1990 public expenditure survey ; advice of the Advisory Board for the Research Councils.

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22 May 1990

Dear Secretary-of-State,

PUBLIC EXPENDITURE SURVEY 1990: THE SCIENCE BUDGET

I am pleased to submit the enclosed advice from the Board for this year's Public Expenditure Survey.

Since it was reconstituted last month, the Board has undertaken a detailed scrutiny of the programmes which the Research Councils and other funded bodies plan to pursue within their present Science budget allocations, and has reviewed carefully their proposals for new activities requiring additional resources. This Advice records our conclusions.

Our major concern is that the government's present spending plans imply a reduction in Science Budget activities of about 6% by 1994. Despite a stringent and continuing process of review the Research Councils will have little scope to redeploy resources so as to grasp important new scientific opportunities: most of the funds which they free for recycling will be absorbed by cost increases in on-going priority programmes.

The Board, and its predecessor, has welcomed the Government's statements of commitment to the importance of basic and strategic science for the nation's future development and of the need to sustain top quality science in our Research Councils and universities. We are thus acutely disappointed that the Government's plans imply a significant fall in the share of the nation's wealth which will be invested in the Science Budget.

This Advice recommends strongly that those spending plans should be revised: that the Science Budget should be increased over the next three years by the amounts needed both to sustain the present capability of UK science and to allow enhancement of research programmes in high priority fields. The Board is, however, very conscious of the other pressing demands for increases in public spending. We have therefore constrained our recommendations for additional funding to a small selection from the many excellent proposals which they Research Councils and other bodies put to us - identifying only the most timely and most promising programmes with the greatest potential for advancing science and the nation's interests. They are opportunities which should not be spurned lightly.

The Board and I look forward to discussing this Advice with you at an early opportunity.

Yours sincerely,

David Phillips.

DAVID PHILLIPS

1990 PUBLIC EXPENDITURE SURVEY

ADVICE OF THE ADVISORY BOARD FOR THE RESEARCH COUNCILS

INTRODUCTION

1. This submission presents the Board's annual advice to the Secretary of State on the implications of the Government's expenditure plans for the Science Budget. It includes an assessment of the health of the science base, comment on the continuous redeployment of resources towards new high priority scientific opportunities, and a judgement of the additional resources necessary to sustain both the strength, flexibility and effectiveness of the Research Council system and the quality of its output in terms of scientific advance and the training of highly qualified research manpower.

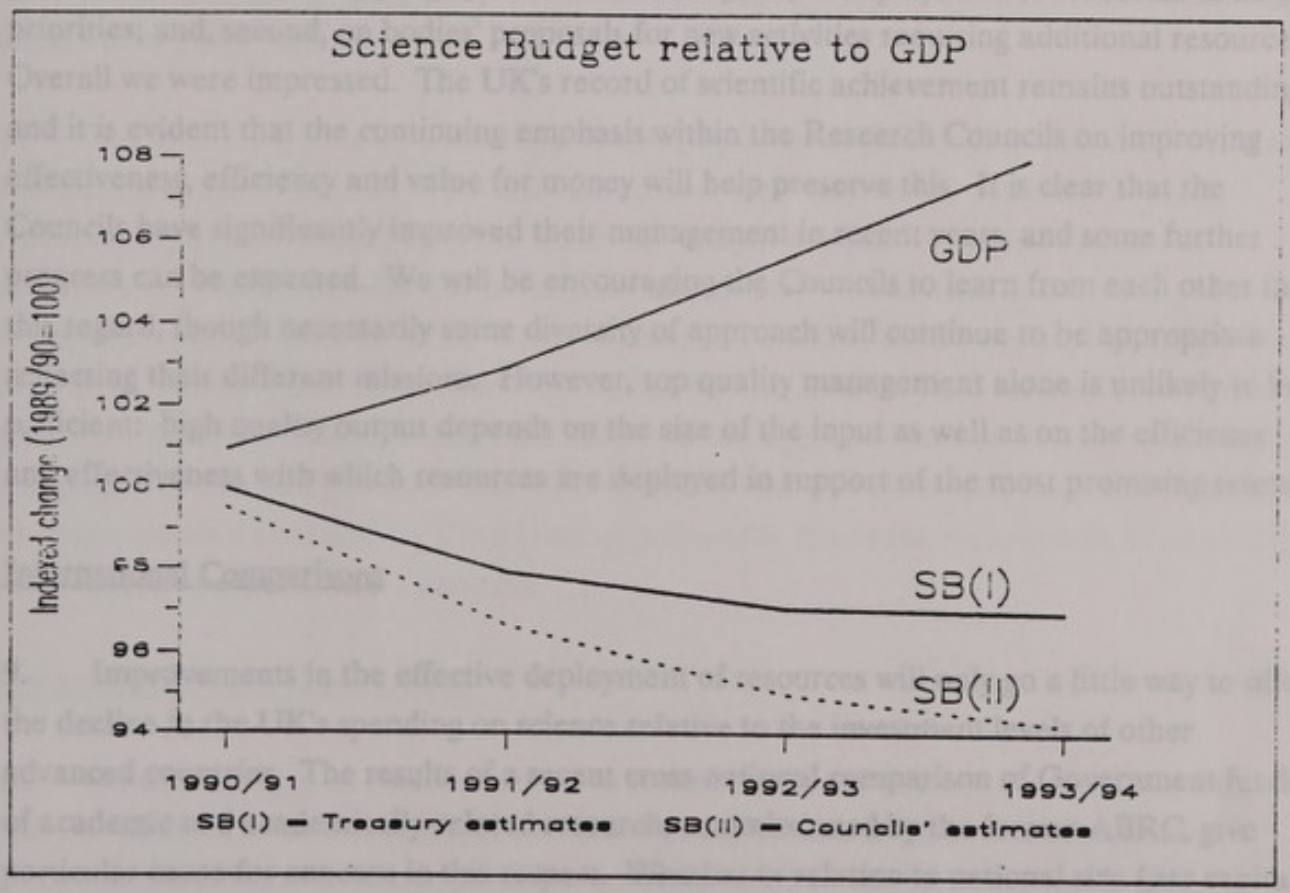
2. The Board was reconstituted in April 1990, with fewer members and new terms of reference. This Advice has been prepared by the new ABRC within an inevitably, and unfortunately, compressed timetable. Much of it is based on work set in train by the former ABRC and on presentations to us by the Research Councils and other funded bodies of their Corporate Plans and Forward Look documents. The judgements in this Advice are, however, those of the new Board. They derive from a careful scrutiny of existing programmes and a detailed examination of potential new activities.

