 15 June, and would respond to the questions you ask in the following way:

(i) The Faraday version of the Fraunhofer concept should, in my opinion, be "right for Britain", as you put it. Time will tell, of course, but it ought to work.

Clearly, it is sensible (and long overdue) to get the best UK scientific talents behind British Industry. In some areas, this does happen, notably in the chemical, oil, pharmaceutical and electronic industries. But for the remainder of British manufacturing industry, technical collaboration is ad hoc, and low in level.

The Fraunhofer system clearly aligns the State and its educational system alongside German manufacturing industry, and that situation (a) is what's wanted, and (b) seems to work well, according to the various reports on, and accounts of, it. The Fraunhofer system does seem in part to be rather elaborate: for example, the cross-posting of senior staff between the II and the HEI.

Another example might be the apparent networking of the Fraunhofer Institutes, regardless of the industries each has most to do with. That seems unnecessarily bureaucratic to me.

The Faraday version looks more simple and direct, and, as such, more likely to succeed. What is being proposed (as I understand it) is: choose an II which has a good record of working with Industry, get it to couple with an HEI of good quality in relevant science to form an FC, give the FC sufficient resources to produce the industrially-relevant research results, and a significant flow of industrially-aware PhD's, and monitor performance. The outcome is almost certainly going to be positive, if all the steps are carried out thoroughly.

(ii) As I read the current proposals, not as far as the II's are concerned. Unless FC funding draws money from eg DTI funds—which currently support a wide range of research in II's not chosen to be FC's, and also non-FC work (ie research projects not involving FC trainee PhD's) in the chosen II's. If it did, this would be bad, because an amount of good R & D work—not necessarily FC material—is able to be carried out with this funding support.

As far as the HEI's are concerned you would have to ask them. I know that there were considerable fears expressed at the CEST QE II Centre Seminar on 3 April: the academics present seemed to feel certain that the FC's would mean less money for the HEI's sooner or later.

Over and above these comments, it seems inevitable that—even if the intention is not in Government's mind at present—funding across the board will become more selective. Government's purse is not infinite. If the consequence of that is that some second-rate work cannot any longer be supported, then so be it—not necessarily a bad thing if the selection process is thorough.

(iii) Probably, on the grounds that there are always improvements to be made. However, to my knowledge, nothing better has so far been proposed: and we will no doubt make improvements, where necessary, as we go along.

[Whatever system is ultimately found to be best, it is crucial that the right climate is created, for Industry to play its part. Please see my comments at the end of this letter].

(iv) Perhaps. But then changes can probably be made later when the WGOI's proposals have been perfected/approved.

One slightly unfortunate consequence of the DTI's response is that the pilot programme is perceived by some as just another route to a Higher Degree, a la CASE or PARNABY. Fortunately, I believe that the successful partners themselves understand the twin aims—namely, industrially—relevant research and the flow of industrially—aware PhD's into Industry—sufficiently well to buckle down and produce the goods. Then people will understand what has been started. It's just unfortunate that the launch wasn't better worded: indeed, Government should now be being applauded for this initiative to attempt to channel more of our best young brains into work for British Industry's benefit.

(v) **Almost certainly, yes.** We will have to see what the successful partners can do with what they've been given.

One clear example is that DTI should have simultaneously given **fast-track status to the projects** mentioned in the successful partnership's submissions. In our case, we are beavering away to get DTI's approval for sufficient work to be in place for the 10 PhD's we are expecting to receive on October 1. We hope to be successful in time (although the process usually takes about 12 months): DTI fast-tracking commitment would have been very helpful. Indeed, it should not jeopardise DTI's principles or controls at all, given that DTI/SERC have already judged the work programme to be of sufficient calibre to warrant the selection of the partnership in the first place.

Start-up costs look pretty lean, but as I've said before, no doubt any changes found to be *really necessary* might be accommodated within, say, project costings. We shall monitor our progress carefully, with DTI.

(vi) First, **running experience of the DTI pilots over the first year** will, I'm sure, be very valuable, in learning what to do and what not to do in the future.

Second, whilst this experience is being gained, DTI/WGOI/CEST/OST could be taking a view on precisely **what areas of science and technology are the most important** to stimulate/develop, in relation to a more successful British Industry for the future.

With such a "blueprint" or "plan", appropriate FC's could be set up as early as October 1993, with the benefit of lessons learnt during 1992–3 with the pilots.

A fundamental question which will need to be resolved before greater commitment is made, is the **extent of Government funding** for this exciting initiative, in terms of **time** and **amount. A long-term commitment is required,** I believe: FC's are not likely just to deliver "quick fixes". And the **resources should be sufficiently large** (a) to be quickly available to back likely winners, and (b) to remove any doubt as to Government's determination to force this sea-change through.

Finally, I have to say that even if all the above is magnificently well done, **the enterprise will fail unless Industry can become**—one way or another—**prepared to invest** in its future by way of R & D. CEST's

Faraday Programme proposals spell out very clearly how they see Industry gradually increasing its financial support for FC's after government funding to start-up/pump-prime. The fact is that—with the exception of the high R & D spend industries already mentioned—British Industry spends appreciably less than one per cent (0.7 per cent is the most recent figure I have) of its turnover on R & D. As is well-known, this is far less than our major competitors, and far less than is necessary if we are to compete properly in technically-based markets.

All this is well documented, and factors such as high interest rates, short-termism etc, are well known. So too is the variety of measures which Government could take to combat this. Probably the most effective would be *tax incentives* for genuine R & D. Indeed, your own Committee recognised this (see amongst references (*) at the end of this letter). **I believe it essential that tax incentives for genuine R & D are introduced as soon as possible:** I cannot see any other way in which companies other than rich ones will be persuaded to invest in technology for their future, including financial investment in the Faraday Centres.

It has been said (e.g. Lord Reay, Westminster, December 1991) that such tax incentives are not the Government's policy because taxes would have to be raised elsewhere, and the Government prefers a "level" tax structure. I understand that, but it ignores the fact that companies, industries and nations which spend more on R & D normally do better than those which don't, by way of income and profits.

Thus a far-seeing Government will do what it can to foster higher genuine R & D spend, not as a tax "hand-out" but *as an investment*—in the expectation of higher returns later on through the corporation tax system.

I hope I have not strained your patience with my thoughts on what is a well-known subject, and what may appear to be outside the Faraday Programme debate. But I do believe it is highly relevant, and that FC's will find it *extremely* difficult to reach the financial targets suggested by CEST in its Final Report to the WGOI, unless Industry is stimulated (in the way I have suggested) as well as II's and HEI's being stimulated (in the way the Faraday Programme proposes).

I hope that these comments are helpful. If I can help in any other way, please let me know.

Dr. D. N. Munro

Managing Director

* *References* (sample):

Getting The Message Across, Innovation Advisory Board, July 1991.

Report of the European Parliament on Industrial Policy, July 1991, e.g. item 27.

House of Lords Select Committee on Science and Technology, Innovation in Manufacturing Industry, January 1991, e.g. Vol. 1, item 10.25.

Focus on Innovation, DTI, 1987, e.g. p.8.

Plus: various public statements by the major United Kingdom political parties e.g. Labour Party commitment to 125 per cent tax credits, June 1991; and

The Parliamentary and Scientific Committee Annual Report 1990, p.20, lines 9–11.

Additional Evidence from the Centre for Exploitation of Science and Technology (CEST)

SMALL AND MEDIUM SIZED ENTERPRISES.

The contribution that Small and Medium sized Enterprises (SMEs) can make to the creation of both wealth and employment opportunities rests on the performance of the medium sized rather than the small companies. The benefits of the Faraday Programme are of particular relevance to these companies, especially those engaged in manufacturing based on the physics based sciences, but some of their characteristics are not well known or, are misunderstood. As a group, medium sized companies employing between 50 and 499 people:

employ twice as many people in total as the smaller ones and are easier to target because of their substantially lower numbers (Figure 1);

create up to 20 per cent more wealth per employee than smaller companies (Figure 2).

INTERMEDIATE INSTITUTES

SMEs are more likely to turn to private research institutions or consultants for technical information than they are HEIs (Table 1). However, the role of these institutions and other organisations 'intermediate' between industry and HEIs is not widely recognised despite the fact that they:

perform significantly more research under contract than do HEIs (Figure 3);

have well developed channels of communication with SMEs, 80 per cent of the clients or members of the 45 members of AIRTO, for example, being SMEs (Table 2).

The Working Group recognised that, particularly for SMEs, the cultural divide between industry and HEIs is too large to be bridged and considered that these organisations could have a significant role to play in improving the competitiveness of these companies through technology. The Group, therefore, recommended that:

> *"the status, role and capability of intermediate organisations engaged in technology development and transfer be substantially enhanced."*

The Fraunhofer Institutes in Germany merely provided the principles on which such a policy of enhancement could be based, namely the flow of:

> ***ideas*** from industry to academia *and vice versa;*
>
> ***skills*** from HEIs to industry via research associates working towards higher degrees whilst engaged on high quality science of relevance to industry;
>
> ***scientific knowledge*** from researchers and HEIs to industry through research to satisfy longer term needs and shorter term contract R and D; the two activities co-existing.

The relationship between the communities involved and the flows between them are shown in Figure 4.

Funding

The Faraday Programme will fill a critical gap in the funding of both Research and Development. The Group believes that responsibilities for scientific research and technology development should be divided as follows:

> the government funds curiosity driven, basic or fundamental research;
>
> the development of generic or enabling technology is a government concern and can be funded from public sources;
>
> collaborative demonstrator programmes, such as LINK and EUREKA, concerned with the identification and exploration of new applications of enabling technologies, are to be funded in partnership between industry and government (50:50);
>
> the development of products or processes under contract and for specific applications is the responsibility of industry.

The second category of generic or enabling technology is a vital step in the exploitation of science which is currently underfunded. Faraday Centres would be provided with an amount of non-directed funding to enable them to engage in technology development. This funding, together with the partnership of the Faraday Centre with HEIs enables the Intermediate Institution to 'refresh' its technology base to the benefit of its members and clients and, to the benefit of HEIs through more effective exploitation of their work. In addition, each Centre will provide a national or international focus for enabling technologies.

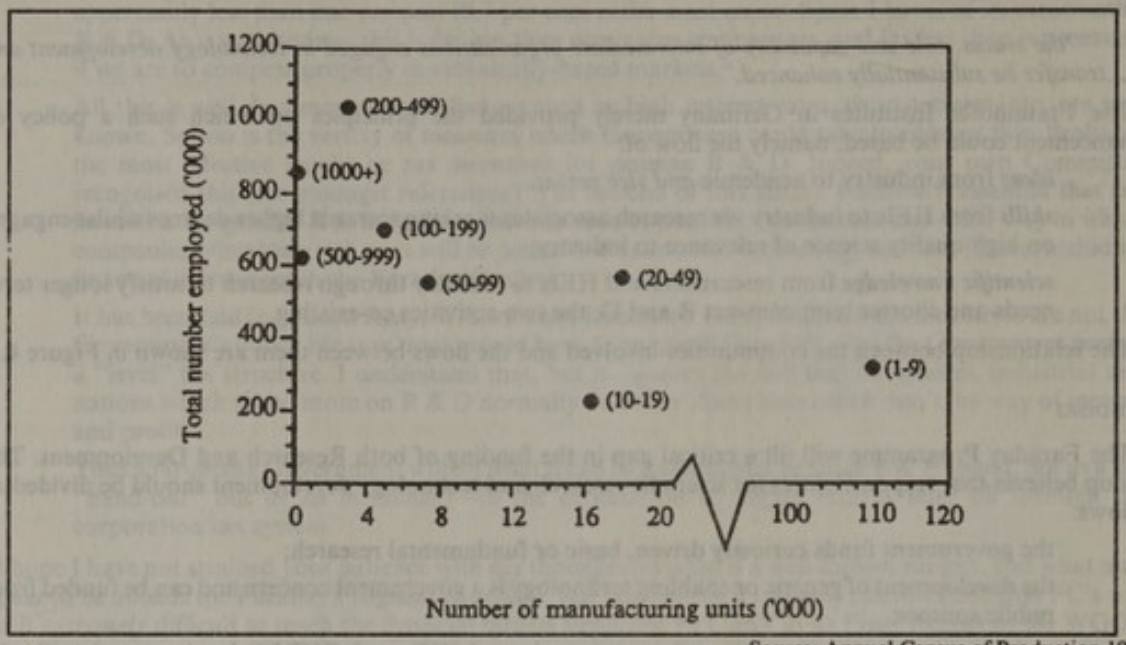
The franchise concept allows for withdrawal of Faraday status from Institutes which are not performing. More positively, it also enables changes to be made to the portfolio of technologies included in the Programme.

The Faraday Programme and other schemes

CASE awards and the Teaching Company Scheme (TCS) rely on individuals. In additions, the impact of TCS, widely recognised as successful, is still relatively small; over the 16 years it has been running, only 1,200 participants had completed their assignments by April 1991. The five postgraduate Training Partnerships alone will produce 100 postgraduates in three of four years time so the funding of the Faraday Programme as recommended would have an impact of an entirely different scale.

Figure 1

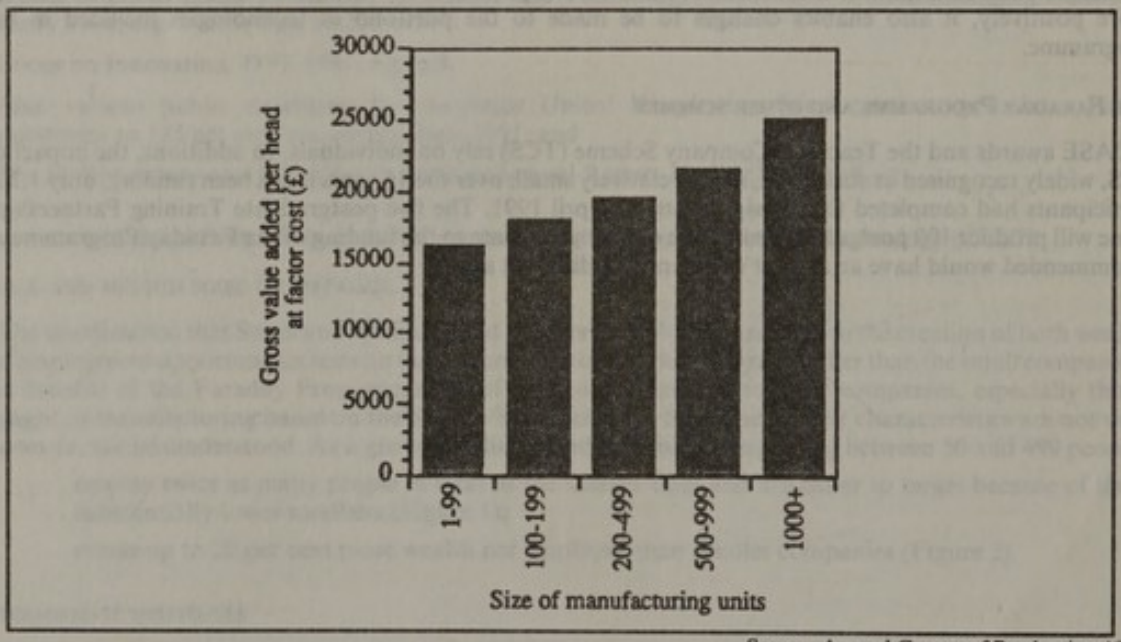
Total number employed in different sized units (employees)



Source: Annual Census of Production 1989

Figure 2

Gross value added per head (£) at factor cost



Source: Annual Census of Production 1989

Table 1

External sources of technical information used by SMEs

External Source	Local %	National %	International %
University/higher education	12.5	12.2	3.3
Private research institutions or consultants	9.4	22.4	5.6
Government research establishments	2.0	11.6	2.6
Suppliers or customers	22.2	54.3	23.0
Other firms	10.7	23.9	9.6
Trade or professional journals	12.4	59.1	24.0
Total responses (no.)	1172	1172	1172

Source: The State of British Enterprise; Small Business Research Centre, University of Cambridge, 1992

Table 2

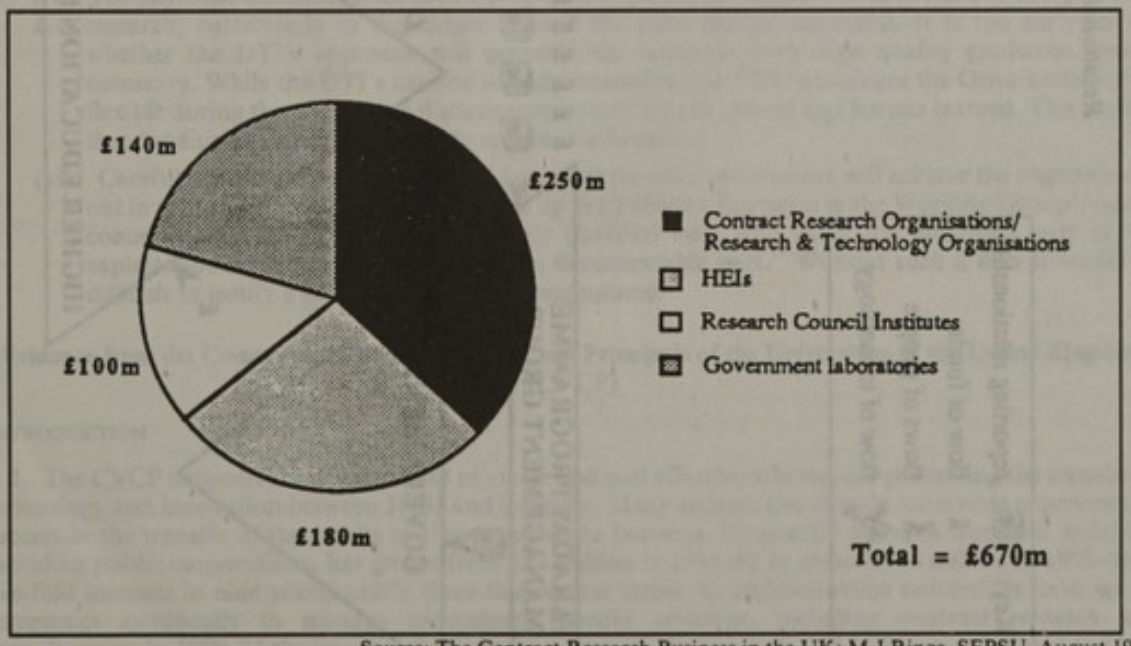
Client/member base of AIRTO members in 1988

Size (employees)	Number	
0–200	12,800	(64%)
200–500	3,200	(16%)
500+	4,000	(20%)
TOTAL	**20,000**	(100%)