3. In its PES submission last year the former ABRC estimated that additions of £94m in 1990-91, £131m in 1991-92 and £135m in 1992-93 were necessary to provide for new scientific opportunities, to ensure adequate provision of manpower and equipment for the science base and to make progress with the restructuring of Councils' institutes. The Secretary of State responded with an announcement last November of increases amounting to about £60 million a year including earmarked additions for BAS and BGS.

4. The former Board greatly welcomed these increases which have sustained the momentum of the previous year's substantial boost in science funding and allowed for some new initiatives in 1990-91. However, there was disappointment that the additions were insufficient to provide for all the timely opportunities in high quality science which the Board had identified or to make a more substantial start on essential re-equipment. The potential effects of future inflation were also a significant worry.

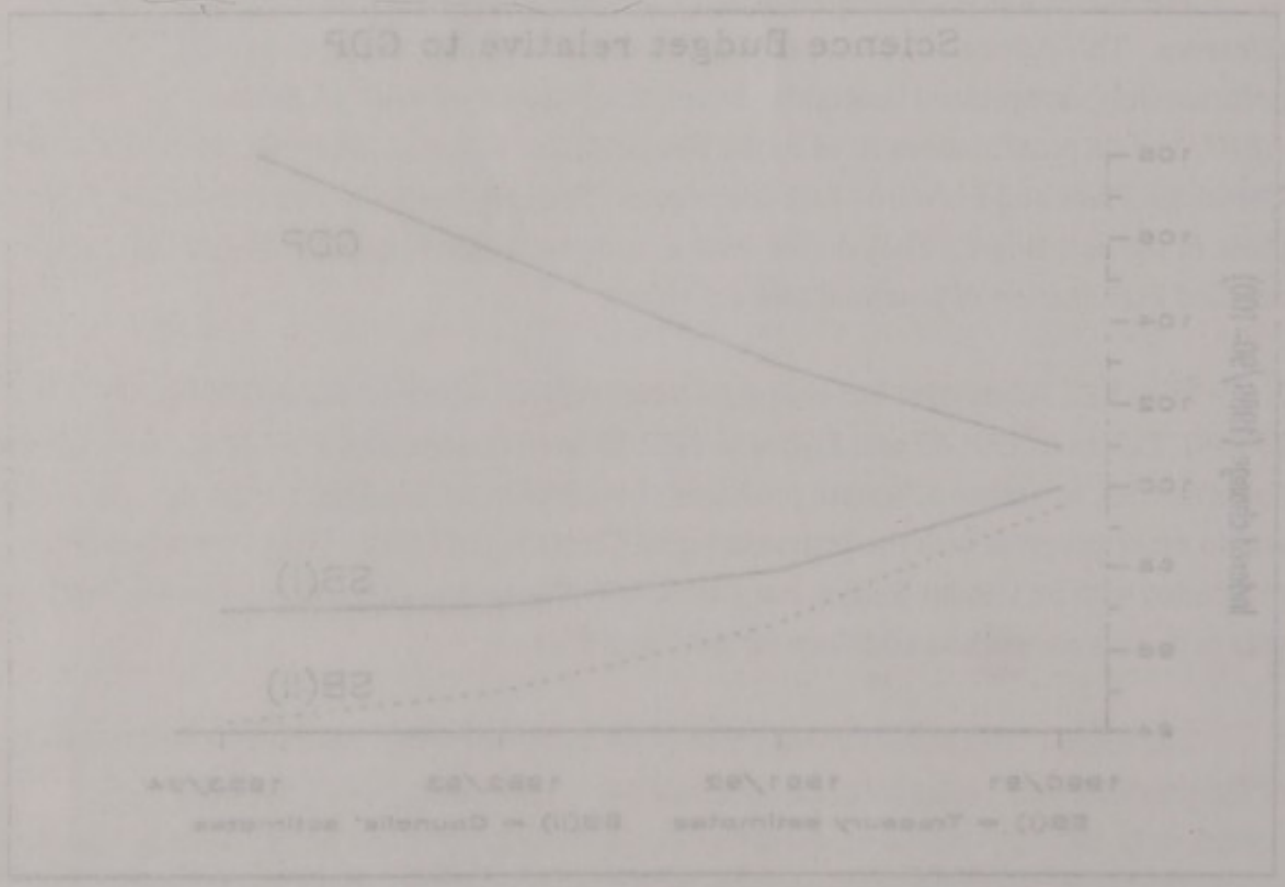
5. When allowance was made for inflation at the level then forecast by HM Treasury for the economy generally (ie using the GDP deflator at market prices), the Government's plans for the Science Budget seemed last autumn to represent roughly level funding over the years 1990-93. This did not, however, imply that a constant volume of science could be supported. On past experience the cost increases which have to be met by Research Councils exceed the Government's inflation forecasts by between 1% and 2% a year - partly because of the relatively large proportion of their expenditure which is on salaries.

6. Since then inflation prospects have deteriorated significantly. HM Treasury's current forecasts for the GDP deflator now imply a "real terms" reduction in the Science Budget of 3% by 1993-94, and funded bodies' own assumptions about inflation suggest that there will need to be a progressive cutback in research activities totalling almost 6% over the same period. This contrasts starkly with the Government's forecast for an 8% increase in the nation's wealth (GDP) by 1993-94.



THE HEALTH OF THE SCIENCE BASE

7. The Board has welcomed the Secretary of State's various statements about "the importance which the Government attaches to civil science in the Research Councils and the universities". Basic and strategic science has a major contribution to make to the continuing



development of industry, the economy and social welfare in the UK - both as a source of knowledge and ideas and as a provider of very highly qualified manpower. To these ends the Board is convinced that the science base in higher education and the Research Councils must be maintained and enhanced in strength and quality. This will be achieved in part through greater concentration of research activities and more selective allocation of resources, the sustenance of basic research, greater responsiveness both to scientific opportunities and to national needs, and (where this gives good value for money) increased international collaboration. The new ABRC intends actively to pursue each of these objectives, and to continue its predecessor's work in encouraging: closer collaboration between the science base and the users of research; and greater efficiency and effectiveness in the management of resources for research and postgraduate training.