Source: The Contract Research Business in the UK; M J Ringe, SEPSU, August 1991

Figure 3

Income from contract R & D for industry 1988-89



Source: The Contract Research Business in the UK; M J Ringe, SEPSU, August 1991

Figure 4
Relationship of Faraday Centre to Industry and HEIs

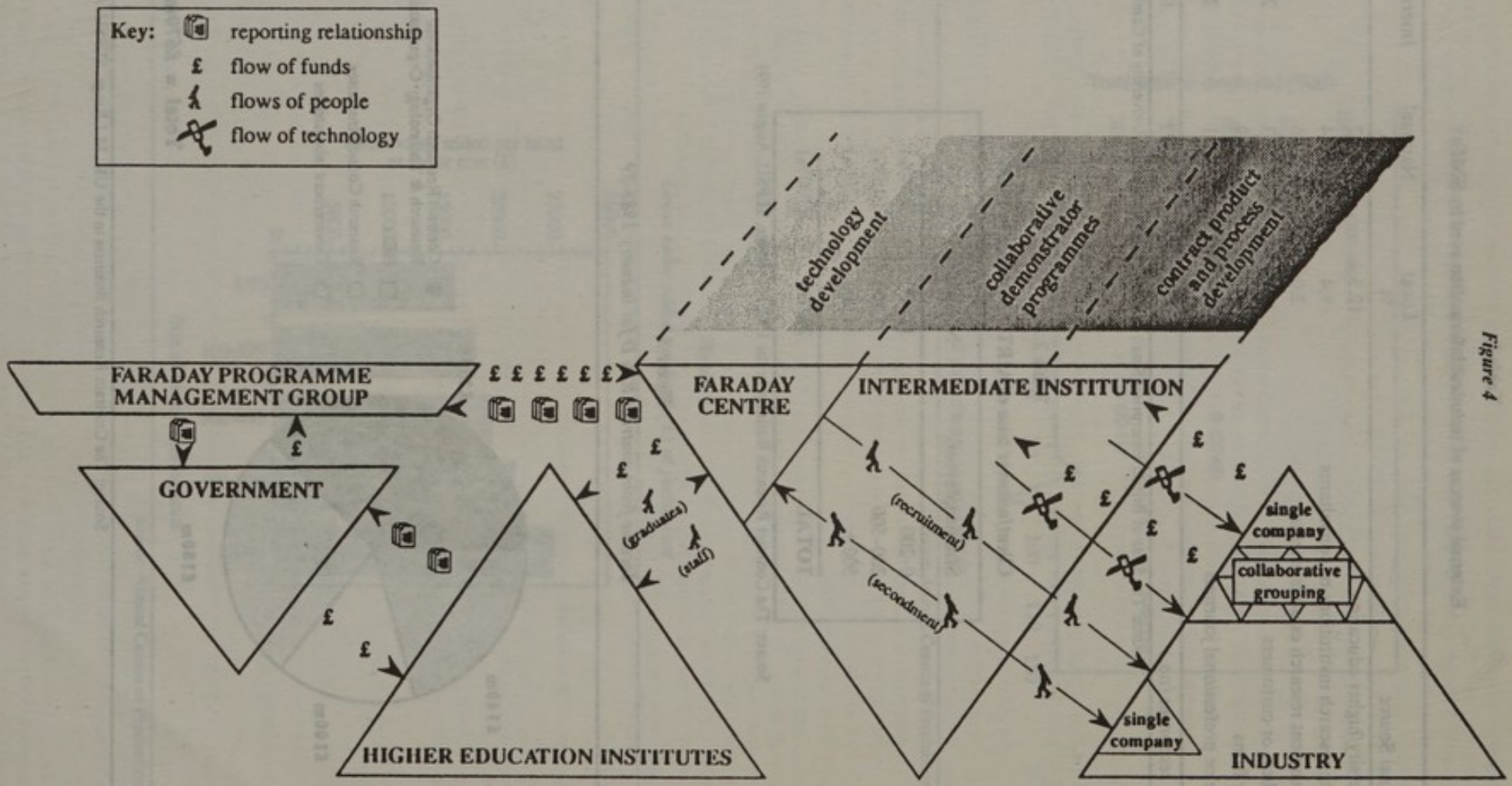


Figure 4

Evidence from the Confederation of British Industry (CBI)

The CBI welcomes the opportunity to comment on the DTI's Faraday Programme which has aroused the considerable interest of members.

CBI members stongly support measures which will

— increase the flow of trained, commercially aware researchers into UK industry;

— improve the exploitation of relevant science and technology by UK industry.

These issues are particularly important if companies are to achieve sustainable growth in the highly competitive marketplace which now exists.

Taking the questions in the order posed by the Committee:

(i) The CBI agrees with the Prince of Wales Working Group that, "The prime role of any proposed programme should be the creation of a continuous flow of enabling technologies for future business opportunities.....", via a mechanism which encourgages the transfer of "...appropriately qualified staff who carry the unwritten part of the exploitation of technology as well as the written part." The CBI believes there would be significant benefits to UK business in general, and SMEs in particular, from the promotion of institutions charged with delivering the improvements listed above. While accepting that the Fraunhofer Gessellschaft concept may have prompted the idea for Faraday Centres, the arrangement of the German model makes it unsuitable for direct translation into the UK context. Although there are institutions in the UK which might claim competence to fulfil the role of the proposed Faraday Centres, which are characterised by:

— post-graduate education/training within institutions intermediate between Higher Education and industry;

— untargeted research funding in anticipation of market opportunities;

none operate in the way envisaged, which makes it essential to proceed cautiously. The CBI endorses, therefore, the 'pilot' approach adopted by the Government and recommends close monitoring of the results. There may well be merit, for example, in widening the scope for host organisations in a full programme.

(ii) CBI members believe that the creation of Faraday Centres should not justify withdrawing funds from existing institutions. Faraday Centres have been proposed to fill a perceived gap in the process of exploiting technology by UK business, particularly SMEs, which should not be construed as criticism or failure of other institutions and their programmes such as, for example, CASE, LINK and Teaching Companies.

(iii) The CBI also agrees that there is a deficiency in the process of exploiting technology within the UK. The Prince of Wales Working Group has proposed a solution and to the CBI's knowledge, no better alternative has been put forward. Indeed the Faraday concept should offer an opportunity to provide added value to the existing mechanisms.

(iv & v) The key issue concerning the DTI's proposals is the supply of suitable applicants to carry out the research, particularly in the longer term if the pilot proves successful. It is too early to say whether the DTI's approach will generate the response from high quality graduates that is necessary. While the DTI's caution is understandable, the CBI encourages the Government to be flexible during the pilot phase if maximum benefit is to be gained and lessons learned. This implies that funding should be adequate to ensure this happens.

(vi) Careful attention will have to be paid whether the pilot programme will achieve the objectives set out in the introduction above. As flagged up in (i) above a key point in the Working Group's report concerns "....the flow of appropriately qualified staff who carry the unwritten part of the exploitation of technology as well as the documentable part." Without such a flow it would be difficult to justify a full Faraday Centre programme.

Evidence from the Committee of Vice-Chancellor and Principals of the Universities of the United Kingdom (CVCP)

INTRODUCTION

1. The CVCP supports the development of viable and cost effective schemes for promoting the transfer of technology and innovation between HEIs and industry. Many universities already have wide experience of success in the transfer of the results of their research to business. Income for research from UK industry, including public corporations, has grown from £23 million in 1981–82 to about £115 million in 1990–91, a five-fold increase in nine years, nearly three-fold in real terms. In addition some universities have set up companies specifically to manage technology transfer activities, including contract research and consultancies. In 1990–91 the income of university companies from grants and contracts amounted to £12.6 million of which £5.4 million came from UK industry and public corporations.

2. Most universities have active directors of industrial liaison; many have wholly-owned technology transfer companies and own or run science parks; some of the CVCP's member institutions have taken a direct stake in the British Technology Group (BTG). The CVCP therefore views with interest the proposal of the

Working Group on Innovation for the establishment of a new type of UK organisation, the Faraday Centre, to further the development and transfer of "enabling" technologies and of technological innovation.

3. The concept of a network of Faraday Centres must be launched on a sound basis. However, the proposals for establishing a network suggests that the concept needs further detailed consideration and clarification if such Centres are to be successful. This paper primarily discusses the issues which CVCP considers to be essential to success and which must be addressed before the launch of a full scale programme. The CVCP urges the Government to consult widely and urgently both with experts in technology transfer and with higher education institutions many of which have substantial experience of links with industry in the commercialisation of the results of their research. The CVCP can offer help in this, particularly through its contracts with university directors of industrial liaison, with science parks and with heads of institutions. The BTG should also be asked to advise at the earliest possible opportunity on the feasibility of the Centres and how they might most effectively be organised.

Purpose and location

4. The proposal by the Working Group on Innovation is for the Faraday Centres to be modelled on the German Fraunhofer Institutes. However, the Faraday Centres are described rather differently from what is understood by a Fraunhofer Institute. The latter are essentially development arms of research orientated university departments or groups of departments. They undertake contract development work and some contract applied research and in this sense complement the basic and strategic research of the university by taking research results nearer to the market place. In contrast, the Faraday Centres are described as intermediate institutes, like private research organisations or research council institutes, with the purpose of developing specific enabling technologies and work on a contract basis. CVCP argues strongly that the Faraday Centres should be modelled more closely on the Fraunhofer Institutes in the form of independent development companies co-located with universities but with a strong management input from an industrial research centre of excellence on a partnership basis. Experience shows that initiatives of this kind which are not linked closely with universities suffer from not having access to the staff and associated resources of the institutions which are intended to provide much of their source material and the life blood for innovation.

5. It is essential to avoid overlap between the Faraday Centres and existing mechanisms for technology transfer. It remains to be shown how the Centres would be truly additional to the teaching company schemes, LINK programmes, research council schemes such as CASE, and the Parnaby Engineering Doctorates which are being piloted in three centres.

6. In the context of clarifying objectives it is essential to define explicit criteria against which to evaluate and monitor the success of the Faraday concept.

Funding

7. The sources of funding for Faraday Centres must be clearly identified before a programme is launched. The touchstone for their feasibility and probability of success will be industry's willingness to contribute a significant share. It is essential that new money is secured. It would be damaging to divert funds from existing institutions and science and engineering programmes since these are crucial to the expansion of the knowledge base from which further enabling technologies will emerge.

8. The Centres must be funded and structured in such a way as to enable them to adapt to new knowledge and technologies and respond quickly to changing opportunities, and in new fields.

9. The arrangements for ownership of intellectual property need further attention. If universities are to participate in Faraday Centres as major partners they will wish to see benefits from the intellectual property generated as a result of their involvement.

Other needs

10. The Government should give serious consideration to the need to provide support structures within industry for enhancing technology transfer and translating inventions into innovation in the market place so as to complement the work of the Faraday Centres. There is a need to provide technicians and supervisors qualified at or below degree level to support, implement and operate the systems which embody research and innovation. Equally there is a great need to strengthen national and company financial and management systems to enable successful transfer to industry from research and to optimise production of goods and services using innovative techniques, materials or designs. Innovation can thrive only if all levels of industry are appropriately developed and resourced to meet the needs of new ways of working, new materials and new products.

The PhD

11. It is envisaged that many of the staff of the Faraday Centres would be research graduates working for higher degrees. However, the Faraday Centres will be concerned largely with developmental work which may not be considered suitable for doctoral research in the UK where universities nearly always require evidence

of original research by students. Further thought needs to be given to whether students in the Centres should be working towards PhDs. The postgraduate training objective of the Centres is more likely to be secured if they are hosted by universities.

REVIEW

12. The CVCP recommends that the performance of the Faraday Centres should be reviewed against explicit criteria and expected 'deliverables' after a period of three to five years, an analysis made of their role in relation to other spending priorities in this area, and an appraisal conducted of the development of the context for successful technology transfer. Contracts for the establishment of the Centres should include clearly defined "sunset" clauses which would enable public funding to be withdrawn if performance targets are not met.

Letter to the Clerk from the Vice Chancellor of Cranfield Institute of Technology

I am responding to your request on behalf of the Select Committee on Science and Technology for views on the Faraday Programme. My response is framed around your six questions:

1. Is the Faraday Programme right for Britain? The primary role of the Programme is defined in paragraph 1.2.2 of the Working Party's final report as:

> "the creation of a continuous flow of enabling technologies for future business opportunities including both the enhancement of existing products and processes as well as new products and processes with the objective of raising the competitiveness of participating industry."

Such a programme has to be good for Britain. It was the reason for the creation of Cranfield Institute of Technology in 1969 and has been our mission ever since. It is for this reason we are both very supportive of the principles underlying the Faraday Programme and cautious about the means proposed to give practical effect to these principles.

The success of Cranfield in achieving its mission has been based on;

(i) Highly skilled staff working in an environment in which the application of knowledge to the solution of the real, practical problems of industry underpins all our work, both teaching and research.

(ii) Since DES (now DFE) funding accounts for only about 15 per cent of our income, it has been essential for our development to generate 85 per cent. of our income from non-DES sources. This has created an entrepreneurial enterprise spirit in which all staff work in very close proximity to industry.

(iii) Technology transfer to industry is effected in two synergic ways:

(a) Direct transfer of ideas to those sponsoring research contracts. Our current industrial UK R&D contract income amounts to about £14 million per annum.

(b) Transfer of ideas into industry by our students. Almost all our students are postgraduate and virtually all of these follow industrial careers after graduation; this is very different to a "typical" university. Whilst at Cranfield, they are taught by staff in very close contact with a range of industrial organisations; they are thus taught in an environment of industrial relevance.

Thus it would be correct, using the Faraday terminology, to describe Cranfield as a number of Faraday Centres on each of our sites. We believe there are significant advantages in having several such centres on one site, because we can demonstrate a number of examples where we have achieved technology transfer from one industry to another, for example between:

aerospace technology

automotive technology

marine techology

process industry

This would be a lot less likely to occur if the relevant Faraday Centres were on different sites. where staff from the different centres met either occasionally or never at all.

2. Will Faraday Centres draw money from existing institutions? Undoubtedly the answer will be yes, in as far as the report suggests that there will be little new money. Furthermore Faraday Centres will compete for EUREKA and LINK funds so drawing further funding away from Higher Education Institutions (HEI's).

Is this good or bad? In so far as the money is drawn away from institutions such as Cranfield, which are already acting as several Faraday centres on one site, we believe it will be bad for at least two reasons:

(i) It will reduce the transfer of technology between industrial sectors mentioned above.

(ii) It will reduce the level of *direct* industrial contact within the HEI so reducing the industrially relevant environment within which all our teaching and research is undertaken. The key word here is *direct*. The success of Cranfield is based on all its staff having close and *direct* links to industry. If any of these links are channelled through Faraday Centres in intermediate institutes they will result in staff

having weaker links with industry and less understanding of the true "coal-face" problems of industry. This will quickly be reflected in their teaching which today has the hallmarks of immediacy and relevance.

3. Are there alternatives? Clearly there are, and one we advocate strongly is to develop Faraday Centres within Cranfield and those few HEI's which have followed Cranfield in developing *significant* links with sectors of industry. *Significant* is an important word here, because critical mass is essential.

4. We believe that the DTI's response could have benefited from more extensive discussion with organisations like ourselves who have years of practical experience in the implementation of what the Working Party is suggesting. We would have liked to see joint DTI-SERC agreement and liaison. From our perspective there seems to be a split developing between SERC support and DTI support. If that split were to develop into SERC supporting basic and strategic research and DTI supporting applied research, we foresee major problems ahead. There is, or ought to be, a very strong continuum between basic research at one end of the spectrum and applied research and development at the other. If there is a change of funding mechanism along that continuum then it is very likely that many projects near the interface will fall down the crack. The result will be to reinforce Britain's historic weakness in converting good basic and strategic research into competitive products on the world market.

5. Should DTI's response have been more generous? The response of the DTI to the HEI's has been particularly ungenerous. In effect the HEI's were initially asked to increase student numbers without any additional funding other than the fee income. This was inadequate to cover the supervision process being asked of the HEI's. This has now been changed under protest to a single payment for the two years of £70K. This is still below cost. Clearly it is up to individual HEI's to respond in their own way. Some we understand have agreed to transfer funds from other sources to subsidise "Faraday students". We can see no justification for this, believing that if a concept is right (and we believe the Faraday concept is right) it should be fully funded. We have resolved this by only agreeing to participate in the Faraday Programme with partners prepared to pay our full costs.

We understand that the DTI has not fully recompensed the SERC for support of the studentships in the first two years of the scheme. At the present time no funds have been allocated to the SERC for the support of the scheme in years three onwards. This has put a further strain on the SERC Engineering Board Education and Training Committee budget which was already being stretched to find additional funds for two further Parnaby Centres, in which the new Engineering Doctorate programmes relevant to the needs of industry are being developed.

6. Two fundamental questions remain to be resolved:

(i) Should Faraday Centres be located soley in intermediate institutes or should some be located within selected HEI's? We believe that Faraday Centres located in certain special HEI's, such as Cranfield, would be even more effective than those based in intermediate institutes for the reasons expressed in paragraph 1 above.

(ii) The second fundamental question which needs to be resolved is one of resources. If the government perceives that the technology transfer process between academia and industry needs improving by whatever means, it is prepared to commit additional funds to the programme? Without additional funds the programme will only be developed at the expense of others.

I trust your Committee finds this response helpful. Should you wish, I or my colleagues would be happy to answer any further questions the Select Committee may have. We feel very strongly that the concept of the Faraday Programme is right for Britain; our comments are addressed to the most effective way of achieving the benefits it aims to deliver.

Letter to the Clerk from Professor Michael Peckham, Director of Research and Development, Department of Health.

Thank you for your letter of 11 June on Faraday Centres.

I am supportive of the Faraday concept and the aim of bringing academia and industry together. The UK's strengths in medical research have not been matched by the necessary emphasis on development and technology transfer. Faraday Centres could make a cost-effective contribution by developing links between HEIs and industry or by promoting links between HEIs and the NHS as a health care 'industry'.

An important objective of the Department of Health R & D strategy is to establish strong links between the NHS, industry, other research funding bodies and the HEIs. Faraday centres could play an important role in enabling technology transfer in, for example, the medical devices industry where the participation of small and medium size firms working in the biomedical technology areas would have particular value.

Medical schools and postgraduate institutes serve not only as a research base for their associated hospitals, but also as a conduit between health care and basic research activities in other settings. In this sense they are intermediate between basic research and the NHS 'industry'. There may be scope for considering whether all or part of a medical school or postgraduate institute which is in the lead in a particular area of R & D of interest to industry, could usefully be a candidate for Faraday status. This is something that might be borne in mind as the NHS R & D strategy and the Faraday programme evolves.

Letter to the Clerk from the Company Secretary of the Defence Research Agency (DRA)

In your letter of 11 June you asked for our views on six questions concerning the proposed Faraday Centre initiative, which the Select Committee is currently investigating. Thank you for inviting us to make an input to the Committee.

We do believe that the Faraday Centre proposal is a potentially valuable initiative, especially in emphasising the transfer of technology and state of the art knowledge to industry via the transfer of people. It is important to strengthen the capability for innovation in UK industry, and to provide career paths for young scientists and engineers in the UK which give them the right initial experience and also motivate them to be champions of innovation.

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

As the CEST working paper notes, the UK already possesses the basis for the Fraunhofer model through for example the 14 contract research organisations in the UK with turnover > 5m ecu pa and the MOD laboratories and other laboratories given agency status. To this existing base must be added the explicit partnership with universities in the training role and the emphasis on the transfer of staff to industry. The marginal cost of adding these two dimensions is small, certainly in the case of the MOD laboratories.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

If the Faraday Centres are successful they will each be a focus of excellence within the UK in their technical area. It is reasonable to expect that the universities associated with the centre may, by virtue of their improved capabilities, compete successfully for a larger share of UK academic funding in that area and may also increase their contract work. This focussing is beneficial provided it results from competitive excellence.

Faraday Centres will also attract contracts from industry. If this were to reduce still further the internal expenditure on R & D within industry it would seem a bad outcome. But as noted in the CEST working paper, the UK contract research is £670 million pa, and unless the Faraday Centre initiative were launched on a very large scale it would not substantially change this level of contract research. Moreover, the market for contract research is expanding worldwide, and the additional revenue could come from this expansion. Indeed, a benefit of the Faraday initiative could be to strengthen the international competitiveness of the UK's contract research industry. Additional revenue may also come from smaller UK firms which are expected to be beneficiaries of the Faraday Centre initiative.

(iii) Are there alternatives to the Faraday Centre concept?

Within the Faraday Centre concept there are alternatives of emphasis. How far, for example, should one emphasise small companies, which though numerous do not contribute greatly to the UK's GNP, as compared to the larger firms which are the main focus of the CEST German-UK comparison?

A concept which has some similarity to Faraday Centres is the Research Initiative concept which DTI launched in 1984 and which was modelled on the successful Japanese VLSI initiative. A few Research Initiatives were set up by DTI within the Royal Signals and Radar Establishment and within Universities, in the areas of neural networks, silicon hybrids, advanced robotics and VLSI circuits. These were quite successful; they provided good co-located research and technology transfer and spun-out commercial contract research activities. But the RI concept has withered recently. The reason for this is not clear but it may be that the effort needed to set up a RI across many participating companies was too large.

(iv) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

There is scope for several models within the overall Faraday concept. The scheme launched by DTI is useful, certainly as a trial. Its advantage over the CASE award scheme is that there is a clear partnership between the University and the II, and the scale is much larger. However the arrangements for flow of staff to industry need to be developed. The DTI also stipulated that the partnership should be between the II and a single University. This restriction prevents smaller University groups participating in parts of a technical area where they have special excellence, and in any follow up to the pilot scheme or if Faraday centres are established, it might be better to allow two or perhaps three Universities to participate in each centre.

(v) Should DTI's response have been more generous?

We understand that there were 58 proposals, and that 5 initial centres have been set up by DTI, none of which are within Government agencies. DRA made 2 proposals and was a partner in a third. None of these was successful, although they were good proposals and cost effective, the only cost being the salary and academic training cost of the student. We therefore believe that DTI must have been forced to turn down a number of good opportunities. Given that the purpose of the DTI initiative was only to trial one, albeit

important element of the Faraday concept on a few cases, the initial expenditure is probably right, even if many good opportunities were turned down. But it would be useful to gain experience of hosting Centres in agencies as well as in contract research organisations.

(vi) What questions remain to be resolved before a greater commitment is made?

Although the MOD laboratories are cited in the CEST working paper as likely hosts there has been no approach to us to discuss the scheme, apart from the invitation to participate in the DTI trial. We therefore believe that much needs to be done to flesh it out in practical terms before making a greater commitment. A sensible next step might be to establish a project office responsible for doing this, which could provide a single focus for the scheme.

Letter to the Clerk from the Chief Advisor on Science and Technology of the Department of Trade and Industry (DTI)

I attach a note setting out DTI's response to each of the questions in your letter. There are two points from DTI's perspective that I would wish to emphasise. First, our primary objective in considering the proposals on Faraday Centres is to capitalise on existing research institutes/organisations and research funding for the benefit of industry. Second, the proposals should not be considered in isolation from the rest of the technology transfer infrastructure in the UK.

If you feel that I can be of further help to your inquiry please let me know. Also, we are currently in receipt of a lot of inputs to the debate on the Faraday proposals and look forward to reading the inputs to the Select Committee's own enquiry.

Evidence from the DTI

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

Answer: It is widely accepted that Britain needs to develop a more effective and coordinated approach to technology transfer, particularly to develop a more effective bridge between academe and industry. The proposed Faraday Programme contains a number of elements which could make a significant contribution to this bridging process. The Faraday proposals incorporate lessons learnt from the German Fraunhofer-Gesellschaft Institutes. DTI accepts that it would not be sensible simply to copy these in the UK and agrees that any Faraday Programme should be based on the development and enhancement of the range of existing research institutes and organisations, in partnership with Higher Education Institutes.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

Answer: It is the clear intention of the Faraday proposals to establish centres of excellence. In a competitive market place such centres would be expected to attract more funds as a result of their growing reputation. In the short-term this could result in a redirection of funding away from other, in some cases less successful, competitors. However, the Government believes that some of the features of the Faraday proposals could stimulate an overall improvement in the industrial relevance and quality of research and technology transfer, thereby stimulate greater market demand for the services of a wide range of organisations.

(iii) Are there alternatives?

Answer: The reports by CEST (Centre for the Exploitation of Science and Technology), AIRTO (Association of Independent Research and Technology Organisations) and the Prince of Wales' Working Group on Innovation have all concluded that the establishment of Faraday Centres, as a way to "bridge the gap" between academe and industry, is the best way forward. Over the same timescale DTI has also been considering how its technology transfer activities could be made more effective. This work has not identified any obvious alternatives but rather the need to ensure that any Faraday Programme would be integrated into the overall technology transfer scene and would not lead to a further proliferation of schemes and organisations.

(iv) Should DTI's response have been more closely modelled on the Working group's proposals and less like modified CASE awards.

Answer: The establishment of the DTI/OST Postgraduate Training scheme in Independent Industrial Research Organisations (IRO pilot) is not the Government's response to the full Faraday proposals. One element of the Faraday proposals deals with the importance of technology transfer through a flow of personnel with industrially relevant post-graduate training. The IRO pilot addresses only this, albeit important, element of the proposals. It was recognised at the seminar held by CEST to discuss the Faraday Proposals (para 7.2 of the Working Group on Innovation's report) that "this initiative (the IRO pilot) would provide very useful data for the full Faraday programme". Thus, DTI believes the pilot to be very much in the spirit and practice of the Working Group's proposals.

(v) Should DTI's response have been more generous?

Answer: Government funding of the IRO pilot scheme is proving adequate to meet the need. The selection panel were under no pressure to choose the five cheapest pilots from the large number of good applications received, although value for money was, of course, considered. It should also be borne in mind that the IRO pilot scheme is just that, to contribute information and experience to the wider debate on the role of intermediate organisations in technology transfer. DTI is satisfied that the size of pilot and range of partnerships selected is adequate for this purpose.

(vi) What questions remain to be resolved before a greater commitment is made?

Answer: In considering the Faraday proposals there are a number of questions and other issues that DTI will wish to address, in consultation with external interests, OST, SERC and other Government Departments, particularly with the objective of increasing the value of research to industry. These include:

(i) The place of Faraday Centres within the overall technology transfer structure and any changes that need to be made to the structure; particular account needs to be taken of the regional/local dimension and of the requirements of smaller firms when addressing the wider picture;

(ii) identification of the customer companies for Faraday Centres and for the other elements of a more effective technology transfer infrastructure;

(iii) determination of the real needs of each of these customer groups;

(iv) identification of the area of technology individual Faraday Centres would cover;

(v) the extent to which "excellence" should take priority over geographical distribution of Faraday Centres;

(vi) the relationship between any Faraday Programme and existing research training and technology transfer schemes such as CASE Awards, Parnaby Doctorates and the Teaching Company Scheme;

(vii) the levels and sources of funding for Faraday Centres;

(viii) the criteria, including duration, for the franchise awarded to each Faraday Centre;

(ix) management of any Faraday Programme (CEST and AIRTO have suggested different approaches).

Department of Trade and Industry

Letter to the Clerk from Electricity Association Technology (EA Technology)

Thank you for your letter of 15 June giving me the opportunity to comment on the proposed creation of a number of Faraday Centres. I take your questions in order and refer to the CEST report where appropriate.

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

I am certainly of the view that it is necessary to increase the scale and capabilities of manufacturing industry in Britain. To achieve this requires action on many fronts and, if Faraday Centres can contribute by drawing Industry and Academe together, by improving technology transfer, by producing more relevant researchers and research and by providing additional funding routes, then I am very supportive.

However, I do not believe Faraday Centres should be closely modelled on the Fraunhofer concept as these Institutions are designed particularly to match the existing industry/technology infrastructure in Germany. For example, links between HEIs and Industry are particularly strong in Germany especially at senior levels; this is helped tremendously by the respect and recognition given to engineers and their role. While we may wish to move towards their model, it would not fit into the current UK industry/government climate. A UK model for Faraday Centres is required which can be instrumental in changing this climate.

Also I firmly believe that Faraday Centres must be seen to be profitable or they will not have credibility with Industry. Therefore, for this and other reasons, I begin to differ from the CEST paper when it comes to implementation. The process described in their document seems to me to be overly bureaucratic and could result in the isolation of the centre of excellence within the IRO. Success in IROs comes from a truly commercial approach to innovation which, by definition, involves inter-disciplinary working and therefore full integration of all IRO activities.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

As a Nation we have insufficient funds for the development of new technologies, so I would have a preference for new monies. However, I recognise this is difficult to achieve. I am concerned at the way we keep attaching new labels to the same basic fund. The schemes we have are many and complex and certainly do not together form an integrated approach to supporting industry.

Most available monies from both EC and DTI come to IROs as a maximum 50 per cent contribution and this seems to me to be inflexible, allowing little room for judgement and pragnatism on the part of those administering the funds. That said, I am not comfortable with the funding scheme described by CEST. As manager of an IRO I would wish, as far as possible, to avoid any major activity requiring 100 per cent funding from government. Any project or scheme of worth should have industrial involvement in cash or in kind. This then should avoid the problem, referred to above, of "ring fencing" a Faraday Centre within an IRO, which seems to be proposed to allow the custodians of public funds to fulfil their duties.

(iv) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

I am satisfied with the Postgraduate Training Scheme as proposed. As a mechanism it is already drawing UMIST and EA Technology closer together and we are exploring other joint activities outside the PGTS. More fundamentally, it matches our own strategy which aims to develop new technologies of relevance to our customers. We therefore require funds for, and access to, developments of a more fundamental nature and the PGTS supports this. The transfer of the technologies, which is achieved when we develop new products and processes based upon them for our customers, is then our main source of income. In summary, the PGTS supports us in a technology business as opposed to a technical consulting business.

(v) Should DTI's response have been more generous?

We did not ask for funds so my answer is "no". However, I do hope that we can access other existing schemes, such as LINK, to support at least some of the projects. In requesting this I do recognise that all the normal criteria used by DTI for such schemes would have to be fulfilled.

(vi) What questions remain to be resolved before a greater commitment is made?

Referring back to the first question, we have a major national need to improve the capabilities and scale of manufacturing industry. The changes needed are fundamental in people, funding and technology terms. Another small scheme which fiddles with one aspect will not do. We need a radical approach and, in my view, there is one question to address first of all. "Do Government, Industry and Finance sources recognise the scale of the problem and have the courage to address it in a major way?"

Thank you for the opportunity to comment.

Dr S F Exell

Managing Director

Evidence from the Economic and Social Research Council (ESRC)

I appreciate this opportunity to contribute to your Lordships' inquiry. I realise that this is intended as a short inquiry and will keep my comments to the minimum. I hope you may find an opportunity to mount a more wide-ranging inquiry on these vitally important issues in the future. I would be happy to elaborate on these comments to such a wider enquiry if this would be useful.

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

There would seem little reason for me to dwell on the marked contrast between the excellence of much of UK basic science (including social science, let it be said—see below) and our overall economic performance. In this context, the development of intermediate organisations to foster innovation and technology transfer through Fraunhofer-type activities has an obvious attraction. However, it has become clear to the Working Group on Innovation initiated by HRH The Prince of Wales, of which I am a member, that the Farady Programme is *only one* of a number of measures that might be taken to improve the tranfer of knowledge and people between basic science and industry. For example, the Centres could be complemented by initiatives to stimulate networks which would bring together, in a specific geographical area, higher education institutions, intermediate institutions, industry, local and central government, and other agencies. Such networks could be a means for a more effective mobilisation of R&D resources than could be achieved by a concentration on Faraday Centres alone.

(ii) Will the preposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

Given that public expenditure always has an opportunity cost, the debate needs to focus on what is the likely value added by the Faraday Centres. It is important to note that the Fraunhofer Institutes are by no means universal in their coverage of German industries. Our selection of Faraday Centres should be clearly directed towards the value added by the new Centre in the circumstances—the 'enterprise culture', if you like—of particular industries. This needs to take account of, for example, market conditions, concentration, the current role of small firms, barriers to entry, R&D performance to date, import penetration, intra-industry trade, as well as posssible 'deadweight' and substitution from additional public expenditure. Further,

selection must look to the future potential of these factors and not over-emphasise the present. I would add that attention needs to be given to the likely standards for evaluation of the Centres; for example, evaluating the transfer of people is particularly difficult—is it a good or bad thing to leave research early for a particular job? Finally, it follows from the emphasis I have placed on the establishment of of Centres being highly selective, that some industries will be disappointed. Any tendency for the selection of Centres to become some kind of symbol of approval for an industry (or even the reverse) must be resisted.

(iii) Are there alternatives?

The emphasis should be on complementary policies (see (i) above). Clearly, there are also different models for the development of an intermediary organisation—the Fraunhofer model is only one, and one which has evolved in a particular form to suit German enterprise cultures. We should not be afraid to develop models of intermediary organisations to suit British circumstances. For example, a wide range of scale of support may be more appropriate than envisaging some kind of norm, directly drived from Fraunhofer experience.

(iv) Should the DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

(v) Should DTI's response have been more generous?

It would appear unlikely that these proposals are the last word in the government's response to the renewed debate on technology transfer. The role of CASE awards and other schemes, such as the Teaching Company Scheme and LINK, needs to be considered alongside Faraday Centres and other new initiatives, for example, are networks. The scale of public support for such activities needs development of standards for evaluation (considered from the beginning of a scheme) and more social and economic research on the public and private returns to successful innovation.

(vi) What questions remain to be resolved before a greater commitment is made?

Three specific points:

(a) Further areas for Faraday Centres

Too little attention seems to have been given to areas which might benefit from Faraday Centres outside of manufacturing industry, natural science and engineering. Three of the Fraunhofer Institutes are in areas of social science. There is no doubt of the excellence of most UK social science. Not only can our social sciences contribute to successful innovation within manufacturing, but they could also make a considerable contribution to innovation in service industries. The future potential of exports in services with the Single European Market and GATT liberalisation are reasons to believe that it is timely for technology transfer initiatives to be considered on a wider front than manufacturing/natural science/engineering. There are implications for the Business Schools which need to be considered. I would be happy to give examples if your Lordships wished to follow this up.

(b) Further consideration of 'feedback loops' to HEIs

All too often it would appear the debate is cast in terms of the flow of ideas and people from academia into industry. I would see further benefits in terms of the flow of ideas (and hopefully people) into higher institutions (HEIs). Industry, for example, is usually well ahead of HEIs in the skills of research management. Even in our most prestigious universities, research management skills are often under-developed. The engagement of HEIs and industry in Faraday Centres should provide a feedback to the benefit of research in HEIs, leading to still further benefits in terms of technogoly transfer in the longer term. However, if Faraday Centres are seen as appropriate to only certain kinds of university, the benefits of the introduction of the concept will be unduly limited.

(c) Implications for the availability of highly skilled staff

Fraunhofer Institutes have the advantage of cultural values and an education and training system which reward and support the acquisition of skills relevant to technology transfer. From Boardroom, through High Table to the classroom, the UK system on the whole compares unfavourably. Recent reforms, such as the National Curriculum, may help in the longer term. However, in the short term, Faraday Centres will have to compete for staff in a very difficult world.

Evidence from G.E.C. plc.

Response to each point of your letter of 8 September 1992:

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

The concepts, and DTI's pilot programme, share a common and valuable objective. It is their intention to improve the efficiency of technology transfer from academia to industry and, most importantly, to give researchers a better training in the practical application of technology within industry.

At present, academia and manufacturing industry concentrate on what each does best. HEI's build the important foundations of education and long term exploratory research. Manufacturing industry uses its technological skills to create and sell products. Clearly, from a national viewpoint, manufacturing industry adds as much value as possible to the skills originating in HEI's.

The role of Intermediate Institutions in the Faraday concept is a sensitive issue. At one extreme, a Faraday Centre in an Intermediate Institution could merely become the channel for HEI technology to reach the highest international bidder—ignoring the value chain which UK manufacturing industry should create. A much more useful role would be for the Faraday Centre to become a centre of excellence. With time, this would gain the confidence of UK industry and undertake a valuable role linking the science base to industrial applications.

Not all Intermediate Institutes are appropriate partners in creating a Faraday Centre. The work of most Intermediate Institutions is dominated by a large number of very short term development projects. This rapid change of topics and disciplines is not the right environment for a researcher who will ultimately work in manufacturing industry. Successful industry constantly evolves its technology through the development of improved products and processes. It requires staff with a deep and growing knowledge of its business. It does not rapidly jump from topic to topic. Consequently a contract research centre does not form a good base in which researchers can be trained or in which long-term technological competence can be developed.

To benefit manufacturing industry, and the country, Faraday Centres should become centres of excellence strongly integrated with academia and with links to manufacturing industry. The work should be dominated by long term, world class, research into topics steered over time by manufacturing industry. As with Fraunhofer Centres, a primary role of the Faraday Centre should be to train researchers to a very high standard.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

A possible redistribution of research funds would be from a widely dispersed research base towards a smaller number of centres of excellence. This could be beneficial to industry because it prefers to work with centres who are strong. A risk, however, is that Faraday Centres become too involved in near-term work and reduce the necessary speculative long term projects currently undertaken in HEI's.

(iii) Are there alternatives?

From manufacturing industry's viewpoint, it is important to influence the content of the science base and to benefit from it. Consequently some Faraday Centres, or equivalents, could be industrially based. This is particularly relevant where industry has the best facilities and has strong links with academia. There are a number of successful existing schemes involving industry and HEI's such as CASE awards and these could be further enhanced by the Faraday Centre concept.