8. In the short time since its reconstitution the Board has undertaken a careful scrutiny of all the funded bodies' Corporate Plans and Forward Look documents. This review has focussed, first, on existing programmes and the scope for redeployment of resources to new priorities; and, second, on bodies' proposals for new activities requiring additional resources. Overall we were impressed. The UK's record of scientific achievement remains outstanding, and it is evident that the continuing emphasis within the Research Councils on improving effectiveness, efficiency and value for money will help preserve this. It is clear that the Councils have significantly improved their management in recent years, and some further progress can be expected. We will be encouraging the Councils to learn from each other in this regard, though necessarily some diversity of approach will continue to be appropriate reflecting their different missions. However, top quality management alone is unlikely to be sufficient: high quality output depends on the size of the input as well as on the efficiency and effectiveness with which resources are deployed in support of the most promising science.

International Comparisons

9. Improvements in the effective deployment of resources will only go a little way to offset the decline in the UK's spending on science relative to the investment levels of other advanced countries. The results of a recent cross-national comparison of Government funding of academic and academically-related research, commissioned by the former ABRC, give particular cause for concern in this respect. Whether in relation to national size (per capita comparisons) or to national wealth (proportion of GDP comparisons) the UK is demonstrated to spend significantly less on academic research than its major European competitors. Moreover, there was a significant deterioration in the UK's relative position during much of the 1980s, notably in relation to France. The report of this study estimates that UK Government funding would need to have been £300-£350m higher in 1987 to match corresponding levels for

European competitor countries. Current extrapolations, allowing for the subsequent increases to the UK Science Budget, suggest a persisting deficit of some £200m a year. Furthermore, spending levels markedly below those of France and West Germany are especially evident in materials science, chemistry, physics and the medical and biological sciences - fields of particular relevance to future industrial and social progress*. On this evidence the Board firmly endorses the recent conclusion by the House of Lords Select Committee on Science and Technology that "as a nation, we are investing too little in civil R&D and the situation is getting worse".

10. Further support of the need for additional investment is evident from analysis of the latest Science Citation Index publications and citations data. Although the worrying decline in the UK share of world scientific output (publications), particularly pronounced during the 1970s, has levelled off in the period most recently examined, the fall in the impact (citations) of UK science persists, although this too has slowed a little. Of much greater concern, is the clear indication that for basic research publications the downward trend in relative output and impact shows little sign of halting.

11. The increasing pace of technological change puts even greater emphasis on the currency and quality of basic research in the national science base, and on the provision of highly trained manpower to underpin future industrial competitiveness. It is thus a matter of considerable concern that the UK performance apparently is weak and deteriorating in certain economically important fields - for example computer science, solid-state physics and polymer chemistry. Moreover, as noted elsewhere in this Advice, international collaboration is of growing importance in several scientific fields - including global environmental research and mapping of the human genome. The UK will not be well-placed to contribute to or benefit from this collaborative activity if our level of investment in science continues to be markedly below that of our prospective partners.

Strengths of the UK Science Base

12. Notwithstanding its decline relative to investment levels in other countries, we consider that the UK science base remains in fundamentally good health. There are excellent foundations for future development to the nation's benefit. The following paragraphs illustrate some of the factors underlying these judgements.

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* For more detail, see "Investing in the Future" Irvine, Martin and Isard (Edward Elgar 1990).

13. The AFRC is well advanced in implementing its major restructuring programme. By 1993 it will have reduced the number of its institute sites from 24 to 11; and by 1995 it will have doubled the proportion of its Science Budget funds which are spent in higher education institutions (to 30%). This slimmer, more targeted, Council will sustain top quality biological science more effectively, and have greater flexibility to respond to new opportunities. The rationalisation of its institutes will enable the AFRC to improve the ratio of its scientific to support staff from 54:46 to 61:39, and - in addition to a virtual halving of its staff since 1984 - to increase the proportion of its staff on period appointments to 21%. Examples of the quality of AFRC science are its acknowledged world lead in aspects of transgenic animal biology, and the fact that 12 scientists supported by the Council won internationally important prizes in 1989.

14. Other Councils have also been involved in restructuring to improve cost-effectiveness, to increase flexibility, and to concentrate resources on the most promising research groups. For instance, the SERC has relocated the headquarters of the Royal Greenwich Observatory so as to create a world class centre of optical astronomy in Cambridge, has continued to increase the proportion of its budget spent on science and engineering at the expense of nuclear physics and astronomy, and has invested heavily in the establishment of 9 Interdisciplinary Research Centres (IRCs) to provide a focus for top quality research in strategically important areas of science. ESRC is also increasing its support for IRCs and other focussed research centres with the aim that a third of its research budget should be so directed; and the Council has successfully reduced the proportion of its budget spent on administration from 13% to 8%. The MRC has closed 27 research units over the last decade and has redeployed the resources, both to 13 new units in higher priority fields and to ensure proper funding levels for other ongoing units. It is currently developing plans for major funding and management changes to revitalise clinical research (see paragraph 30 below). NERC too has been rationalising its institutes, with the loss of 20% of its staff since 1983; and is developing a major new centre for oceanographic research in association with Southampton University. An increasing focus for the Council is the development of priority research through "community programmes" involving its institutes and higher education institutions on a collaborative basis.

15. The need for improvements in collaboration between Research Councils has been much discussed in the last two years. The new Board will be giving high priority to this aspect of its remit, particularly in areas of the biological sciences. However, possible deficiencies should not be allowed to mask the considerable and successful cooperation between Councils which already takes place. The joint programmes between AFRC, ESRC and NERC on agriculture and the environment; between ESRC, MRC and SERC on the human/computer interface; and between ESRC and NERC on geographic information systems - for each of

which the former Board had previously recommended allocation of additional funds - are all now yielding high quality outcomes. There is also an impressive list of long-standing collaborations which continue to be successful: for instance between AFRC and MRC on slow viruses and on complementary aspects of nutrition research; and between SERC and NERC in the development of instrumentation and data acquisition and analysis for satellite and in situ observation of the Earth, and in their applications to geodesy and oceanography.