(iv) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

and

(v) Should DTI's response have been more generous?

DTI should have developed a wider range of pilot programmes. It would have been possible to create different types of centre to assess the merits of each. For example, a Faraday Centre as proposed by the Working Group, a Centre based in manufacturing industry, and intermediate solutions hosted by HEI's or by a wide range of Intermediate Institutes.

DTI's financial commitment is appropriate for the limited scope of the pilot programme.

(vi) What questions remain to be resolved before a greater commitment is made?

An important question is the role of the Intermediate Institute. Manufacturing industry will be cautious about the quality and relevance of training given to postgraduate students by contract research institutes and will also question the ownership and exploitation of intellectual property.

A second question is the subject of Faraday Centre funding. Manufacturing industry is unlikely to make funds available to Faraday Centres unless it can see a significant advantage over established links with HEI's and contract research institutes. Only when a centre is established and has demonstrated a high level of competence is it reasonable to assume that manufacturing industry will begin to use Faraday Centres in preference to other sources.

Finally, it is worth noting that science and technology alone will not lead to new wealth-creating industries. Long term success is derived from competitive products and services, produced by efficient processes, and underpinned by competent sources of enabling technology. The key question, therefore, is whether a Faraday

Centre becomes a useful source of enabling technology or whether commercial pressure will drive it to near-term product related activities. This near-term role would dissipate the funds for important speculative research and it would be seen by industry as yet another contract research centre.

Evidence from ICI PLC

Thank you for inviting us to contribute to your short enquiry about The Faraday Programme. We only learnt of this via the CBI and that very recently, hence our late reply.

The closing words of Dr R C Whelans Final Report on The Faraday Programme are—"Such a bold step would signal that technology development and exploitation is a key part of wealth creation." We have long heeded that signal and our own commercial prosperity has been largely due to just such activities.

In most of the areas in which we operate we are crucially dependent on the health of the Science Base. We are reliant in particular on HEIs for a continued supply of bright educated youngsters and for basic research. To emphasise this reliance and to meet our own needs we have a large and vigorously maintained network of academic interactions. For example, we support over 60 Postdoctoral Fellowships of our own, 289 CASE Studentships and 28 SERC Cooperative Awards. We are active in over 30 Link Programmes and take part in about 50 EC collaborations.

As we have pointed out to your Committee on numerous occasions, most recently in connection with your study of 'Innovation in the Manufacturing Industry', we find the existing mechanisms for technology transfer and research collaboration involving HEIs in this country, to be largely satisfactory. We are more concerned about the parlous state of academic funding for basic research than about the creation of new schemes for such transfer and collaboration, however laudable. Academic morale is now at a very low ebb in the UK and this is bound both to stifle research creativity and to disillusion the next generation of students.

All that being said, the aims and organisation of the proposed Faraday Centres seem very reasonable. Although the larger science based companies such as ourselves have traditionally had extensive academic interactions this has not usually been the case for smaller companies. The Faraday Programme should do much to remedy this by making such interactions easier. The fact that the Programme makes use of existing organisations is additionally attractive in that it can be run on an experimental scale without vast expenditure. Although we have not so far taken much active interest in this Programme ourselves, there may well be topics and organisations for whom this new vehicle is best suited. The idea is sufficiently different from other schemes to be worth trying.

Providing they do not result in reduced funding for existing collaborative and technology transfer schemes, we wish the Faraday Centres well. We shall do all we can to help them. We shall study their Projects with interest and no doubt collaborate with the Centres where we have cognate interests.

Letter to the Clerk from the Rector of the Imperial College of Science, Technology and Medicine

Thank you for your letter of 11 June 1992 asking for views on the proposal to establish Faraday Centres. First I comment generally before addressing your question.

Imperial College was delighted to be chosen as one of the five HEIs involved in Faraday pre-cursor projects. Our partner is the Water Research Centre (WRC).

It is as yet unproven whether the arrangements proposed for Faraday Centres will actually work well. Hence the trial nature of the pre-cursor projects. We will of course do everything we can to make a success of our Faraday pre-cursor project, but in the circumstances it is not surprising we have some reservations mentioned below.

Our original understanding was that Faraday Centres were conceived to aid transfer of technology out of HEIs into industry. It turns out that the pre-cursors, at least, are not primarily about transferring technology. They are about doing further research.

The research projects for our first 10 PhD students, to be recruited this autumn, are being selected by the academics at the College who will be involved in supervising the students in conjunction with WRC staff. The plan is that the students will spend most of their time at the WRC. Since involvement with research students in bulk will be a new experience for the WRC, there must be substantial reservations about how successful this will be. The WRC plans to solicit research contracts from their clients, mainly water utilities, to support the student projects. Such support is vital, but it is not clear how easy it will be to secure this.

A question that springs to mind immediately is whether it would not be better for the Faraday students to work mainly at their home university and for the research contracts which support them to be placed directly with the university. The argument for involving an Intermediate Institution (II) must surely revolve around what added value it brings. If the II has the right environment to educate research students, has better or more relevant scientific facilities for the students to use, and has stronger pulling-power at bringing in research contracts to support them, then the involvement of the II could be crucial.

When research results of commercial importance begin to appear from the work of the students, the II will have the main responsibility, as I understand it, of transferring these to industry. To make the whole Faraday

operation worthwhile, the II should be in a better position to undertake technology transfer than its collaborating university. In this context it should be remembered that universities in recent years have put considerable effort into setting up efficient technology transfer units or, in some cases, subsidiary companies dedicated to this same end. Some of the universities with Faraday pre-cursor projects are already quite skilled in technology transfer, perhaps more so than their II collaborators.

The Faraday concept has been described as based on that of the Fraunhofer Institute (FI). It is in fact rather different. In essence FI is very much an extension of its parent university. The FI mainly undertakes contract development work, together with a minor amount of contract applied research. It many cases it takes development to the stage of constructing a pre-production prototype. In this way the FI complements the basic and strategic research undertaken in the university with a technology transfer mechanism, which helps exploit the university's research results, by moving them one step nearer to the marketplace. In short an FI acts as the development arm of a research-orientated department (or group of departments) in a German university.

The biggest FI, for example, is that devoted to Engineering Manufacture and Automation and attached to Stuttgart University. Whilst separate from the university in a strictly legal sense, it is, in practice, virtually under common management with the university. The Director of this FI is a professor at Stuttgart University. Fifteen of its senior staff also have joint appointments with the university.

The FI and Stuttgart University are geographically co-located. This arrangement makes it easy for doctorate students to study in the FI, which has an academic-like environment, similar enough to that of the university itself to make this possible. Work for a doctorate in German universities can, it seems, be much more development-oriented than that for a PhD at a UK university.

In contrast the Faraday concept, as proposed in the CEST report, requires two separate parent organisations to be involved, an HEI and an II. The HEI and the II will remain under their own separate managements on their own (geographically-separated) sites following their own (dissimilar) objectives.

The II will probably have little experience of housing groups of ten or more research students, as the CEST proposal requires. Nor in the normal course of its business will the II be engaged in the sort of projects likely to produce suitable thesis material for higher degrees. There is even the danger that the true role of the II will become distorted in attempting to accommodate the needs of a group of research students. In contrast, the HEI is skilled in training research students and implementing their projects. Yet, in the CEST proposal, the HEI is called upon to play only a secondary role in this.

In summary, the CEST proposal seems to be based on two misconceptions. First, that technology transfer involves doing more research. It doesn't. Technology transfer involves arranging for development work to be carried out to exploit existing research results. Second, that higher degree students should engage in development work. Unless UK university degree regulations are relaxed, such work will not, in general, lead to a PhD or equivalent higher degree.

I turn now to your specific questions.

(i) the Fraunhofer concept should be copied closely as possible in the UK, in the form of development companies attached to HEIs. Each company would exploit the research results generated in its HEI (or in a group of its departments). University research usually requires such development work before it is ready for commercial exploitation by licensing or other means.

The CEST proposal, in its present form, should not be pursued widely without obtaining experimental proof, derived from the performance of the pre-cursors, that the concept works well. The arrangement may actually inhibit, rather than help, the transfer of technology. Interposing an intermediate organisation between an HEI with technoloy to exploit, and an industrial company keen to exploit this technology, could make the transfer problem more difficult to solve, not easier.

(ii) It is my understanding that funds for the university-related components of a Faraday Centre would come mainly from the Research Councils, principally SERC. If this is so, it will represent a diversion of funds intended for research, already inadequate in scale, into development and techology transfer. (Preliminary negotiations concerning our pre-cursor project bear this out.)

Furthermore there also must be a danger of industrial research contracts being lost to the university by diversion into the II.

(iii) For the reasons given above I recommend straightforward copying of the well-tested Fraunhofer concept.

(iv) Both the Working Group's report and the DTI response, understandably, lack any firm evidence that what is proposed or counter-proposed will actually work. It is therefore somewhat inappropriate to make comparison.

(v) As universities have learned to their cost with new initiatives, the end result is almost always inadequate funding.

I would draw your attention to the findings of the workshop session on Costing held under the chairmanship of Dr Alan Rudge of British Telecom during the 3 April "town meeting" on Faraday Centres attended by 150 delegates. The conclusion of the session was that the cost of each researcher in a Faraday Centre should, realistically, be taken as £50k pa. A Faraday pre-cursor project, with

its steady state population of 20 researchers, would therefore cost £1m pa. The funding offered by SERC and DTI jointly for the Water Research Centre/Imperial College pre-cursor is less than £200k pa. It is not clear how the shortfall of £800k pa is to be found. That is a lot of money for the II to raise from its clients through research contracts.

(vi) First, the whole question of whether PhD students should be involved in development, as opposed to research, needs to be addressed. Second, the proposal that the pairing of an HEI with an II will produce a smooth mechanism to transfer technology is open to serious doubt. If such an arrangement were appropriate, why have examples of it not occurred naturally in the UK already, or indeed elsewhere in the world?

I trust the above will be of some help to the Committee with its deliberations. If you require further information I would be most pleased to supply it.

Letter to the Clerk from the Institution of Electrical Engineers (IEE)

The Institution is pleased to comment to the Select Committee on the subject of Faraday Centres. We support the concept and believe it to be a very effective method of ensuring that the outcome of research activities is exploited by industry, and a means of developing the skills of scientific and engineering personnel so that they can become the industrial leaders of the future.

The five pilot schemes already implemented by the Government are a welcome first step, but it is essential that the proposals of the Working Group on Innovation should be further developed. The choice of the research areas is particularly critical as they must build on existing research strengths in areas which UK industry can exploit.

The Institution's detailed response is given in the appendix to this letter.

Dr J C Williams

Secretary

Appendix

The Institution wishes to express its general support for the principle of establishing Faraday Centres, modelled on the German Fraunhofer Institutes, and regards these as a effective interface between academic institutions and industry which will encourage the transfer of knowledge and personnel between the two sectors.

However the Institution would stress that the pilot partnership recently initiated are not a full implementation of the principles formulated in the report of the Working Group on Innovation, and that progress towards implementation of the full Faraday Centre concept must be maintained.

It should be noted that the brief description of the Faraday Centre concept given in the terms of reference of the Select Committee is not an adequate representation of the nature and mode of working of the Centres. The terms of reference state that "many of their staff would be research graduates working for higher degrees. Their purposes would be to develop specific enabling technologies and work on a contract basis and to help bridge the gap between industry and the HEI's". It is our understanding that those being trained in the Faraday Centres would not be staff, but trainees placed in an "apprentice-type" role working under the direction of some of the Intermediate Institutes permanent research staff, who will be people with an international reputation in their own fields. The work undertaken would be on an appropriately advanced topic for which full financial funding would be provided by industry and government. Such projects must be of such a nature that they will run for three or more years in order to provide adequate continuity and be of suitable originality to satisfy the HEI for the award of a PhD. The HEI must be technically and practically involved in the project for which they, too, would need to be fully-funded.

It will be seen that the requirements of the scheme are that:

1. the Intermediate Institutes must be a high standard in respect to their research programmes and staffing
2. The projects undertaken must be of such an academic level as to meet the HEI's qualifications requirements
3. The projects undertaken must be of such a nature that they meet the long-term business objectives of an industrial sector.

Clearly these requirements are stringent and will require the best in the way of funding and resourcing, but, equally, if met, will provide a very powerful means of transferring research programmes into products, and training personnel to operate effectively in an industrial environment.

We wish to respond to the specific question raised as follows:

1. *Is the Fraunhofer concept, or the Faraday version of it, right for Britain?*

There can be no doubt that, if properly funded and staffed, the Faraday Centres would be an effective means of re-vitalising UK manufacturing industry, just as the Fraunhofer Institutes play an effective role in German industry.

2. *Will the proposed Faraday Centres draw funds away from existing institutions, and, if so, is that good or bad?*

The proposed Faraday Centres may draw industrial funding away from those existing institutions which do not respond positively to new ideas. This is not bad as the money will be spend more effectively.

This conclusion assumes that the amount of industrial funding available is fixed, and therefore investment in Faraday Centre programmes must entail reductions eleswhere. However if Faraday Centres become effective 'centres of excellence', industry may believe that their R & D funding can be increased, because of the foreseen benefits. However it will take a number of years to develop and prove the Faraday Centres, and so initially there may well be a diversion of funds from other activities in the absence of adequate Government funding.

3. *Are there alternatives?*

There are many ways by which the more-effective application of research by industry can be effected. However the Faraday Centre scheme proposes a very strong partnership between industry and academia, in a manner not achieved by other methods, and it is regarded by the Institution as the most encouraging approach.

4. *Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?*

In the view of the Institution the DTI's response should have been modelled more closely on the Working Group's proposals, as it provides a more stronger link with industry and industrial objectives.

5. *Should DTI's response have been more generous?*

The requirements for effective Faraday Centres are stringent and the development of 'centres of excellence' will be a long-term process. More time and discussion is needed for proper planning and selection of research topics to ensure that they are worthwhile and hence properly funded.

6. *What questions remain to be resolved before a greater commitment is made"*

The formation of an Industrial Research Technology Council (IRTC) as outlined in the CEST report would provide an independent body to progress the development of Faraday Centres.

In particular the selection of research topics is a very important activity, which should depend not simply on the current areas of research, but be related to the industrial activities which can exploit the new technology. Regrettably there are many areas of technology—and solid state electronic devices is a particular example—where UK no longer has a development and production capability. The work undertaken by Faraday Centres can only be productive in the long-term if it relates to industries where UK has a current capability, or could enter a market in the foreseeable future.

Evidence from the Institution of Professional Managers and Specialists (IPMS)

1. There is a major and continuing problem of technology transfer within the UK. IPMS welcomes CEST's recognition that intermediate institutes have a major role to play in bridging the gap between basic research and application. We also welcome the proactive approach displayed in the Faraday Centre concept.

2. We are, however, not wholly convinced that it will not be able to meet its more ambitious objectives of improving the flow of technology and high calibre R&D staff into industry and in particular into small and medium sized enterprises where the need is greatest. We therefore regard the pilot schemes as a crucial part to an evaluation of the likely effectiveness of the concept.

3. For the Faraday Centres to be acceptable and successful, the following conditions in our view need to be met:-

- Sufficient "new money" to enable project to get off the ground and to provide continuing support for the basic physical and intellectual capital required within the 'host' intermediate institute and the Faraday Centre.
- The Faraday Centres should be additional to and not a diversion from existing institutions engaged in innovation and technology transfer.
- The need for continuity and a long-term perspective should be reflected in the policies of the FC and its 'host' institute. We are pleased to see that the initial contract length has been extended to 10 years and would hope that discretion would be exercised in favour of longer initial contracts where the

scale and expense of equipment and long 'lead' times associated with the technology would justify it.

— Similarly, the proportion of staff employed on fixed term contracts should be limited to cases where there is a genuine management need to make appointments of limited duration. Large scale use of fixed term contracts is dysfunctional for the effective management of the FC and is unlikely to prove popular in attracting high calibre staff to the centre when they can find permanent jobs elsewhere in the UK and in the EEC.

4. As CEST itself recognises Faraday Centres are only a part of the solution to the problems of technology transfer and innovation identified in the UK.

5. There are many intermediate institutes already operating in the UK and they could operate much more effectively if given sufficient encouragement and funding. In particular it is vital that:-

— the ill-judged Government ban on public funding for "near market" research should be lifted.

— research council institutes and government research establishments should be allowed once again to range along the full spectrum of research from basic to "near market";

— they are supplied with continuing funds for long-term research as part of each specific research contract ('Rothschild' 10 per cent.).

6. Equally important is the overall framework of policy on innovation and technology transfer in the UK including the need for:-

— "a national strategy for the UK should be developed by the Minister for Science and Technology in consultation with research bodies, industry and trade unions.

— the DTI to stimulate innovation and technology transfer and expand support for regional technology centres.

— industrial research agencies should be retained in DTI as a source of inhouse expertise and a resource for projects with industry.

— DTI should serve as an easy access point to public sector databases for engineering, scientific and marketing information and provide 'one-stop shop' access to its various funding schemes.

— the adoption of more long term perspectives and greater appreciation of the vital role of innovation and technology by industry and the city.

1. The Institution of Professionals, Managers and Specialists (IPMS) is the trade union which represents 90,000 scientific, technical and specialists staff in the civil service, related public organisations and an increasing number of private sector companies.

2. Of particular relevance to this enquiry, IPMS represents scientific and professional staff working for AEA Technology, government laboratories granted agency status including the Defence Research Agency (DRA), Laboratory of the Government Chemist (LGC) and National Physical Laboratory (NPL) and Research Council laboratories. All have been cited by CEST as possible Intermediate Institutes which would host Faraday Centres. Comments made on the proposals are based on an earlier report on the future of science policy in the UK and responses from members employed within the institutions in the CEST proposals.

Failure of Technology Transfer

3. In its report "Science in Crisis: a trade union response",[1] IPMS expressed its concern that Britain lags behind other countries in technology transfer. It noted that there was a particular problem among small to medium sized companies. We, therefore, welcome the initiative by CEST[2] which recognises that there is a major and continuing problem wth technology transfer within the UK and that intermediate institutions have a major role in bridging the gap between basic research and application.

4. It is commonly asserted that the UK is good at research and generating ideas but poor at translating them into new products and processes. However, as IPMS[3] and CEST in its original comparison of German and UK R&D[4] point out, recent analyses of the technological balance of payments in the 1980s indicate that there has been a marked decline in British scientific performance as measured by publication indices and patent registrations. In pursuing the goal of better technology transfer, therefore, it is important to consider the needs of basic and strategic science also.

5. IPMS made a series of recommendations to improve innovation and technology transfers. These included:

— "A national strategy for the UK should be developed by the Minister for Science and Technology in consultation with research bodies, industry and trade unions.

— The DTI should stimulate innovation and technology transfer and expand support for regional technology centres.

— Industrial research agencies should be retained in DTI as a source of inhouse expertise and a resource for projects with industry.