16. Collaboration with industry is increasingly extensive and diverse. For example, AFRC earns over £8m a year from contracts with more than 200 companies. Examples of its technology transfer include the joint development of a grain stripper which has doubled the world record for rapid harvesting of cereals; and the Council's involvement in 6 of the present LINK programmes. ESRC is currently developing new strategies for increasing private sector involvement in social science research (particularly as regards planning, marketing and management aspects), in the light of recent consultancy reports. The MRC's Collaborative Centre is on course to becoming self-financing by 1991, and the Council's income there and elsewhere from industry now exceeds £5 million a year; particular attention is being given to the safeguarding of Intellectual Property Rights through the prosecution of patent applications and the negotiation of licensing agreements (see below). NERC is steadily increasing its links with the private sector from which it now receives about £4m a year; this includes, for instance, a marketing agreement with Shell for environmental software and a contract from Logica to develop a computerised river flow forecasting model. The Council has recently received a Queen's Award for Technological Achievement, jointly with VG Elemental Ltd. SERC is involved in 21 LINK programmes across a wide range of disciplines and collaborates with DTI to ensure that its major programmes of support for academic research in information technology and biotechnology effectively complement the Department's support of industrial research in those fields. The Teaching Company schemes supported jointly by SERC and DTI (and to a lesser extent by ESRC) are widely admired for their success in both technology transfer and training. Advanced research training is being further enhanced through the Integrated Graduate Development Scheme developed collaboratively with industry, and SERC has persuaded industry to contribute £750 a year to all CASE studentships.

17. Although falling as a proportion of the increasing international total, the output of the Science Base has been maintained in absolute terms. More than 12,500 scientific papers have been published by staff in AFRC institutes over the last four years and the productivity per scientist has increased by 25%. The new "RAPID" outputs database established by ESRC has already logged a record of 9,000 publications and other outputs in 1989. Established staff in MRC have published over 13,000 papers in refereed scientific journals in the last five years. Some 35 patents have been filed directly by MRC since 1985 and nearly 100 patents have been

filed by other organisations on its behalf. As well as scientific papers, NERC has produced nearly 4,500 widely available publications over the last three years in addition to several hundred open reports and environmental maps. UK needs for highly trained manpower are strongly dependent upon SERC which supports almost 7,500 postgraduate research students and over 2,000 advanced course students every year. About one third of the research students go into private sector work after their awards finish, as do nearly half of advanced course students; and about one-third of the research students go on to academic appointments.

18. It would be possible to write at considerable length about the scientific successes supported by the Research Councils. But their Annual Reports cover this ground well and lengthy descriptions in this Advice would not be appropriate. Some flavour of the return on the resources invested can, however, be gleaned from the following examples:

a. Global Environmental Research

NERC's Biogeochemical Ocean Flux Study has discovered a new seasonal cycle in the transfer of material out of the biotic zone to the sea floor, locking up atmospheric carbon; its Fine Resolution Antarctic Model, now simulating over 10 years, has elucidated key components of the world ocean circulation pattern and its climatic impact; and work on the RRS Charles Darwin has unravelled the effects of salinity on El Nino phenomena. SERC, in concert with NERC, is now well advanced in developing instrumentation for ESA and NASA Polar Platforms, including the doppler wind sensor and the dynamics limb sounder: both novel and essential for measurements to increase our understanding of the middle and upper atmosphere. Joint satellite laser-ranging and other space geodetic techniques have been used to identify the effect of ocean circulation on patterns of sea-level elevation and to test current geodynamic hypotheses. ESRC's support for research by Professor David Pearce has produced advances in cost-benefit analysis which enable more rigorous development of policy as applied to environmental concerns.

b. Molecular biology

Three Research Councils are heavily involved in this rapidly expanding area of science with pervasive effects in many areas of national interest. AFRC's transgenic animal research is presenting new understanding of animal development; and the Council has strengthened its work on slow viruses and BSE, which is linked to MRC's work on neurodegenerative diseases. AFRC's outstanding work on neuro-transmitters is being complemented by SERC's initiative on invertebrate neurosciences which, with industrial links to identify the insecticide potential, has increased fundamental understanding of

how tiny transmitter molecules can change the property of large receptors to transfer information between cells. AFRC's plant molecular biology initiative provides a platform on which AFRC and SERC will develop programmes on the molecular processes underpinning plant physiology and development. Rational drug design and 'smart' screening - on which research is sponsored by both SERC and MRC - promise massive cost-benefit improvements in the field of human health. MRC has developed a mouse model for human sickle-cell anaemia at the NIMR, an example of the current excitement produced by transgenic technology. Its Laboratory of Molecular Biology has continued to make outstanding advances on a number of fronts, including the development of an important new technique to produce active fragments of monoclonal antibodies (Dabs). Work at MRC's Reproductive Biology Unit holds promise for the development of a contraceptive vaccine; and links with a major pharmaceutical company now provide the infrastructure to carry this through to clinical application. MRC supported research using SERC's synchrotron radiation source has determined the structure of the foot and mouth disease virus, and AFRC is funding follow-up work on possible preventive and treatment strategies. NERC's Institute of Virology and Environmental Microbiology is pioneering work in the UK involving release of genetically modified organisms and has made significant progress in the development of genetically modified viral insecticides.

c. Computer Modelling

This, in its many guises, is part of all Councils' research. Developing the huge and complex models of the world's oceans and atmosphere is central to much of NERC's activity. The ABACUS group at Strathclyde University, supported by SERC, have animated a model of the City of Glasgow that allows users to interactively walk, drive or even fly through its streets. This modelling technique will offer planners major new opportunities to assess the impact of proposed changes in the built environment. World-class macro-economic modelling in the UK is substantially supported by ESRC. And MRC-sponsored computer models are being used in epidemiology to analyze patterns of cancer clusters and leukaemia, leading for instance to new hypotheses for potential causes of childhood leukaemia near Sellafield through a paternal route, and in Cornwall through radon gas in houses.