— DTI should serve as an access point to public sector databases for engineering, scientific and marketing information.

— BTG should be returned to the public sector so it can exploit public R&D with the private sector."

6. We also argue in our report that government decisions on the structure of public funded R&D have also meant that the bridging role formerly played by government research establishments (GREs) and research council laboratories has been abandoned. The withdrawal of public funding from "near market" research and the inability of British industry or agriculture to fill the funding gap has resulted in the destruction of a natural link between the basic and "near market" ends of the research spectrum.

Faraday Centre Proposals

7. The basis of the argument for Faraday centres is that the current structural arrangements mitigate against the flow of ideas and people between higher education establishments (HEIs) and industry. Large companies normally have better relations with HEIs through collaborative R&D arrangements, student sponsorship and recruitment. The same cannot be said for many small and medium sized companies (SMEs) which do not have the resources to deal with the fragmented structure of institutions and schemes.

8. The suggested method of overcoming these difficulties is the use of a network of "Intermediate Institutes" (IIs) which would act as a bridge between HEIs and industry and host the Faraday Centres (FCs). The proposed structure is modelled on the system of Fraunhofer Institutes which operate in Germany.

9. In its summary of the Faraday Programme, CEST explains that:—

> "Each centre developes enabling technologies, identifies, and proves applications and works on a contract research and development basis with companies to develop new produces and processes. Each centre will become a recognised centre of excellence ... A Faraday Centre works in partnership with an HEI, commissioning research, exchanging staff and awarding higher degrees for work done at the centre."

Positive Aspects of Cest Proposals

10. IPMS warmly wellcomes the recognition that there is a major and continuing problem of technology transfer within the UK and that intermediate institutions have a major role to play in "bridging" the gap between basic research and application.

11. We also welcome the proactive approach displayed in the Faraday Centre concept. At the very least it will provide a useful mechanism for harnessing the collaborative funding available from DTI and EEC sources. We hope that it achieves the more ambitious objectives of improving the flow of technology and high calibre R&D staff into industry and in particular small and medium sized enterprises where the need is greatest.

12. Where existing public or private intermediate institutions are not or cannot effectively "bridge the gap" between basic and "near market" research themselves then there is a role for an extra institutional innovation of the Faraday Centre type and we welcome this positive approach to overcoming the problems.

13. It is important the Faraday Centres should be "in addition to" and not instead of mechanisms which are already actually or potentially effective. The last thing which UK science needs is a further major upheaval to pursue untested new schemes which divert scarce resources from other worthwhile activities. Care also needs to be taken that Faraday Centres do not become an extra hurdle in the technology transfer process rather than improving links between basic research and industry.

14. In the final report issued in May CEST suggested that there could eventually be 28 Faraday Centres. CEST proposes an incremental expansion of the scheme from an initial establishment of five to 10 centres. These would be pilot schemes with a further five approved if assessment after the third year proved positive. We attach great importance to the notion of pilot schemes. There has been little work to evaluate the effectiveness of the Fraunhofer Institutes in Germany, whether all are equally effective, and if not what accounts for the differences. Nor do we know whether the concept will transplant succesfully in the UK. It is essential that a thorough assessment of the pilot schemes should be carried out before expanding the scheme and in doing so the criteria for assessment set out in the report should be rigorously applied.

15. We agree with most of the points made concerning the role of the Faraday Programme Management Group (FPMG) and would stress particularly the importance of its links with ACOST and CEST and would add to these the ABRC and the new Office of Science and Technology (OST) in order to ensure a sufficiently strategic view of what gaps require to be filled. It will also be important to include representatives of SMEs and other primary target groups on the FPMG. It is not clear from the report how relations between the proposed Industrial Research Technology Council and ABRC would operate with regard to Research Council Institutes acting as IIs.

CONCERNS WITH CEST PROPOSALS

16. Although the final report to the Working Group on Innovation on "The Faraday Programme" answers some of the reservations we had on the previous drafts on the Faraday Centre proposals we are still sceptical that it is an appropriate solution to the problems identified, and certainly it would need to be accompanied by other measures involving government and industry, as indicated in the recommendations of the original CEST study.

17. Organisations and institutions capable of bridging the gap between pure and near market research and/or HEIs and industry, already exist. Indeed, CEST lists some of them as potential Intermediate Institutes. CEST proposes to import structures operating in a different environment and culture and weld them on to existing UK institutions. Is yet another institutional upheaval and possible redirection of funding either necessary or desirable? Or will less radical change achieve the stated objective?

18. The role of government in securing change must not be underplayed. This is not limited to funding the proposed centres, nor even reversing the disastrous policy switch away from "near market" research. Government has a role promoting change through agencies such as the DTI and encouraging the greater exploitation of the results of publicly funded military research and development 5.

19. That said, IPMS concerns about the proposed network of Faraday Centres focus on two areas:—

— Whether the Fraunhofer model is one which can be adapted and made to work within the UK environment.

— Whether the funding and organisational needs and objectives will be met.

Fraunhofer To Faraday

20. A major concern is whether Fraunhofer Institutes work and can they be used as a model for adaptation and introduction into the UK economy?

21. CEST's own comparison of the German and UK attitudes to innovation provides some relevant information. Fig. 7.12 of that document (reproduced here for ease of reference) (*see figure 1*) demonstrates not only the quantum differences in expenditure but also emphasises the large gap between what the CEST report calls "public science", mostly of the basic variety and "private" industry in the UK, whereas in Germany there are many "intermediate" research organisations "filling the gap" between universities and industry.

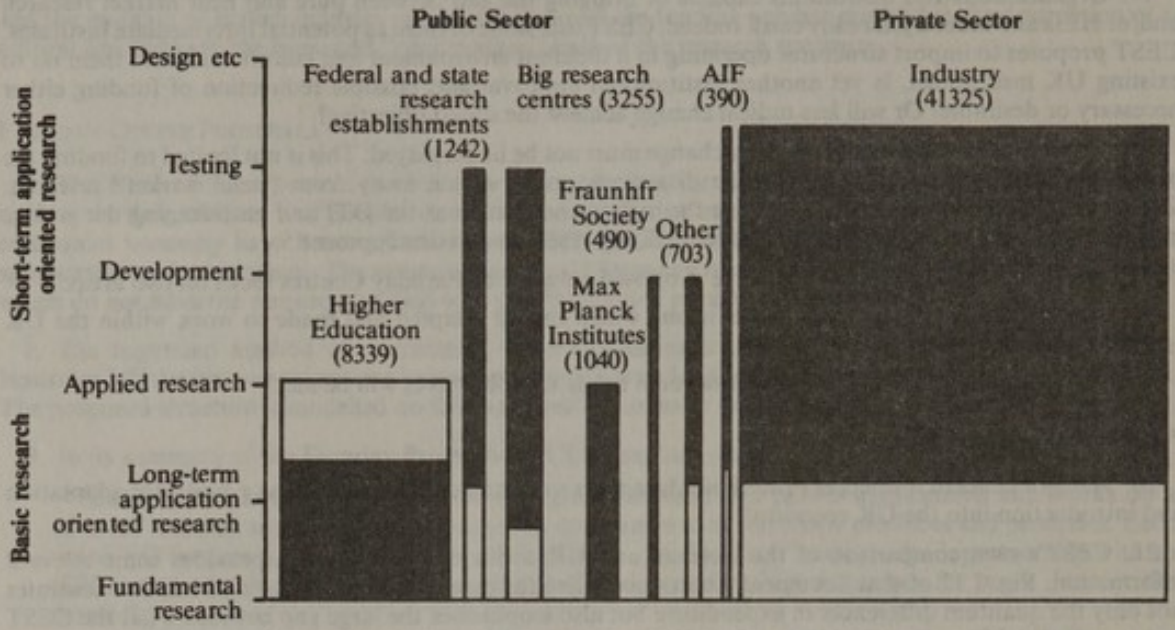
22. However, as the CEST report goes on to show this 'gap' partly results from the 'privatisation' policies of the last decade. For example, they quote the removal of the UKAEA from the "public sector" category in 1986 (which switched £400m turnover from the 'Intermediate' to the "private sector" in Fig. 7.12 at a stroke). As they also point out "the privatisation of R&D performers like the UKAEA effectively nullifies these organisations as instruments of national technology policy and also makes them less 'visible' because they are no longer promoted as part of the national technology infra structure. This, and the commercial basis on which they operate make them less accessible, particularly to the SMEs who need them most.

23. Moreover, as we noted in paragraph 6 above the Government deliberately drove a wedge between 'basic' and 'near market' research and withdrew public funding from the latter which was henceforth to be picked up by industry or not at all. In one sense, therefore, the gap revealed in Fig. 7.12 is artificially created and many of the institutions required to bridge it already exist.

Figure 1.

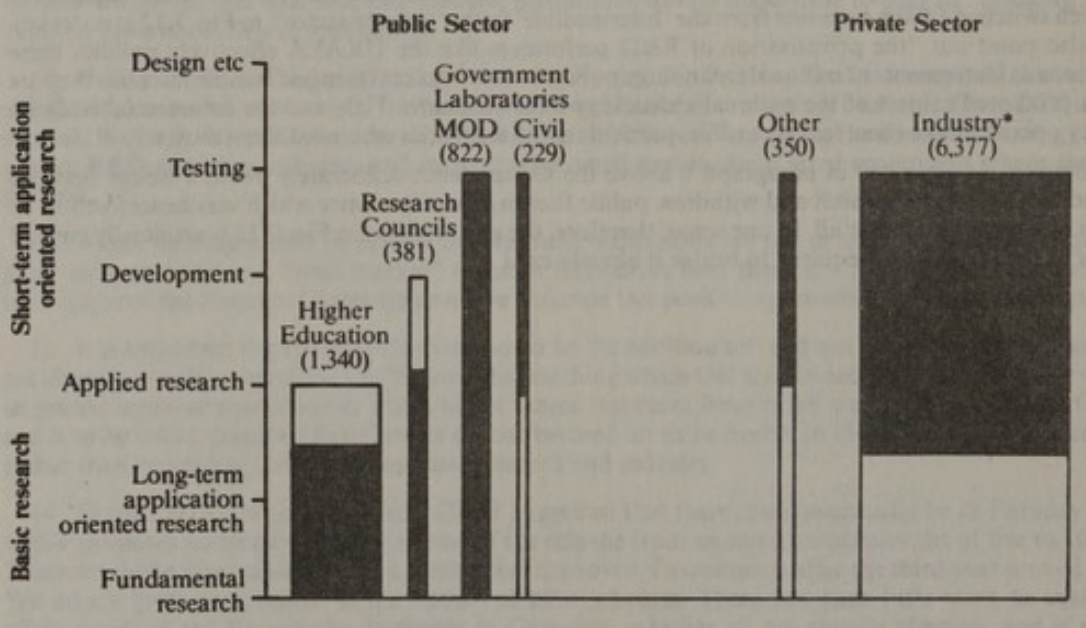
Research Expenditures in Germany and the United Kingdom

FRG Research Expenditure 1987 (DM mio)



Sources: Meyer-Krahmer. ISI: BMFT 1990. Tables VI13 & VI120: SERC 1990 vol. 2

UK Research Expenditure 1987 (£m)



* Includes £400m of R&D performed by the UKAEA and £300m by AIRTO

Sources: Annual Review of R&D. 1987: SERC 1990 vol. 2

■ Major area of performance

□ Minor area of performance

Bar area is proportional to R&D expenditure.

24. There are, in fact, more 'intermediate institutes' in the UK than in other EEC countries and almost as many as in Germany. As we stated in our own report there are many research council institutes, GREs and other public bodies which are well equipped to perform this bridging role. "They have the ability to assemble the critical mass of scientific and technical personnel, expertise and physical equipment. They also have the ability within single institutes to range from basic, through strategic to near-market research."[7] They should be encouraged to resume their technology transfer role with renewed public funding and encouragement to carry out the role more effectively.

25. The original CEST study also made it clear in its analysis that apart from the differences in institutional structure and the public funding policies there were also major cultural factors behind the German success in innovation and technology transfer—

> "The German firms in the survey emphasised their total commitment to building up capabilities over the long-term, through investment in R&D and training. This long term view is central to Germany's economic success. It is fostered by an environment which imposes no pressures on firms to sacrifice long term health for short-term profit and which also recognises that they have a wider obligation than to their shareholders alone."[8]

26. CEST therefore recognises that the Faraday Centre proposals are only a part of the answer to the problems identified and need to be accompanied by other actions, such as a national technology policy with an active regional dimension; and the adoption of more long term perspectives and greater appreciation of the vital role of innovation and technology by industry and the city. These are views which as indicated in paragraph 5 above IPMS would heartily endorse.

Funding, structures and staffing

Selection

27. The report recognises that there may not be many IIs which will be able to meet the stringent criteria of selection suggested. If that is so then it is important that infrastructural support should be offered as part of the pump-priming mechanism. It is also important that such problems are addressed urgently since if IIs are to compete successfully for contracts both internationally and nationally they will need to exhibit similar characteristics to those suggested for FCs.

28. We also fear that the benefits to the II as laid out in the report, may not be sufficiently attractive, and may inhibit many potential candidates from coming forward. While the potential benefits for the FC, HEI, industrial collaborator and even research associates are clear, the potential advantages for the II seem outweighed by the costs. The II has to deal with the realities of fluctuating workload, managing funding, equipment and rapid transit research associates. The payback in terms of closer links to HEI and industry and improving its own research base could be achieved without the necessity for hosting an FC. There is a danger that the FC will enjoy a somewhat parasitical relationship with the II.

29. If Faraday Centres are to be centres of excellence in their field they should not simply be judged by industry but by criteria reflecting the needs of all the players i.e. the Intermediate Institutes themselves, HEIs and the technologists, scientists and engineers involved, especially when the pilot schemes are being assessed. Their details should also be included in the Annual Review of R&D and form part of the OST/ACOST strategic review process.

Funding

30. With a contract turnover of £10 million, and using the Fraunhofer 70/30 split for funding, CEST estimates that the 28 Centres would require £70–90 million in public research funds. At a time of increased pressure on government expenditure there must be concern that this will not be "new" money but be derived from cutting other programmes.

31. We are pleased to see that CEST has revised its proposals on contract length, 10 years with a review after 5 years. This meets a number of our concerns. In particular the original proposals of a standard five year contract suggested a perception of a franchise more akin to McDonalds than long term research. As the switches in Government R&D policy in the 1990s have demonstrated, it takes some considerable time to build up organisations and rapid switching of priorities and funding are wasteful of capital and intellectual resources. We would also argue that given the different scale of equipment required and the varying "lead" times associated with different types of research and technology there should be more flexibility to extend initial contract terms beyond the ten years envisaged in cases where the nature of the scientific work being done would justify it.

32. We are pleased to see the emphasis laid in the report on the need for technology development of generic or enabling technology as a government concern and the need to fund it from public sources. We also welcome the specific reference in the FC funding arrangements to start up funding and the need for an annual grant for technology development. It is essential, if the FCs are to make an effective contribution to innovation and technology transfer that they should be able to build up long-term equipment and intellectual capital. It is vital that this is a continuing responsibility otherwise the FCs may be able to survive for a few years on the previously accumulated "capital" in the host intermediate institute but that must be replenished otherwise

both the FC and its host institute will become less viable in the longer term. The Rothschild principle of a 10 per cent surcharge on contracts to provide funds for this purpose has never been fully implemented in practice. The concept of a percentage levy on contracts or some similar mechanism needs to be reinstated to ensure the long-term health of the intermediate institutes and FCs.

Staffing

33. The primary goal of the programme is to improve the flow of people between HEIs and industry. As the CEST paper states, much technology transfer is inside people heads. Apart from the directorate, they propose that the staffing would be split between supervisory staff and, predominantly postgraduate student, research associates.

34. In the organogram of a Faraday Centre structure produced by CEST graduates move from the HEI, via the Centre into industry. Supervisory staff are drawn from the HEI and industry with collaborative organisations also providing contract R&D and skilled staff. Research students would be on fixed term contracts, with an agreed academic goal.

35. Fixed term contracts are proposed in the report in order to ensure a flow of "new blood" through the organisation. However, most young graduates move jobs relatively rapidly following graduation in order to broaden skills and gain experience without the need to embody a short term contract in their terms of employment. While some post graduate researchers may accept the insecurity inherent in fixed term contracts, first rate graduates looking for careers in industry are more likely to be picked up as permanent employees by the major companies than opt for the uncertainty of an STA. With the opening up of the European labour market for scientific and technical staff this position will become even more pronounced. Most of the science posts in both France and Germany are permanent not fixed term.

36. Moreover, the efficacy of fixed term appointments in organisations undertaking contract research is open to doubt. The performance of many researchers tails off in the second half of their contracts as they seek alternative employment. It is also the experience of organisations such as NERC that few fixed term contracts are completed as staff leave towards the end of their contract, either for a new fixed term contract or permanent employment. For example over the period 1986-1990 in a cohort of 165 fixed term appointees in NERC, the average contract length was 2 years 10¾ months; the average length of stay was 1 year 9¼ months and the number completing their contract was 47. As a result of this and other disbenefits to the organisation of the type highlighted in our report[9], the AFRC and NERC are re-examining their policy in order to achieve greater continuity of researchers.

37. The need for continuity is also mentioned in the CEST report which records that many industrialists and members of the contract research community stressed the importance of continuity in building up the culture and motivation of the staff. Ironically such continuity and the emphasis on building on the skills of the permanent work force is also one of the crucial features of the German system which the original CEST report highlighted. While stressing the important role of people in the technology transfer process the report does not give enough attention to the importance of building up long-term managerial skills and intellectual capital in the Faraday Centre and the host institution if it is to remain a centre of excellence.

38. While accepting that there may need to be a small proportion of short stay research associates passing through on their way to industry the number on explicit fixed term contracts should be as small as reasonably practicable and more attention should be paid to the need for a balanced high quality core research staff within both the FC and the host institution. Fixed term appointments should only be used where there is a genuine management need to make an appointment of a limited rather than open ended duration.

39. Staff working at the FC must be clear about the identity of their employer and their terms, conditions and status. There have been a number of cases recently where organisations have sought to avoid their obligations to staff through the use and abuse of fixed term contracts. In particular, the use of waiver clauses to remove employees rights to statutory protection is deplorable and will eventually prove counter-productive as the best candidates refuse to be employed on such a basis.

NOTES AND REFERENCES

1. IPMS 'Science in Crisis: A Trade Union Response'. November 1991.

2. CEST 'Final Report to the Working Group on Innovation: The Faraday Programme' May 1992.

3. IPMS op.cit pp 13-14.

4. CEST 'Attitudes to Innovation in Germany and Britain: A Comparison' June 1991 pp 106-7.

5. IPMS op.cit pp 42-45 and see also the paper produced by ESRC/SPSG Defence Science and Technology Policy Team for POST 'Future Relations between Defence and Civil Service and Technology' March 1991.