Threats to the Science Base

19. An assessment of the present health of the science base would not be complete without some consideration of prospective threats to its well-being. The principal worry at present is the prospect of significant reductions in flexible resource deployment, which will mean that

vital new programmes can only be allocated very limited funding. The Research Councils have each developed management systems to provide flexibility and facilitate the movement of resources to areas of increasing priority. However, a substantial part of this flexibility is lost when the resources freed by Councils' stringent review processes are absorbed by the primary need to sustain the highest priority programmes in the existing portfolio against the impact of general cost and price increases. We present evidence of this impact below and indicate the severe constraints implied by the present funding profile.

20. Second, we must draw attention to the changing world competitiveness of the UK science base, the development and maintenance of which is threatened by relative declines in both inputs and outputs (as described in paragraphs 9-11 above). Third, we draw attention once again to the increasing opportunities for international cooperation which are available. AFRC has doubled the number of its international collaborative projects since 1987, while SERC now spends over £90m a year on formal international collaborations and is involved in 47 international agreements. UK science is often in a position, as it is in responding to the challenge of global climate change - building on NERC's research base and wide international links - to have a leading role in new programmes. But the ability of British scientists to participate fully and realise the potential impact which our science can have is severely constrained by the prior call on available funds to sustain our existing national programmes.

21. Fourth, we believe that much greater consideration must be given to the availability and diversity of the highly trained manpower which is required to support the scientific programmes identified by Councils. Present levels of training and supply must be sustained and, preferably, enhanced to ensure that we have the manpower base that will be required in the latter part of the decade - despite the sharp demographic downturn in the number of 18-30 year olds. Cooperation, travel and exchange within Europe is becoming increasingly commonplace; and the Board is conscious that the increased mobility of scientific manpower following the completion of the single European market may have a significant impact on the personnel resources available for UK science.

IMPLICATIONS OF PRESENT EXPENDITURE PLANS

22. As noted in paragraph 6, the Government's published expenditure plans imply that - if cost increases match the Treasury's current forecasts for the economy generally - by 1993-94 the Science Budget will amount to only 97½% of its present value. However, past experience is that actual levels of inflation faced by Research Councils are on average between 1% and 2% higher than Treasury forecasts. The Councils thus estimate that the Government's plans for the 1993-94 Science Budget will finance only 95% of present activity levels. Additionally,

we understand that present spending plans are to be reduced by some £8m a year on account of EuroPES attributions in respect of the newly increased EC R&D Framework Programme; this implies a further 1% cut in programmes funded from the Science Budget. Given that the Treasury is forecasting an 8% increase in GDP over the same period, it would appear that the Government intends to reduce the proportion of national wealth devoted to the Science Budget by about one-seventh by 1994. The Board regards this as undesirable in the extreme and likely to be detrimental to the future development of the UK's economic and social welfare.

23. This "real terms" reduction in the Science Budget will have significant implications for the volume of programmes which each funded body can support. The following paragraphs outline the main anticipated impacts.

24. The AFRC estimates that its present Science Budget planning allocations fall some £3m a year, cumulatively, short of the amounts needed to sustain current activity levels. As a result, although the Council has rigorous procedures for review of existing programmes - which are likely to reduce present commitments by about 20% by 1993-94 - some two-fifths of the resources thereby released for recycling to new scientific priorities will be pre-empted by the need to cover expected cost increases within a declining real budget. Nevertheless, the AFRC plans to redeploy some funds to new priority areas including: institute security; stem cell biology; biological response to environmental change; image analysis; farm immunology; food safety; and clean technology.

25. But the funds available for new initiatives in these areas will inevitably be small, and the main casualty of the cost squeeze on AFRC's budget will be the possibility of mounting a more substantial new research programme in the rapidly emerging field of stem cell biology in which the UK currently has a world lead. This would be a significant and irreparable missed opportunity.

26. This difficult picture for the AFRC could, however, be made much worse if it is required to meet substantial contingent liabilities related to its former Institute of Horticultural Research. The IHR is now part of the British Society for Horticultural Research which is accountable to MAFF, but the AFRC remains liable for various costs - including superannuation and redundancy compensation - until such time as responsibility for the IHR's staff is formally transferred to their new employer. We understand that MAFF is also seeking an AFRC contribution to the up-front costs of restructuring within BSHR. The Board trusts that the Government will resolve these matters - at no cost to the Science Budget - as speedily as possible.

27. ESRC, too, expects that cost increases will offset the prospect of important new research programmes to which it would otherwise have intended to redeploy resources. In response to increasing demands, the Council plans to give priority within a declining real budget to sustaining expenditure on responsive mode research grants and postgraduate studentships. This implies a squeeze on its research initiatives budget, amounting to perhaps 8% by 1993-94. It will be possible to redeploy funds for some new programmes: for instance in the fields of human development and cognition, health and welfare, and the environment - at the expense of continuing research on education, communications technology, and science policy studies. But several major initiatives will have to be put in abeyance. The major loss will be plans for a wide-ranging study of the economic, political and social changes now underway in Eastern Europe; these will have to be scaled down very considerably.

28. The MRC is engaged in a continual process of reviewing scientific priorities and research quality so as to free funds from existing programmes for recycling and redeployment to new work. For instance, in the current year funds have been released by this process to: provide start-up support for IRCs in brain repair, and brain and behaviour; initiate trials on CHART cancer therapy; provide unit support in protein phosphorylation; start trials to detect osteoporosis fracture risks for women; and increase spending on health and safety and on security at its institutes.

29. On present spending plans, however, such recycling will not be possible in the next few years. Rather, the MRC will need to find £8m in 1991-92 rising to £14m by 1993-94 to cover the costs of maintaining priority programmes within a declining total budget. Research areas which will be put at risk in consequence include: cellular immunology; radiobiology; genetics of malaria parasites; control of autoimmunity; addiction; ischaemic stroke studies; and cell mutation. There will also need to be a significant cutback in the numbers of responsive mode research grants despite burgeoning demand.

30. In line with the approach agreed last autumn, the MRC is in the process of developing detailed proposals for redeploying resources from the Clinical Research Centre at Northwick Park: some to build-up capability at the RPMS, Hammersmith (though much less than previously proposed); but with the majority dispersed to 8 provincial centres building on established strengths in particular aspects of clinical research. The MRC aims to meet about half the capital and staff restructuring costs from within its baseline resources and from charitable sources. The Board is satisfied that the MRC has now produced a much more cost-effective plan for this initiative and, subject to the outcome of a DH-led review of the NHS consequences of the Council's proposals, we shall be recommending that the additional building and equipment costs (totalling £16m over 3 years) should be allocated from our Flexibility Margin.