6. CEST 1991 p 107.

7. IPMS op.cit p 26.

8. CEST 1991 p 65.

9. IPMS op.cit pp 49-52.

10. CEST 1992 p 6.

11. The 'Rothschild principle' was laid down in the 'Framework for Government Research and Development' Cmnd 5046 HMSO June 1992 para 9.

> "9. The Government accepts that contractors will in many cases be better able to contribute effectively to these exchanges if they have some freedom to undertake work which, while being financed by the customers, is not immediately related to a specific programme of work. Lord Rothschild proposed that this need should be met by a general research surcharge. He suggested an average, in money terms, of 10 per cent of a customer's programmes. The Government accepts the proposal in principle, but the degree to which this provision is needed will vary; for example in private industry it is already the practice to include where appropriate an element for private research and development costs in the prices charged to the Government. Departments will make appropriate arrangements in agreement with the Treasury."

Evidence from the Medical Research Council (MRC)

1. The Council's view is that Faraday Centres can form a very useful mechanism for technology transfer but they should be seen as one of a wide variety of such mechanisms. We would therefore welcome the proposals for setting up Faraday Centres but would not wish to see such centres being given special priority. There are dangers in being locked into large-scale initiatives in an area which demands flexibility of approach. We would therefore favour, at least at the outset, an experimental approach that was modest in scale.

2. In making these general observations Council is drawing on the experience in technology transfer that it has built up over the last 10 years. The Council now exploits a wide variety of mechanisms for encouraging technology transfer to industry:

- industrial consultancies held by MRC scientists;
- collaborative (CASE) studentships;
- collaborative research projects undertaken in MRC institutes, units and Interdisciplinary Research Centres with funding from industry;
- collaboration over clinical trials;
- licensing of intellectual property to industrial partners;
- co-operating in the establishing of "start-up" companies based on MRC discoveries;
- dialogue with industry-wide groups such as in the Nutrition Forum and Toxicology Forum;
- the MRC Collaborative Centre set up in 1986 at Mill Hill in North London to undertake strategic research, with support from industry, aimed at developing the work of MRC institutes and units in directions leading to new medical products and processes.

The Committee may be particularly interested in the Collaborative Centre which has similarities to a Fraunhofer Institute in that it brings together highly skilled, entrepreneurial scientists who have close ties with both industry and academic research and with access to state-of-the-art equipment. On the other hand unlike a Fraunhofer Institute it is entirely self-financing; there is no subsidy from public funds.

Lessons from that might be drawn from the Collaborative Centre experience which are relevant to Faraday Centres are:

(i) considerable interest exists in many parts of industry in the marriage of academic knowledge/innovative ability with commercial disciplines in managing and delivering projects;

(ii) given sufficiently specialist and high-calibre skills, industry are prepared to pay full economic costs;

(iii) marketing of the science/technology resource is essential and requires a major investment of management time;

(iv) only suitable for certain kinds of work. For example in many cases the technology transfer process needs to take place in close conjunction with the innovative research activity. Hence, for example the extent of the direct involvement of our Laboratory of Molecular Biology at Cambridge in technology transfer. Hence also for example, our decision to fund jointly with ESRC a Social & Applied Psychology Unit in Sheffield, concerned with research into the effectiveness of people at work, which is engaged in both contract work for industry and innovative research;

(v) there is potential for more collaborative centres on the MRC model but they must have a strong academic base or clear channel into one (so further MRC collaborative centres would be located in areas of MRC research strength).

The Council is at present exploring the case for setting up a Collaborative Centre-style development, in conjunction with a centre for Health Services Research, to facilitate the transfer of health technology (equipment, procedures, drug regimes, techniques) and best practice to the NHS. Funding would be sought from industry and the NHS.

In summary the Council's view would be that there can be no single approach to technology transfer. Different fields of science and different stages of research development demand different mechanisms.

Evidence from the Natural Environment Research Council

INTRODUCTION.

1. The gap between the science base and industry that restricts the flow of research results and ideas into the market is often quoted as one of the reasons for the poor performance of UK industry in bringing new products and services at the market place.

2. Any action that aims to close the gap between HEIs and industry resulting in greater technology and skills transfer is to be welcomed. It is important, however, to ensure that any action taken is effective. Ineffective action will simply do a disservice both to science and to industry putting back the time when a solution can be found.

3. Various schemes have already been introduced that aim to enhance the flow of skills and ideas between the research community and industry. The NERC and SERC cooperative awards (CASE) studentship schemes, the SERC Parnaby PhD scheme, the Teaching Company Scheme, the LINK initiative and Interdisciplinary Research Centres (IRCs) are current examples. It is important that the success of such schemes are properly evaluated and any lessons learnt before new schemes are started.

(i) Is the Fraunhofer concept, or the Faraday version of it right for Britain?

4. The Fraunhofer concept must be seen in the context of the German research system (government and industry) as a whole and the commitment of the Federal Government and German industry to funding research. There are a range of different elements in the German R&D system that focus on technology transfer between academic research and industry. Some 100 Industrial Research Associations carry out precompetitive generic research using funds from the Federal Government and industry and the 130 regional Steinbeis Transfer Centres aim to make existing polytechnic research accessible to industry (predominantly projects with SMEs). The part played by the Fraunhofer Institutes (mainly contract R&D) needs to be examined within this broader framework and the better track record of German industry in funding R&D than its British equivalent.

5. A key feature of many of the Fraunhofer Institutes is the involvement of local state governments. There are major differences in local government arrangements in the UK and Germany. Are such differences significant in assessing the likely success or failure of the Faraday Centres (FCs)?

6. The proposed steady state funding for a FC is £5m pa. Industry is expected to provide slightly more than 50 per cent of this. This seems higher than the industrial input provided by German industry to a typical Fraunhofer Institute and will be a difficult target for UK industry.

7. If the technology and skills transfer aims of the FCs are to be achieved there must be commitment both in the HEIs to export research and talent and in industry to use these to improve competitiveness. The time needed to forge better links between HEIs and industry, to increase motivation of researchers towards industrial R&D and short termism in UK industry are all important factors that do not seem to have been adequately addressed. The suggestion that the creation of FCs as foci for technology transfer will quickly remove the barriers that still exist despite significant investment in different schemes over the years seems somewhat naive.

8. This is not to say that a limited initiative in a carefully defined industrial sector should not be attempted in the UK and the outcome carefully monitored. Assessment of the pilot project after three years may provide some indication of the attractiveness of the scheme. It will, however, be too soon to expect clear evidence of success or failure in terms of quality of outputs.

9. Cooperation between research laboratories and external customers in industry and government already exists at a significant level. As examples the commissioned (non-Science Budget) incomes for the NERC Institute of Hydrology and Institute of Freshwater Ecology in FY 1990–91 were 80 per cent and 63 per cent of total income respectively.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

10. Given finite sources of public funding for R&D, the creation of FCs is likely to draw funds away from other parts of the research establishment. This could be worthwhile if it generated extra R&D funding by industry and led to a real increase in the flow of skills between research and industry. Both these criteria must be monitored in order to measure the success of the initiative.

11. Any redistribution of funds to support the Faraday Programme must not be at the expense of important strategic but non-industrial science.

(iii) Are there alternatives?

12. If an aim of the FCs, along with their Intermediate Institute hosts, is to bridge the gap between cultures, there must be a risk in introducing a third "intermediate" culture with the associated increase in interfaces. An alternative would be to use existing structures in industry, research institutes and HEIs more effectively both to meet the skills transfer and the R&D aims of the initiative.

13. Industry's need for skilled researchers and R&D will differ depending on the size of the company. Alternative schemes may be required to meet the needs of large companies and SMEs and of different sectors. For example, it is not obvious that large companies are interested in centres of generic research; there is little if any gap between HEIs and the pharmaceutical industry; German experience suggests that Fraunhofer Institutes with an environmental mission do not fit well into the system, having very little industrial contact. It is important to understand the reasons for this and the differences between industrial sectors. It may make little sense to impose one solution on a number of different situations.

14. Promoting technology transfer can be achieved in a number of ways. The provision of fiscal incentives, higher prestige to science and engineering, career opportunities, IPR can all have an impact. The long term nature of the problem and the elusiveness of the solution clearly show that no one action by itself will be sufficient. A multiple action approach will be necessary. More emphasis needs to be placed on determining what the different elements of this "multiple" solution should be rather than firing off single shots somewhat at random.

(iv) Should the DTI response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

and

(v) Should DTI's response have been more generous?

15. The postgraduate training partnerships recently launched by DTI and OST are a good start and need to be viewed together with the Parnaby and CASE schemes. The differences between the proposed new scheme and the existing schemes is not clear from the documentation. An evaluation of the current schemes would have been a useful pre-cursor to the DTI/OST pilot.

16. The postgraduate training partnerships launched by DTI/OST will result in the placing of 100 students in the five collaborations. This is a good start and is likely to lead to further placements.

17. Dramatic improvements in the flow of research results and skills between HEIs and industry will not be achieved quickly. It will take time to understand how the FCs will compare with and complement existing schemes. For these reasons a slow start, along the lines of the DTI/OST partnership initiative, is to be preferred.

(vi) What questions remain to be resolved before a greater commitment is made?

18. The Fraunhofer Institutes are suggested as a model for the proposed FCs. Much more information is needed, however, on the impact that the Fraunhofer scheme has had on the competitiveness of German industry and the efficiency of the technology transfer process.

19. The needs of industry are different according to sector of activity and size of company. Any technology and skills transfer arrangements between the science base and industry must take these differences into account. The capability of the proposed Faraday Programme to cope with these differences needs to be examined.

20. There is a danger that the FCs would focus their activities on current industrial problems and concerns. Would new industrial interests concerned, for example, with pollution control, environmental monitoring and impact assessment be adequately covered?

21. What evidence exists that shows that industry is prepared to contribute funds to FCs? If funds are provided would this be a net increase in industrial R&D expenditure or simply a redistribution?

22. Attitudes will have to change if the initiative is to succeed. UK industry has to recognise the long term nature of the commitment that has to be made. Motivation of researchers to seek careers in engineering and science will have to be rekindled.

23. The arrangements covering Intellectual Property Rights for participants to the proposed scheme must be clearly stated.

24. The training received by postgraduate students within the FCs will be different from the normal academic route. It may be necessary to introduce a new qualification linked to industrial R&D that reflects this difference.

Evidence from Professor W D P Stewart, Chief Scientific Adviser, Office of Science and Technology (OST)

Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

I will address my remarks to the first part of the question. I have an open mind on the suitability of the Fraunhofer concept in the circumstances of the UK although I think it would not be advisable to attempt to copy the German model slavishly. The Government is examining how best to develop its manifesto commitment to: "encourage the establishment of centres of excellence linking industrial research organisations with universities and polytechnics". But first, let us be clear about what the German Fraunhofer Institutes (FIs) are.

FIs are sited close to HEIs with particular technological strengths. They are easily accessed by adjacent academics and there is a flow of graduates into the FIs, some of whom eventually flow through into industry at the age of 34 or 35. On average, some 28-29 per cent of FI funding is derived from contract research with the private sector; the rest mainly comes from the public sector either as non-directed funding or in the form of project funding. Virtually all the FIs specialise in the physical science technologies because private sector links with the chemistry and life science technologies are so close as to largely obviate the need for bridging institutions. The German supervisory body, the *Fraunhofer Gesellschaft*, insists upon four conditions in setting up FIs:

— there must be significant industry interest and participation in the FI technology;

— FI research must be seen as strategically important by Government;

— The FI must be sited adjacent to an HEI;

— there *must* be a leader with scientific and entrepreneurial skills to head up the FI: to attract high quality staff and link with industry.

There are several interesting features in this thumbnail sketch; and I am sure you will be receiving descriptions of FIs from other observers. For my part, the aspects of the FI concept on which I personally need assurance are:

(i) *Bridging Institutions in general:* I am all in favour of our HEIs building up technological strengths which are of immediate and strategic relevance to industry. However, we would need to be clear why new bridges are needed in addition to the existing bridges between academe and industry. As I have noted, the FIs do not seek to replicate the very strong relations which the chemical and pharmaceutical companies have with HEIs. The same might be said in the UK; I would be interested to hear the views of the chemical, pharmaceutical, aerospace and telecommunications companies in this connection. It is worth noting here that the total support given to HEIs by UK industry is estimated by the Council for Industry and Higher Education to be of the order of £300-350m pa. About £140m of this is in the form of research contract money. The total turnover of the FI system (which does not cover all HEI-industry links in Germany) is estimated at about £275m pa. Having said all that, there *may* be sectors of UK industry where better bridging structures are very much needed. So my second point is:

(ii) *Industry participation:* It is important to be convinced that there is a healthy industry demand for bridging institutions, in particular for new generic research, and for skilled research professionals. The strength of demand needs to be established by some form of market research. It is also important to ensure that new proposals are market-tested against existing institutions—and we have some excellent institutes already in the UK eg the John Innes Institute.

I have no trouble at all with the concept of sharpening postgraduate research skills so that they are of practical relevance to industry. Government already supports much activity of that type. Your Lordships will be very familiar with the existing initiatives (see below, the answer to question 3).

Question 2: Will the Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

The Faraday Centre proposals are just proposals: no decision has been made by Government to set up a network of ITCs. Hence, it is clearly premature to say what the budgetary implications might be. If some form of intermediate technology centre programme is established and the centres develop into centres of excellence, it likely that they would tend to increase their *share* of total available funding. However, it is clearly very difficult to forecast whether this would entail an absolute decline in the funding which existing institutions attract.

Question 3: Are there alternatives [to the proposed Faraday Centres]?

There are some alternatives: the private sector, including such concerns as the British Technology Group, is actively forging links with academe. There are also several existing Government initiatives such as the Teaching Company Scheme, CASE awards, the Integrated Graduate Development Scheme, LINK, as well as the recently announced DTI/OST initiative in respect of Postgraduate Training Partnerships. We have to assess whether there is a need for more bridges and whether new added value would arise from a set of dedicated institutes.

Question 4: Should DTI's response have been more closely modelled on the Working Groups proposals and less like modified CASE awards?

Government needs to examine the case for ITCs very thoroughly. But the joint DTI/OST scheme for Postgraduate Training Partnerships (PTPs) was not a *response* to the "Faraday" proposals of the Working Group on Innovation (WGI). In fact, the PTPs scheme was announced in February 1992, before the Faraday proposals of the WGI were produced in May. The scheme is a *pilot*; it will contribute to an assessment of the concept. This pilot will enable postgraduates to work for higher degrees in industrial research organisations rather than in HEIs. There are to be 5 pilot partnerships, each enrolling ten students in the academic years 1992–93 and 1993–94.

Question 5: Should DTI's reponse have been more generous?

My answer to question 4 covers my response to this question.

Question 6: What questions remain to be resolved before a greater commitment is made?

Clearly, the question of industrial participation has to be resolved (see question 1). I aslo believe that, if there is to be a commitment to ITCs, the question of location has to be addressed. We have a fair number of HEIs with excellent technological strengths; not all of them are adjacent to existing bodies which might be considered as suitable candidates for ITC status. The question arises whether completely new institutions would be appropriate. That, in turn, raises the question of resources. We would have to assess whether such an initiative could be accommodated within existing budget, or whether a bid for extra resources, which would be competing against other priorities, could be made. So I see the key issues as: demand by industry, location, and funding. These issues, particularly the first, needs careful assessment. On all of these issues I shall be consulting with colleagues in DTI and SERC.

Letter to the Clerk from the Science and Engineering Research Council (SERC)

Thank you for your letter of 11 June, regarding the Select Committee's deliberations on a possible Faraday Programme for the UK. The Committee's involvement in the continuing debate is timely. I am a member of an ABRC Working Group which has studied the German Fraunhofer programme notably during a visit to Germany between 15 and 17 June 1992; the Working Group will be reporting to the ABRC shortly. This response to your specific questions represents a SERC view, and should not be confused with those of the ABRC Working Group. I think Sir David Phillips will be writing to you separately on behalf of ABRC.

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

The attached diagram shows the positioning and the relative size of spend by the Fraunhofer Gesellschaft (FG). There is no doubt that the spend performs a useful function in Germany. In particular it is deployed in the gap between the more "academic" work of the University Departments (Departmental Research on the diagram), the National Research Centres of the BMFT and the Max Planck Gesellschaft. The distinctive role of the Fraunhofer system is to take exellent scientists and engineers who have academic distinction as their driving aim and to make them no less excellent scientists and engineers who have commercial exploitability as their index of achievement.

Before going on to discuss the relevance of the Fraunhofer model to the UK it is important to stress a number of features of the system not widely acknowledged in the UK.

(a) The Society has been growing and developing for about 40 years now though there was a significant change in emphasis about 20 years ago. Evolution has been continuous over that period.

(b) The very great majority of FG Institutes are focused around people already distinguished as *University* Professors. On the founding of an FG Institute the Professor assumes a *dual* appointment in the Institute and in the University. During his appointment as Director he (or she) retains a large active research group within the University Department. All FG Institutes are set up following an initial phase of funding on a more modest scale.

(c) The Institutes are usually created as specific facilities alongside the University research laboratories. Thus, for example, in Aachen, the Institutes are on a site shared with the University and are contiguous with the University laboratories. This is regarded by the FG as an essential ingredient of success.

(d) The FG system was created during a period of plenty as far as the funding of Science and Technology in Germany is concerned. Currently they are coming under a severe squeeze with cut-backs and closures being sought.

(e) The FG does not charge industry and other consumers full commercial rates. An element of subsidy by Government is involved. This is beginning to raise questions in respect of European Community rules and subsidies to industry.

As far as the UK is concerned, I believe there is a place for FG-type support, but I am very doubtful whether the funding of fully fledged Institutes is desirable. In fact officials of the FG warned us as far as possible to avoid that. Basically if the UK is to do anything in this area it should be built up slowly. There is no way that a programme of the Fraunhofer type can be a quick fix. A lot of work and discussion to formulate the "right" approach for the UK will be needed. I do not feel that the current proposals are anywhere near adequate for the purpose.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

The starting assumption must be that Government will not provide new funds for a Faraday Programme—so funds will need to be diverted from other activities. If a programme—is to be launched, then sensible levels of funding will be required; certainly of the order £20 million to £30 million p.a. if not more. Redirection of

such sums, should they come from the Science Base, would represent a significant perturbation to the potential for academic research—which is the prime input to the innovation process. Any redirection of funding certainly should not be from the HEI research base.

(iii) Are there alternatives?

There are certainly alternatives to the training element of the Faraday Programme. SERC has its long-established CASE scheme, which gives an industrial input to PhD training. It has recently launched 3 pilot schemes for "Parnaby" Engineering Doctorates—which include placements in industry. The Intermediate Institutions can (and do) take part in CASE—and could be involved with Parnaby training. The Teaching Company Scheme is focused in this general area and is much applauded for it success.