31. NERC's room for manoeuvre is significantly constrained by the Government's commitments to sustain funding levels for the British Antarctic Survey and the British Geological Survey. For the remaining two-thirds of its programmes the Council has published medium-term science strategies which are designed to enable funding and research efforts to be focussed on a series of identified areas so as to maximise the potential return. Global environmental research is a key priority for the Council and substantial additional resources have been directed in the last two years towards marine and atmospheric aspects of such research. The next priority is to redeploy funds towards terrestrial and freshwater processes, drawing together a good deal of presently disparate research. Regrettably, the scope for this will be extremely limited on the Government's present spending plans: the real terms decline in NERC's budget will account for the majority of the funds otherwise freed for recycling.

32. The greatest prospective cut in real resources would, however, not surprisingly fall on the largest Council. SERC estimates that its present planning allocations fall some £23m in 1991-92, rising to £47m in 1993-94, short of the amounts needed to maintain its 1990-91 programme in later years. Like the other Councils, SERC has a substantial annual turnover of research work within its portfolio - amounting to some £70m a year in its case. Much of this, however, relates to project grants and postgraduate studentships; and inevitably it would be these cornerstones of the science base which would need to be reduced in the short-term (by as much as 40% on new research grants and 33% on new studentship awards in 1991-92, because of their uneven expenditure profiles) if cuts in real funding were necessary. In the longer term, SERC's substantial commitments in its central facilities and through international subscriptions (roughly £90m a year each) would need to be scaled-down, but in the interim there would be major perturbations in the Council's commitment to further increase the proportion of its budget spent on research grants in science and engineering relative to its spending on nuclear physics and astronomy.

33. Real terms funding reductions would also curtail SERC's recent efforts to ameliorate some of the serious deficiencies in the stock of research equipment in higher education institutions - on which it is currently spending £65 million a year through research grants. This would have serious long-term consequences.

34. Similarly, the impact of the progressive reductions in the number of University Research Fellows which the Royal Society will be able to fund from its present planning allocations is likely to most noticeable some years hence. The highly successful URF scheme was designed specifically to provide for some of our best young scientists until permanent academic jobs become available for them later in the 1990s. If less URF posts can be offered, some of this talent will inevitably be lost to the UK science base.

35. Overall, the consequences of the volume reductions implied by the Government's plans for the Science Budget will be a marked reduction in the science base's capacity to redeploy funds towards new scientific priorities. Despite the Councils' continuing efforts to increase the margin within their budgets available for recycling to new priorities, important opportunities will be lost; and the reduced flexibility will be a profound discouragement both to the Councils and to the scientific communities they serve.

36. As well as providing the basis for the above assessment of the implications for each funded body of the Government's present spending plans, the Board's detailed scrutiny of funded bodies' baseline expenditure plans has facilitated analysis of spending patterns across the Science Budget as a whole. Summary tables illustrating trends in the balance of expenditures are attached at Annex A, and the following paragraphs comment on a number of key features.

37. Expenditure on postgraduate studentships is planned to increase as a proportion of the Science Budget from 11.6% in 1990-91 to 13.8% in 1993-94. A small part of this growth reflects the flow-through of the small increases in numbers of new awards introduced by some Councils in 1988, 1989 and 1990. A greater part is a reflection of Councils' intention to maintain expenditure in this high priority area despite reducing total budgets. Only the third element represents a change in previous spending plans: the intention to increase the value of studentships by £400 from April 1991. This plan - which will restore the autumn 1989 purchasing power of studentships - derives from continuing concern about the quantity and quality of applicants for studentships. Some of the evidence for this is anecdotal; but there is no doubt that there have been serious recruitment difficulties in some places, even the MRC's Laboratory of Molecular Biology. It is also clear that postgraduate support was unduly constrained in the 1980s by the now discredited policy of tying it to levels of undergraduate support. The two categories of student are quite different, with postgraduates being unable to supplement their increases by vacation work and more likely to be deterred by reductions in relative living standards compared with their contemporaries in industrial and other employment.

38. The £600 increase in studentships from October 1989 was a significant improvement and had a marked impact on recruitment. Subsequently, inflation, introduction of the Community Charge, and the impending loss of Housing Benefit have reduced the real purchasing power of studentships. Against the background of all these factors, the Board is convinced that a further increase is necessary, even within the constraints of present expenditure plans. We are therefore recommending that the costs of a £400 increase should be met from the Board's

Flexibility Margin, our strategic reserve - this being in our view the highest priority call on these previously unallocated resources. This should have some of the necessary impact though, if the funds were available (see paragraph 64 below), we would recommend that studentships should be increased in value by £700 - to restore their former relativity with graduate starting salaries.

39. The analysis in Annex A also displays a small change in the balance of responsive mode grants and "pro-active" mode grants, the latter including so called "directed" programmes. Some concern has been expressed by HEIs about the trend away from support through the responsive mode. However, the Board is satisfied that this concern is misplaced. Most of the funds planned for "pro-active" programmes will in fact be open for competition in a typical responsive fashion, albeit within a defined subject area. There is no question that quality will be the key criterion in deciding what science is funded, since competition within these programmes, at the frontiers of science, is high. Indeed, the Board believes that the changing balance shown in the Annex is a healthy sign that Councils are reacting positively to the increasing need for selectivity by identifying, targeting and seeking to stimulate those areas of the science base which will be most important in the future. Nonetheless, the Board is also committed to preserving a sufficient level of funding for curiosity motivated research through the responsive mode.

40. There will also be some increase in the proportion of funds absorbed by international subscriptions, despite the reviews which have taken place in recent years. These subscriptions - which represent a long term priority commitment to which the Science Budget is tied - take up over one-fifth of the SERC's budget, with concomitant implications for that Council's ability to protect its more flexible spend on studentships and research grants when planning within a declining baseline. Overall, SERC's commitment to "big science" - nuclear physics and astronomy - is still larger than the allocations for either Engineering or for the rest of Science combined. Whilst recognising the very considerable shifts in balance already achieved by SERC, the Board considers that some further movement away from big science is desirable - especially if the Science Budget as a whole declines in real terms.