The other aspects of innovation are encouraged through a variety of schemes—for example LINK, and a variety of DTI schemes (particularly to catalyse innovation in small companies).

(iv) Should DTI's response have been more closely modelled on the Working Group's proposal?

The Working Group's proposal, and the report from ACOST, are rich on concept—but rather poor on detail. The proposals certainly could not be implemented immediately. The DTI/OST "precursor" scheme drew out one element of the Faraday concept (the training dimension in Intermediate Institutes), and (working with SERC) the detail for that limited programme was developed in short order. SERC is operating the studentship component of the precursor scheme—and although we were initially sceptical about the scheme, we feel the quality of the proposals has turned out to be high. The level of demand is dramatically higher than we had anticipated.

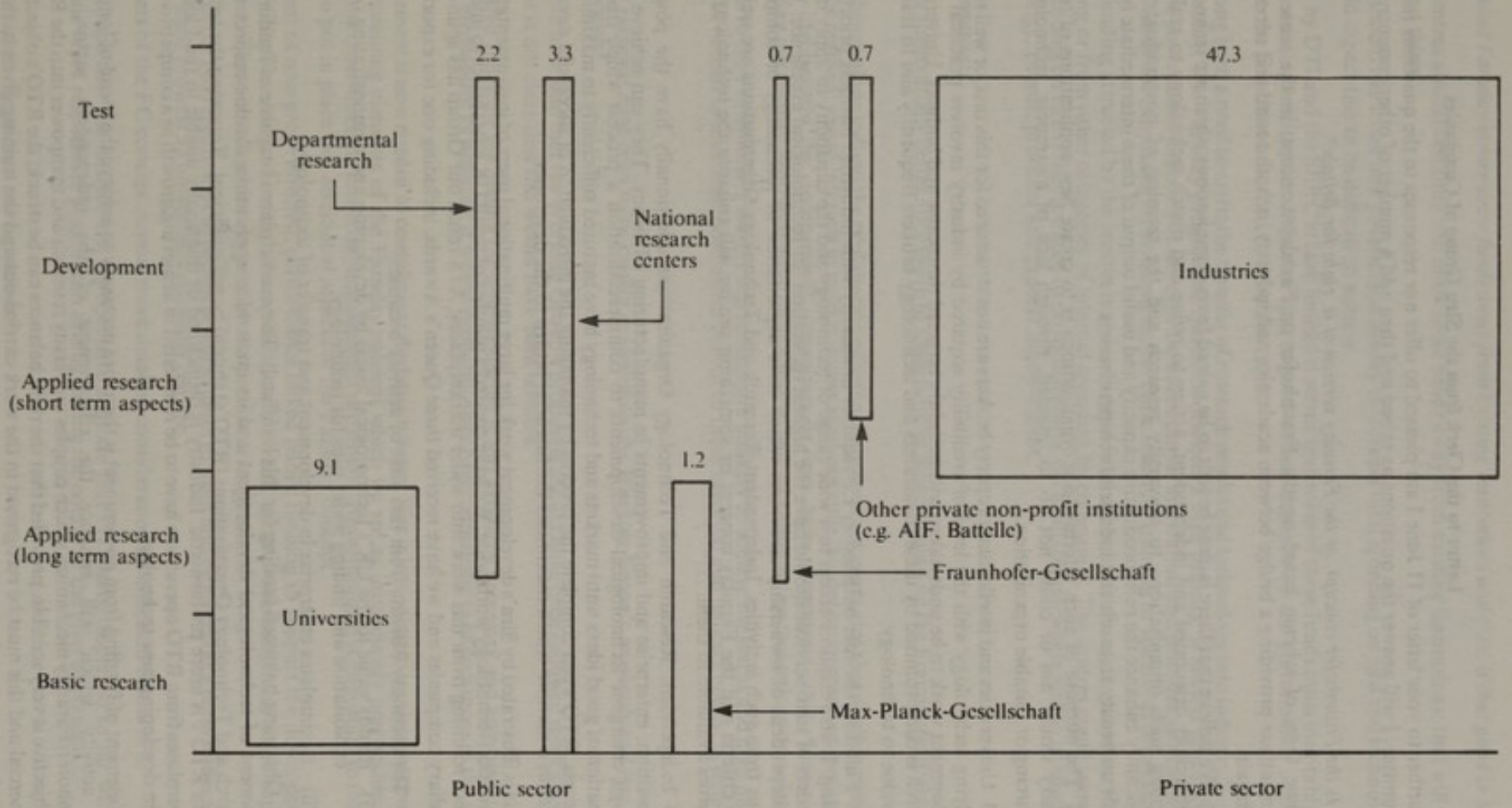
(v) Should DTI's response have been more generous?

No comment.

(vi) What questions remain to be resolved before a greater commitment is made?

There is a huge programme of work needed before an effective Faraday programme could be launched. Officials from DTI and OST need to work up a detailed scheme, including selection criteria, appropriate funding levels, interfaces with other related schemes, evaluation criteria, the respective roles of Government and industry, the impact on academia, and, above all, the positioning of the scheme within the cohort of other devices currently funded by Government to support technology transfer. SERC would hope to be involved in the on-going consultation process. There have been suggestions that bodies such as CEST or AIRTO should have responsibility for running the scheme. Any agreement for these bodies to do so should be subjected to vigorous assessment against a detailed contract to do so. On the face of it neither would seem to be appropriately constituted to do the job.

The System of Research Institutions in the Federal Republic of Germany 1989
(Expenditure in bn DM)



Letter to the Clerk from the Sira Group of Companies

Further to your letter of 11 June I am pleased to offer our responses to the questions raised by the Select Committee. I will answer the questions as raised and then add a number of other comments.

(1) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

Some form of scheme based on the Fraunhofer or Faraday concept, in the sense of intermediate organisations providing a bridge between academics and industry, is both sound and necessary and is right for Britain.

1.1 We believe that there is clear benefit to be gained from organisations which are technologically strong, commercially orientated and independent, acting to refine and match technology to real industrial need. Coupling such organisations to university research and the training of postgraduate manpower will significantly enhance the role, productive capacity and useful output of these intermediate bodies. It will also benefit university research and industrial competitiveness.

1.2 The purpose of such intermediate organisations is to create new applications of technology where industry would not or could not do so unaided, through lack of awareness, technological capability, resourcing or suitable organisation.

1.3 Universities and intellectual property brokers are not structured for this task or well suited to this role. Applying technology with the level of credibility required by industry involves practical engineering and development work to be undertaken within tightly targeted timescales and budgets. University teaching and research is compromised by these constraints and technology brokers frequently aim to transfer rather than add value to technology.

1.4 Fulfilling the role outlined in 1.2 requires familiarity with industrial business priorities and ways of working. It also requires access to a wide range of technology and the capability to apply it. To be credible, providers of such services should have the highest reputation for technological excellence. They should also be independent of ownership structures which stifle exploitation of technology or compromise financial returns from such activities. Independent Research and Technology Organisations are well placed to meet these criteria and the Faraday concept or something similar will enhance the technology and manpower resources available to them.

1.5 Independent Research and Technology Organisations additionally have the power to stimulate competition, enterprise and improvements in manufacturing efficiency. They can achieve this by carrying through emergent technological developments to commercialisation a process which frequently requires incubation of good ideas until markets and technology have matured sufficiently to maximise the likelihood of success. RTO's can complete the process by managing the introduction of successful developments to the market in a manner which maximises the financial return to the developer.

This is illustrated by Sira's development work for large multinational users of instrumentation, control and information technology worldwide. We have created a number of small UK enterprises to inject newly created product resulting from this work into wider marketplaces. As a result our Group has spun-off a number of subsidiary companies and we have received three Queen's Awards, including one for export.

1.6 The economy benefits from this kind of activity because:

(i) it adds value to the UK's technological assets by developing and demonstrating opportunities for exploitation and finding wider uses for technology.

(ii) it stimulates enterprise in development and transfer of technology.

1.7 Obtaining balanced funding for this is difficult. The marketplace is capable of funding the short term component of technological development and its immediate application. In this respect the independent Research and Technology Organisations (RTO's) should be self-sufficient. Renewing the technological asset base in RTO's is more problematic. Industry is disinclined or financially unable to fund longer-term work, and surpluses from RTO operations have to be reinvested in achieving growth in a competitive market, rather than in developing new technology.

An element of funding from government is therefore necessary to achieve the blend of long term and short term activity which will enhance the effectiveness of the independent sector. The proposed Fraunhofer/Faraday mechanism which couples university research and manpower into the RTO's to achieve this objective is very sensible, provided that the right balances can be struck; the RTO's objective is ultimately commercial and this must be recognised in the work carried out and the training given to the postgraduates involved.

1.10 Additional long-term benefits will come from a UK Fraunhofer/Faraday scheme if we succeed in raising the public status and awareness of science, technology and manufacturing in the UK. If we succeed in getting PhD students excited about setting off on the right track for an industrial career early in their lives we shall see an immediate benefit to industry as well as progress towards changing the cultural background to science, technology and manufacturing in this country.

(2) Will the proposed Faraday centre draw funds away from existing institutions and if so, is that good or bad?

The Faraday Centres almost certainly will draw some funds away from existing institutions; that will not necessarily be a bad thing.

2.1 Ideally, we should like to see new government money to increase total spending on r&d and technology transfer. We would expect this to be difficult to achieve.

2.2 If spending by DTI and the SERC is cash limited it seems that some of these funds must inevitably be drawn away from existing institutions. Whether that is good or bad depends on the performance of these institutions and on the priorities accorded to their activities.

2.3 There has long been a need to assist the transfer of research results and technology into industry for the benefit of the economy. The Faraday programme therefore deserves a high priority. It should probably be funded, in terms of government support, at the expense of industrial innovation and problem solving work elsewhere rather than at the expense of other spending, on basic research, training or standards for example.

2.4 Industrial funding attracted by the centres may be diverted from other institutions, from industry's in-house r&d spending or from other categories of internal spending by companies. The centres could increase total industrial spending on r&d if they are seen to provide features not available elsewhere and to be effective sources of technology, people, products and process improvement.

(3) Are there alternatives?

It is hard to see a substantially better alternative to some form of scheme based on the Fraunhofer/Faraday concept.

3.1 Leaving industry alone to fund the exploitation of technology does not guarantee that anything like its full potential will be realised; vested interests in market domination can stifle, hinder or surpress technological advance. Active involvement by independent organisations can help circumvent this. Using the Fraunhofer/Faraday mechanism is probably the most effective way of aiding active technology transfer.

3.2 Alternatives to the Fraunhofer/Faraday mechanism are unlikely to achieve the status and high public profile which will be needed to maximise both direct benefit to those involved and indirect benefit in terms of public perception.

(4) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

Initially we would have said that the Working Group's proposals should have been followed more closely, but on reflection it is not clear that this would have been sensible.

4.1 In the declared timescale for getting the scheme started it was probably necessary and appropriate to create as simple a mechanism as possible; it would probably have been unrealistic to expect more in the time available.

4.2 Some refinement is now needed to compliment the basic scheme. Sira is intending to implement certain of the essential remaining elements of the Faraday concept which we see as immediately practicable; for example, some of the cross-teaching and cross-management provisions. Nevertheless it is important to follow through quickly to put in place two additional aspects of the Faraday concept.

(i) an element of non-profit directed, performance linked public funding to support the development of the FC, sponsorship of some basic research at the HEI, certain overheads and some capital equipment. These costs are not covered by the present arrangements.

(ii) adaptation of PhD regulations to permit postgraduates to work and be judged as a team rather than on individual prowess as universities currently require.

4.3 Other aspects of the FC concept require more detailed consideration as indicated below in 6.

We very much hope that the flexible and co-operative attitude that DTI have displayed so far will be extended to provide rapid response to suggestions arising during the course of the pilot operations.

(5) Should DTI's response have been more generous?

DTI's response was probably sufficiently generous given the short-term imperative to get a pilot postgraduate training scheme off the ground.

5.1 In the longer term, the funding is not sufficient; the present level of support will not ensure the ongoing success of the postgraduate training scheme on its own since industry will have to bear the full burden of administration and overheads after the contracts covering setting-up activities expire in two years time.

(6) What questions remain to be resolved before a greater commitment is made?

The principal questions to be resolved concern the management of the overall programme and the relationship of each FC to its host institution.

6.1 We have misgivings concerning the proposed Faraday Programme Management Group but more serious concerns about the concept of the FC as an autonomous limited company embedded in and possibly competing in some respects with its host. Various subsidiary questions follow from this; for example, how should contracts of employment for FC staff and students be established and how should a coherent funding scheme be created (as opposed to the present split funding between DTI and SERC, presumably in order to fit existing rules).

General comments

We have no doubt that the Faraday concept can provide a very valuable resource for industry. We have some worries that in the present financial climate, industry may not be able to take full advantage of it. Short term priorities, as always, will tend to outweigh the need for investment for the future. Any encouragement, financial or otherwise, to industry to look to the future would help. Perhaps we are just beginning to see a realisation that cutting dividends to provide funds for innovation would be in the long term interests of shareholders.

The case for involving some form of intermediate or bridging organisation between academic institutions and industry to facilitate the innovation process is a very strong one. Organisations in this position do not have an easy or comfortable role and their success depends critically on the characteristics of their staff. Those they employ have to have a good knowledge of that part of industry they seek to serve, not only of the technological barriers to progress but also of the non-technical constraints imposed by competition, finance, legislation and so on. These same people must also be able to understand a wide range of acedemic work and to see the relevance of it to the solution of industrial problems. Their task is to seek out usable technology and scientific understanding, to interpret it to industry and to demonstrate its application. Such people are rare.

The proposal that the centres through which this activity is carried out should be partially staffed by postgraduate students is very sensible in that it facilitates close liaison with the educational institutions and provides a source of trained engineers and scientists with a better knowledge of industry than that normally possessed by the more conventionally trained postgraduates. These must, however, be surrounded by a significant nucleus of experienced staff having the characteristics outlined in the preceeding paragraph.

We would also see merit in arranging for close liaison between the centres and local schools and further education establishments in order to generate positive interest in the application of science to industry. Without such interest at secondary level there will be no supply of future postgraduate students.

We are well aware that some companies, particularly some of the larger ones, have a history of fruitful co-operation with university departments. The intermediate institutions should be able to ensure that the advantages which flow from such arrangements are actively developed and are more widely accessible to smaller companies.

I hope that these comments will be of assistance.

Richard Brook

Managing Director

Letter to the Clerk from The Society of British Aerospace Companies Ltd. (SBAC)

Further to our telephone converstaion of last week about your letter to CBI asking for additional comments from industry on the proposed Faraday Centre initiative. Thank you for Faxing me a copy of the letter and for agreeing to take a late input from the SBAC. The SBAC Research Committee had discussed the concept as outlined in the Final Report to the Working Group on Innovation on the Faraday Programme, and the following comments have been produced ex-committee in order to meet the very short response time.

The UK Aerospace Industry supports the concept of the Faraday Programme as a mechanism for improving the competitiveness of UK industry by bringing industry and academia closer together in what should be a very effective manner. It is considered that this effectiveness will stem primarily from the envisaged flow of high calibre research staff between industry, universities and the Faraday Centre. There are, however, some reservations about the proposed implementation of the programme.

Whilst it is obvious that the three functions: university, 'intermediate institute', and industrial exploiter, are essential ingredients of the Faraday Programme, it is considered that it is the process of maturing and transferring technology which should be the basis for funding. It is not clear, therefore, why the Final Report concluded that the 'intermediate' role could be fulfilled only by a commercial research organisation acting as a host.

Since each sector of industry will have its own culture of research, this should be taken into account, and no hard and fast rules should be laid down in respect of the hosting arrangements. Rather, a flexible approach should prevail which permits the host organisation to be based either in industry or a commercial research

centre, depending on the nature and size of the companies involved in the specific initiative. Bearing in mind that the total activity must have a strong industrial focus, should a commercial research organisation be chosen, then it must be one with a significant industrial orientation.

A logical next step would be to arrange for consultation between industry—through the main Trade Associations, academia, CEST and the DTI to formulate the strategy for the progressive implementation of what is considered to be a very important initiative. For our part, we would be very pleased to act as the point of contract for the Aerospace Industry and would ask you to keep us informed of future developments.

M. Garrigan

Assistant Director (Technical)

Letter to the Clerk from Unilever

Thank you for your letter of 7 September concerning the Science and Technology Committee's proposal to establish Faraday Institutes based on the German Fraunhofer Institutes.

We are of course familiar with the Fraunhofer Institutes. They have worked well in Germany over the years and their experience is of much value. We would also agree that creating links between industry and higher education is of enormous importance to the UK economy. Over the coming years, international competition will be increasingly innovation based, and it will be essential for any country to make effective economic use of the skills and knowledge within its Higher Education Sector.

The problem with commenting on this specific proposal is that the proposed Faraday Institute will find themselves within a British rather than a German context. To a very large extent, it will be the interaction of the Centres with the other elements in that context, as much as their own excellence, which will determine success or failure.

To be frank, the prospects are hard to predict. We believe that the Government are right to begin with a pilot programme. What we would emphasise is the need for the pilot to be designed and monitored in such a way as to provide a real test. An incomplete test, which does not constitute a realistic trial of the basic concept, will tell us nothing. A test which is not systematically monitored, in terms of costs, benefits and underlying reasons for success and failure, is likely to provide misleading conclusions.

I am unable to assess how far the Government's proposals fulfil these criteria, but I believe that this is the essential issue.

As to diversion of funds, the case depends on the effectiveness of the Institutes. Once more, a real trial is required to give the answer.

I am sorry that I could not be more precise but hope that these comments are of use.

M S Perry

Letter to the Clerk from the Provost of University College London (UCL)

Thank you for your letter of 12 June 1992. I must say it came as a surprise that the S and T Committee should choose to ask these questions now. I could have understood it when the Faraday proposal first emerged, and it would be logical in a year or so's time when the present programme can be initially assessed. Now is the least appropriate time in my view.

To answer your questions:

(i) Who knows? It seems to work in Germany as a contributory factor to their economic success, and on that basis worth an experimental evaluation in the UK.

(ii) As one of the participants, I am unlikely to criticise. Non-participants (including failed proposers) are likely to be more critical. Only the relevant Government Departments can comment on the impact of funding.

(iii) Yes, of course, but that is part of the British Disease to do nothing whilst considering the options.

(iv) Possibly, but there is ample opportunity to develop the programme—and I do not see it as merely "modified" CASE awards.

(v) Possibly—but there are other, higher priorities for tax-payers—and the DTI "lack of generosity" didn't seem to put off the applicants.

(vi) An intelligent analysis of how the present scheme works—but only when there is some experience on which to base that analysis.

I have always been impressed by the quality of House of Lords S & T Committee studies and reports, but this time I have my doubts!