41. Capital spending will decline over the PES period, from 11.2% (including the RRS James Clark Ross and the completion of the Polaris House extension) to 4% of the Science Budget. There will be a countervailing increase in the proportion spent within institutes and HE-based units. The Board notes that all Councils have indicated their intention to monitor the balance of their support for institutes and HEIs and that open competition for funds between the Councils' own institutes and scientists in universities and polytechnics is increasingly the norm. This is a very positive step towards ensuring that the best science and the best scientists are funded within each programme.

42. The Board has been impressed with the diversity of exciting new science that is being planned within Council's declining baseline allocations. However, for each new programme that a Council has been able to initiate there are components (and usually the bulk rather than the balance) of the same programme which cannot be funded within current allocations. In every case, despite recycling and prudent redeployment of funds, after inflation has been taken into account the Councils will be able to plan for less work in the future than they are supporting in 1990-91.

43. The detailed information provided by the Councils, the broad analysis in the summary tables, and the various plans for change which have been reviewed by the Board, all confirm that one of the most important factors in the health of the science base is a sustained capacity for dynamic flow and change. At a detailed level we see established projects maturing and being succeeded by new. At the broader level we see these as part of a developing programme which contains a constantly changing pattern, with interweaving strands, within and between Councils, that produce new research themes with novel characteristics. Ensuring that basic research is sustained and increasing the responsiveness of the science base are two of our, and the Government's, main policy objectives for science funding. However, our analysis convinces us that the present plans for the Science Budget will be insufficient to preserve the essential dynamism of the science base.

44. The Board has therefore concluded that increases in the Science Budget are not only justified but also essential to maintaining the ability of the Councils to sustain their obligations to the science base and to the nation. Without regard to other opportunities for scientific innovation that will be foregone in the absence of additional targeted allocations, we believe that the first priority must be for a sufficient increase in funds to preserve the natural shape, balance and vitality which the science base requires. This will restore the 'framework' which allows scientists to 'achieve their purposes', to quote from the then Secretary of State's speech to the Academia Europaea (26 June 1989).

45. The funds required to restore this framework - providing for cost increases on existing programmes to be fully covered without pre-empting the flexibility to redeploy resources to new priority areas of science - amount in total to £39 million in 1991-92, £60 million in 1992-93, and £74 million in 1993-94. Whilst the allocation of such additions should not be earmarked, the Board understands that the AFRC, ESRC and NERC would give priority to mounting the major new research initiatives mentioned in earlier paragraphs - namely on

stem cell biology, Eastern Europe, and terrestrial aspects of global environmental change. In MRC's case a significant part of the addition would be used to avoid cuts in the number of projects grants, and the remainder to safeguard research in some of the areas listed in paragraph 29 as "at risk". The Board considers that the major part of any increase allocated to SERC should be used to sustain "small" science - avoiding the marked reductions in the award of new research grants and studentships which will otherwise be necessary in 1991-92. The Royal Society is expected to give priority to maintaining its target of supporting 200 URFs.

NEW SCIENTIFIC OPPORTUNITIES

Global Environmental Change

46. All the Councils are aware of the need for closely focused research on the nature, extent and implications of environmental change. To this end they have identified new areas of high priority work which they believe should be initiated, and are working in concert to develop these plans. This process is being overseen by the Inter-Agency Committee for Global Environmental Change (IAC-GEC) which also includes representatives of the Meteorological Office, BNSC and DoE. The IAC-GEC's remit is to develop an agreed view on the overall programme of research considered necessary in this field, and the priorities within that programme - taking account of work in other countries and relative UK strengths. It will also identify the optimal balance of activities which can be undertaken with existing resources and areas requiring additional support. The expert groups which will advise the IAC-GEC are expected to report in July. It is thus premature to forecast the volume of additional work that might be judged necessary to bring existing programmes up to the required level.

47. At this stage, therefore, the Board wishes simply to highlight a number of proposals put forward by Councils which, prima facie, seem likely to merit additional funding. These would cost a total of £10m in 1991-92 rising to £14m in 1993-94. But this is an initial judgement and we will submit further advice in late summer in the light of the IAC's considerations.

48. The largest of these proposals is from NERC, which is the lead agency in this field and has a large and diverse existing portfolio of environmental research on which to build. The main element of the Council's new proposal is the Terrestrial Initiative in Global Environmental Research (TIGER). This would permit a major expansion in the terrestrial and freshwater sector, developing work on the sources and fluxes of greenhouse gasses in the terrestrial environment and the interactions between the land and the atmosphere. Most of this programme would be funded from the "sustaining UK science" allocations recommended

above. The terrestrial environment is becoming a more important focus because of new work implying that the land may play a more important role in the carbon cycle than hitherto believed. This research will underpin UK participation in a number of international programmes where involvement in current debate is deemed essential to the national interest. NERC's activities in this area link both to AFRC's research (see below) and to the Royal Society rain forest project in Sabah and the new international work at Lake Baikal (both of which require minor funding enhancement). The Royal Society is also responsible for UK contributions to ICSU, on which a small increase seems appropriate.

49. The major Antarctic programmes led through BAS have reinforced the need to understand the distinct environmental features of the polar regions and their influence on global change. NERC now believes that it is timely for the UK to build up its contribution to the international Arctic science programmes in areas where it has particular strengths - including atmospheric circulation and modelling, stratospheric ozone, and glaciological processes. SERC is working with NERC on the Satellite Earth Observation programme in new instrumentation and data-handling; both Councils are building on substantial existing investment in this field but need to spend more if the potential of future satellite missions is to be fully realised.

50. A significant part of AFRC's planned initiative on the biological response to environmental change will be funded from within the Council's baseline allocation. This research affects many aspects of the AFRC programme and builds on current input of about £5m a year which reflects the Council's strength in this area. But substantial enhancement of this work would be timely and offers significant prospects of new scientific insights and potential exploitability - particularly as regards soil, plant and microbial interactions; food production and nutrition; and molecular and biotechnological aspects of solar energy conversion.