Dr D H Roberts

Provost

Letter to the Clerk from the Vice Chancellor of the University of Leeds

I am writing in response to your letter of 11 June (which was addressed to my predecessor).

I do support the concept of the Faraday programme but, before I respond to your specific questions, it is important to articulate some basic principles.

(1) There is serious under-investment in r & d in most firms in most British industries. ICI spends around £500m pa on r & d—but is only ranked 35th internationally. Most British firms spend very little.

(2) There is under-investment in non-industry r & d institutions: HEIs, Research Councils, and intermediate institutes. The r & d investment is considerable—of the order of £600m in HEIs via the UFC; and perhaps the same again via research councils. But this is thinly-spread. Compare the ICI figure above.

(3) Notwithstanding (1) and (2), the monies available are not always targeted effectively because the conceptual basis of the problem has not been thought through. (There is considerable scope for retargeting the substantial government department r & d spends.) This is not to say that there is a simple "master plan" solution but a number of issues have to be identified. This is attempted in broad terms in what follows.

(4) There are various possible foci, each important for an element of the argument:

* disciplines—the knowledge and skill cores, mainly available in HEIs; note that many disciplines are enabling technologies for others
* enabling technologies—worth trying to define—but this is a not-trivial task
* people—the real skill base: pg students, post-doctoral fellows, industry research staff, academic staff
* industries—no simple classification; increasingly global
* regions—while the large firms are national and global, much of the economy remains in small firms with a more local reach

(5) This analysis demonstrates the existence of a complex network linking basic and strategic research, eg in HEIs, with industry. While the current Faraday proposals are important, they are a small contribution, at this stage, to a larger problem.

Against the backcloth of this analysis, I can now respond to your questions.

(i) Is the Faraday concept right for Britain? Faraday Centres would increase the pool of appropriately skilled *people* and that alone would be worthwhile.

(ii) Possible drawing away of funds. Given existing underfunding, *new* investment is required. On the other hand given the weaknesses of the present system, an element of redirection would not necessarily be bad.

(iii) Alternatives? The background analysis shows the situation to be so complex, that there are bound to be alternatives—essentially by investing at other modes of the r & d/technology transfer network. However, any such significant specific investment could still be deemed to be a Faraday Centre—if the centre's prime objective was to develop new kinds of skills—to give people different kinds of experience. Specifically, a Faraday Centre could be in an HEI on the one hand or in industry on the other. The latter is more difficult because of competition among firms within an industry.

In Leeds, we have a considerable *applied research* activity both in departments and via university companies. We plan to strengthen these by new investments (eg in an Institute of Information Systems and Manufacturing Engineering, and a Science Park Network) which in combination could be the core of an on-campus multi-disciplinary multi-industry Faraday Centre.

(iv) The current DTI scheme. Pilots are almost always valuable and the present scheme will provide important experience and results. However, the focus is almost entirely on post-graduate research students—and ultimately the scheme should involve postdoctoral fellows, research and academic staff.

(v) Should the DTI's response have been more generous. Yes, but I recognise that more of the thinking implied by the backcloth analysis above needs to be done. The fact that there were 58 bids for a first-round pilot bears out the analysis: there is serious underfunding; there are opportunities; there are many different ways of investing.

(vi) Questions to be resolved. I would recommend some rapidly-executed research to develop an explicit *enabling-technologies* agenda; and then in the light of this, a substantial number of pilot projects of varying size. Even for this, the investment would have to be substantial.

Letter to the Clerk from the University of Manchester Institute of Science and Technology (UMIST)

Thank you for your letter dated 11 June 1992 and for the opportunity to comment on the questions you have raised.

It would help the Committee, perhaps, if I were to answer the questions as posed rather than to give a lengthy discourse about matters already well known to the Committee.

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

One of the major problems we face in this country is our attitude to wealth creation through innovation and manufacturing. I believe that the German attitude is quite different and this is manifested through their recognition and remuneration of engineers, investment into capital equipment, support for R&D, the use of Government funds to support private manufacturing industry, and well developed links between HEIs and industry, etc. The Fraunhofer Institute has played its part in the development of these areas. In this sense, therefore, although Faraday Centres are, in my view, right for this country, we would be well advised to develop our own version of the Fraunhofer Institute rather than simply to copy them as they exist in Germany. It is equally important that the Faraday Centre concept is able to embrace all of those other initiatives which, in various ways, support innovation, technology transfer, student and staff interchange between academe and industry. For example, my own institute is deeply involved in Teaching Company Schemes, CASE studentships, TOTAL TECHNOLOGY doctoral programmes, PARNABY engineering doctoral programmes, LINK research programmes, Industrial Units and Campus Companies, and in the POSTGRADUATE Training Partnership with an IRO, EA Technology Ltd. UMIST is located in the centre of a rapidly changing Victorian city which itself has Development Corporations, Regional Offices for the DTI and DoE, a Chamber of Commerce, and is central to an area which is abundant in large industrial companies and SMEs. In developing the Faraday Centre concept, therefore, my view is that they should be targeted towards those universities and regions, particularly cities, where there is every opportunity for success. I would support, therefore, the establishment of Faraday Centre pilot schemes in such regions, properly funded, and using the experience obtained from the Postgraduate Training Partnership scheme.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

It would be a pity, in my view, if funds for the Faraday Centres were not new monies but simply a re-distribution of the scarce funds which are available to support research in universities, eg by re-distributing existing Research Council funding. The overall benefits which should be available from successful Faraday Centres justifies new sources of funding but it is essential that one measurement of the success of such centres should be a measure of the financial benefits generated. I recognise the difficulties that are brought about by seeking new sourcing of funds, and the concept of using public funds to support private industry, but this problem needs to be embraced, it seems to me, if we are to launch the pilot schemes from a universally supported position by all concerned.

(iii) Are there alternatives?

Not all industries need Faraday Centres, and particularly the sciences based industries where the relationships and working arrangements between senior academics and senior scientists appear to be more highly developed than in the more traditional manufacturing industries and with SMEs. For example, the process industry, chemical engineering, medical and pharmaceutical industries have probably developed to the point where Faraday Centres are not required. It may be possible in these cases, however, to develop an intermediate institute within an HEI, building on the existing industrial partnership and to specifically work on an agreed enabling science and technology programme.

(iv) Should DTI's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

Possibly, but I would take the view that over the period of study of a typical PhD student, 3 years after graduation from a first degree, some 30 such students would have been enrolled onto suitably defined projects within an IRO with each student receiving both HEI and IRO supervision. This type and level of activity is significant by any standard, and through this activity increased levels of co-operation and staff transfer would take place, as well as indirectly opening up research opportunities for the HEI with the industry or supporting the IRO, together with opportunities for staff interchange. To this extent, therefore, the Postgraduate Training Partnership is a much more extensive exercise compared with CASE awards, and provides the opportunity for the development of pilot studies on which the Faraday Centre principle can be developed.

(v) Should DTI's response have been more generous?

This question is more relevant to the IRO since the DTI contract is directly with the IRO and not the HEI. Students are financially supported by the SERC, with an extra top up from the IRO. The HEIs are compensated by the student fee income, once the students have been recruited, but receive a setting up grant from the DTI, via the IRO, for the first year of operation. Finally, industry financially supports the IRO for research projects and, no doubt, this indirectly provides the resource required for the student project but perhaps at the margin. There is therefore a multiplicity of funding, with the DTI taking the lead. At least the financial contributions from each of the partners is probably affordable and it is possible that DTI contributions towards the project cost is an area where discussion about extra funding could take place.

(vi) What questions remain to be resolved before a greater commitment is made?

My views on the questions which need to be resolved are as follows:

(a) How successful have the PGTP pilot schemes been and what are the parameters which need to be defined to judge their success or otherwise? Will students, for example, be persuaded to study in IROs or intermediate institutes rather than in the collegiate atmosphere of a university?

(b) Will a Faraday programme receive the support of all the agencies and HEIs concerned in order to justify the expenditure required and hopefully be supported with new monies?

(c) Is there enough support to launch a significant Faraday programme or should a pilot Faraday Centre be launched in one or two cities?

(d) Is there enough commitment to give the programme sufficient prestige and visibility, as Interdisciplinary Research Centres were, and will the resources provided for the HEIs match that commitment?

(e) Have the downsides of the Fraunhofer Institutes been looked into—are they suppported by German academe or would German academe prefer to work with Max Plank Institutes?

(f) Will private industry or the DTI commit funds on the necessary scale and will industry put the PhDs and intellectual property to effective use?

(g) Will the Faraday programme be seen as regenerating that part of UK industry that needs to seek alternative products as the Peace Dividend reduces other opportunities?

I hope that the Committee finds these comments helpful.

Professor H C A Hankins

Principal

Letter to the Clerk from the Registrar of the University College of North Wales, Bangor

My attention has been drawn to the enquiry which your Committee is undertaking into the proposed Faraday Programme and I am therefore writing to draw to your attention the work of the Biocomposites Centre at this College which is, in many ways, already fulfilling the role of a Faraday Centre in its specialised area of expertise.

It so happens that independent consultants have recently reviewed the first three years' work of the Centre for the Welsh Development Agency and a copy of the summary report they have prepared is attached for your information. This indicates far more eloquently than I could, the reason why the Biocomposites Centre does seem already to fulfil, albeit on a relatively small scale, the functions of a Faraday Centre. The report does give some information about the Centre's list of clients and I would be grateful if you could, therefore, regard the paper as having "commercial in confidence" status.

Finally, I would like to emphasise that the Centre has been successful because it has been located on a University campus. It seems to me that the suggestion in the original report on the Faraday Programme that all such Centres should be located away from Universities was unduly rigid. The crucial issue is what arrangements are best likely to work in any individual situation and I would, therefore, like to impress upon your Committee the strong wish of many higher education institutions that they should not automatically be barred from offering themselves as locations for these exciting new Centres.

Please do not hesitate to contact me if you would like further clarification of what I have written.

THE BIOCOMPOSITES CENTRE—A SUMMARY OF ACHIEVEMENT

The Need for Excellence

The Biocomposites Centre was established in 1989 as a Centre of Excellence in biocomposites contract research. Its first Director, Dr James Bolton, an internationally renowned expert in the field of Wood Science, had recognised the considerable unrealised potential of plant-based composites for manufacturing high performance, environmentally friendly composites, at a fraction of the cost of other materials. The strategic objective of the Centre was to search for these novel materials, and through the development of new processes

and materials based on natural plant fibre, improve existing low value-added commodity products, such as paper and fibre board, and develop new higher value-added and competitive products. Its focus was the practical and commercial application of its discoveries.

By establishing the facility at the University of Wales in Bangor based around the Wood Science Group, the Centre built on a nucleus of scientists with world-wide reputations. The result was the largest concentration of biocomposites expertise in the world, combined with unique facilities for testing and implementing new products and processes up to pilot stage in the following areas:

— support of existing plant fibre processing industries
— development of novel products reinforced with plant fibres
— control of plant surface chemistry for selective absorption, filtration, catalysis
— the development of plant fibres as alternatives to man-made fibres
— the development of novel materials based on plant polymers

Establishing the Centre

The BioComposites Centre was established as a self financing organisation. Initial support came from two sources:

— The **Welsh Development Agency** provided £400,000 to cover initial employment of staff, seed strategic research and fund the plant through to commissioning.
— The **University College of North Wales** at Bangor provided low cost accommodation and serviced the Centre's initial debts interest free in its early years.

Early support also came from industry in the form of assistance with pilot plant installation and research contracts.

Financing the Centre

The Centre's income derives from:

— contract research
— fees for its services
— the hire of its pilot plant
— grants
— and ultimately the sale of licences

Set backs encountered in the initial three year phase have been overcome and the Centre will break even in its fourth year. Research contract earnings have grown quickly, and the Centre already has £3 million worth of proposals awaiting approval—equivalent to more than three times the Centre's annual running costs—with other large proposals to be submitted. By the end of its fifth year, the Centre's management are confident that the aim of financial self-sufficiency will be achieved.

A Marketing Direction

The BioComposites Centre has a well-defined marketing direction which sets it apart from most contract research organisations.

Senior staff have close links with industry in the UK and overseas, and have established commercially based working practices that give cost effective and usable results for their customers. The technologies, products and processes that emerge from the Centre are in an advanced stage of development, ready for commercialisation.

The Centre's clients, whether hosts for new products or research collaborators, include leading international corporations such as Hoechst, DSM, Dalgety, Hicksons and Ciba Geigy. This success in attracting a high-quality clientele is due in large measure to the market research skills of the Centre's senior staff. The broad customer base also ensures a stable flow of contracts for the future, eliminating reliance on any one target sector.

In essence, the Centre can provide a fast response, cost efficient service geared to industry's current and future needs.

Liaison with University

The link between the Centre and the University is of crucial importance for its success. For the University, the Centre provides a vital link with industry, helping academic staff translate their research into commercial applications, and giving them access to industrial research partners and new research facilities.

The University, and in particular the Wood Science Group, provides a high-calibre graduate pool and an academic base of research into which the Centre can tap. At the same time, the BioComposites Centre has immediate access to the University's facilities, including the latest spectroscopy equipment, electronmicroscopes, libraries etc.

Achievements So Far

The Centre is now poised to consolidate its role as the World's leading research institute for biocomposites:

* **People**—the Centre now employs 23 full time and 4 part-time staff from a wide range of science disciplines and industrial backgrounds. The team includes 7 PhDs and 5 MSc's, all leading researchers in the biocomposites field. A further 8 staff are qualified to degree level. With further funding the Centre will seek to employ 3 additional staff in the short term, including 2 PhD's in Materials Engineering and Plastics Technology, and a Polymer Scientist.
* **Plant**—a key element in the Centre's creation was the establishment of a pilot plant to simulate existing and newly developed industrial processes, thus giving credibility to the Centre's activities. The plant, now operational, is the most flexible of its kind in the world, offering a unique service to international industry.
* **Practicality**—through its strong industry links, the Centre has already generated a high level of practical, implementable market-oriented technology geared to the market's needs.
* **Perception**—the Centre has successfully promoted its facilities, its staff and its results to industry. Worldwide PR has generated public awareness of its work, and the Centre's staff have presented papers, press articles and publications in the international media.
* **Patents**—the Centre has already filed three patent applications and is seeking suitable licencees amongst major industrial companies to exploit the technology commercially.

Factors for Success

The factors that have brought success are:

* Strong leadership from the Centre's Director, Dr James Bolton, who has the scientific expertise and reputation, combined with commercial acumen to promote and guide the Centre along the most financially and technically profitable avenues.
* The initial support given by the University and the WDA, and the ongoing investment by sponsoring companies has provided the Centre with a well founded, professionally directed launch pad.
* The Centre can rightly call itself a Centre of Excellence and Expertise, with a high calibre, multi-disciplinary and highly motivated staff, second to none in the world.
* Its bridging role between industry and academia enables the Centre to develop practical and manageable technologies that solve industry's real materials problems, whilst maintaining the environment needed for the vital cross-fertilisation of ideas.
* The pilot plant has given the Centre a unique opportunity to develop the results of their research into implementable technologies for industrial use, as well as an income generating tool.
* The Centre is run on commercial not academic lines, demonstrating a professional attitude to its R&D and giving clients confidence in its ability to manage projects efficiently and achieve profitable results.

Letter to the Clerk from the WRc

We are pleased to respond to your letter of 11 June 1992 to our Dr John Davis.

We would make the following points and comments under your headings.

(i) Is the Fraunhofer concept, or the Faraday version of it, right for Britain?

We believe that the Faraday version of the Fraunhofer concept should be right for Britain. It should provide the commercial stimulus to achieve the required flow of technology and people necessary for the success of British industry at the turn of the Century. Fraunhofer works in Germany largely because the commercially successful institutes receive continuing Government funding. Any poor ones go to the wall so it is self-regulating. Given this belief, our successful partnership bid with Imperial College reflects our commitment to the principle. Such an active technology development process will facilitate flows of industrial technology and skilled people between industry, technology development organisations (independent institutes like WRc) and Higher Education Institutes (HEI's). We believe that we can make it work in practice.

(ii) Will the proposed Faraday Centres draw funds away from existing institutions and, if so, is that good or bad?

We are not in a position to judge whether or not funds would be drawn from existing institutions. It is a matter for political decision-making. For Faraday to be taken seriously, substantial funding will be necesseary.

Unless new funds are to be made available, then the effectiveness of existing institutional arrangements will need to be assessed against a criterion of Britain's international competitiveness in key technological areas. Our own view is that:

(a) It is unlikely that the status quo situation will be considered tenable.

(b) The Faraday concept allows careful and targeted spending of public funds through specific initiatives (eg the recently announced DTi Technology Transfer Programme).

(c) "Start up" costs for Faraday Centres are a one-off commitment by Government. The future viability or otherwise of a centre will be dependent on normal business principles and market considerations. The use of public funds for Technology Development using strategic science from HEI's would form part of its contractural responsibilities (eg as part of a Faraday franchise).

(iii) Are there alternatives?

There is no unique model for success and in this sense there are probably alternatives. We believe that the Faraday concept, as developed, is workable and provides an institutional framework which supports rather than constrains the likelihood of success. The success of any particular Faraday Centre will be dependent on the ability and commitment of people. Our early experience of putting together a partnership bid and developing the partnership gives us a degree of optimism.

(iv) Should DTi's response have been more closely modelled on the Working Group's proposals and less like modified CASE awards?

From our perspective, the pilot partnership initiative was set up with modified CASE awards to maximise the use of existing administrative procedures. We would value a more specific dialogue in the setting up of detailed administrative and contractual procedures for Faraday Centres. In this sense, we would regard the current procedures as appropriate for a partnership. We believe that partnership experience should be brought to bear in drawing up tailored contractual procedures for Faraday Centres.

(v) Should DTi's response have been more generous?

In relation to the partnership initiative, we are satisfied with current funding provisions for start up costs and have signed our contract with DTi on this basis. We believe that the funding framework for Faraday Centres requires further detailed consideration.

(vi) What questions remain to be resolved before a greater commitment is made?

Nothing additional in points of principle. Remaining questions involve matters of detail such as number of Faraday Centres, their terms of reference, detailed contractual/funding provisions, etc.

(vii) Additional comments

The only additional points which we would wish to make are as follows:

(a) We believe that SME's in the UK tend to be less technically based than in Germany. In paralled with the Faraday initiatives, consideration should be given to the support and encouragement of training initiatives for SME's. This will be part of the cultural change necessary to begin the flow of technology and people. Once the flow begins one would expect it to be self-funding backed by the Faraday Centres.

(b) The initiative needs to be medium/long term in its aspirations and in this sense is an act of faith and political judgment. Real achievement will start to be measured in three to five years and true success will be judged in five to ten years.

I trust that these views are of value in relation to your enquiry. We would be pleased to respond to further questions if required.

Printed in the United Kingdom by HMSO
19585 C7 2/93 211435

ISBN 0-10-405093-4

9 780104 050934

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