51. ESRC has funded the work by Professor Pearce which is informing DoE on approaches to environmental economics. Further developments in this area, based on the results of planning consultancies, have led the Council to redeploy funds for a new research centre on global environment change and a number of fellowships. But additional resources are required for a complementary initiative built around four key themes of economic aspects, institutional responses, public policy and regional case studies.

Other Scientific Opportunities

52. As mentioned previously, the highest priority new scientific opportunity for which AFRC needs additional funds is stem cell biology, where the Council has a world lead. It already holds important patents, including for the use of embryonic stem cells for multiplication of identical embryos. Such cells can also be used to elucidate the mechanisms by which cell lines become dedicated to specific tissue formation, for the study of histocompatibility (for tissue transplant), and to understand genetic change at the cellular level. There is potential in much of AFRC's animal-based work for further development of the excellent links with MRC sponsored researchers in this area; and AFRC's associated work on crop plants will link with research SERC is supporting on plant meristematic cells. The excitement of the planned initiative at these scientific frontiers provides real potential for drawing in top quality scientists from overseas in support of a major UK programme.

53. The AFRC also needs additional funds to supplement resources it is redeploying towards new research programmes on clean technology (jointly with SERC, see below) and on microbiological aspects of food safety. The latter will be aimed at major gaps in our knowledge of the physiological behaviour of pathogens in the food chain, particularly those whose role has only recently been recognised. The research, which will take account of trends towards new and less severe forms of processing and preservation, will employ a wide range of techniques to enhance understanding of pathogenic micro-organisms at the cellular and molecular levels with potential for new insights as to their rational control.

54. The universally acknowledged political and social significance of the changes in Eastern Europe make clear the timeliness and excitement of ESRC's research initiative in this area. But only if the funds we recommend for "sustaining UK science" are available will the Council be able to support a comprehensive study of restructuring of the complex systems of the disparate Eastern Bloc countries. This would cover: embryonic development of multi-party democratic systems; the changing balance of local, regional and central power as new social forces and old regional identities assert themselves; and the reconstruction of market economies as central command economies are dismantled. Detailed analysis of these issues should provide a well informed basis for addressing critical questions about the evolving implications for Western Europe nations.

55. The Board has also been impressed by an ESRC proposal to establish an Interdisciplinary Research Centre on the study of positive health, which would undertake simultaneous investigations of health questions from the economic, social, cultural and psychological perspectives. The potential prospects of programmes aimed at health enhancement as well as disease prevention would be a principal focus of its interest, taking account of aspects such as the protective nature of social support, cultural influences on perceptions of health risk, and the effect of work and home environments upon individual health.

56. MRC has identified the need for a major expansion of molecular biology research into inherited disease: what it terms the genetic approach to human health. This is timely because work on human gene mapping has advanced to the stage where increasing numbers of disease genes are being identified: opening up enormous opportunities for understanding the biochemical basis of inherited diseases and for developing new methods of diagnosis and treatment. There are plans for joint expansion with AFRC of facilities for the study of transgenic mouse models. Funds would also be used for additional manpower, for the stimulation of interdisciplinary collaboration and for the expansion of transgenic facilities in several major research centres.

57. MRC also wishes to reinforce substantially its research programmes in neurosciences, including through: the substantive development of the IRCs on brain repair and brain behaviour which it is launching in a limited way this year; major new work on slow viruses (linked with AFRC's research on scrapie and BSE); research on the molecular genetics of major psychoses; and enhancement of studies of the causes and possible treatments of Alzheimer's Disease.

58. The British Mid-Ocean Ridge Initiative (BRIDGE), which is supported by NERC, is a framework with multidisciplinary themes within which specific projects can be developed by the research community. The UK has made major contributions to the understanding of the plate-tectonic processes which drive the Earth's crust and in which the mid-ocean ridges play a key role. These important global features exhibit phenomena new to science which are as yet known only in outline. The technology is now available for more detailed studies of high scientific potential which promise to answer key questions on how the dynamic Earth works. The physical, chemical and biological processes at hydrothermal vent sites would be a particular focus for study if additional funds were available; and there would be major investment in a Swath Bathymetry system for high precision topographic mapping of the deep sea floor. This area is logistically very demanding and is best managed on an international or multinational basis; so NERC is developing this initiative in concert with national programmes planned by the USA and France.

59. In collaboration with AFRC, SERC wishes to promote a major new programme in clean technology, building on work it is already supporting in response to current environmental concerns. The main objectives would be: development of new processes which are inherently clean; rethinking of existing processes so that unavoidable noxious by-products are produced in tractable form; and development of new processes for dealing with the legacy of past pollution. AFRC's particular concern will be with processes to deal with agricultural pollution and the role of biological systems in pollution control. However, both Councils need additional funds if this research is to be advanced as rapidly as we consider the national interest to demand.

60. SERC also wants to build-up the capability of the six centres it has established for research on molecular recognition, particularly through the provision of sophisticated equipment including high field NMR, protein sequencers and X-ray generators and detectors. This would substantially increase capacity for high quality interdisciplinary work at the chemistry/biology interface, ensuring that each centre had a strong critical mass of scientists with the necessary technological infrastructure for front rank research in this area.

61. The Board strongly supports each of these programme enhancements and recommends that - over and above the increases recommended for sustaining UK science - an additional £17m in 1991-92 rising to £34m in 1993-94 should be made available so that they can be properly funded.

RESEARCH GRANTS

62. Alongside these major new research programmes the Board would also like to see additional funds provided to increase support for responsive mode research grants. It is clear from the significant increases in the number of high quality applications received by all Councils that there is much good science which is currently unfunded - aspects of which might potentially lead to major discoveries. Given that we expect part of the MRC's and SERC's allocations for sustaining UK science to be spent on such research grants, a further addition of £3m in 1991-92 rising to £10m in 1993-94 should be adequate for this purpose.

MANPOWER

63. An issue which pervades the planning of all the funded bodies is that of manpower. In its 1989 PES Advice, the former ABRC presented considerable detail about how the problems of meeting the pressing needs for very highly qualified manpower might be met. It noted that this question involved not only the science base, which is both provider and user, but also the wider economy, which is primarily a user but may become a provider through company training schemes. We too regard this as a matter of prime concern requiring priority treatment - hence our decision to recommend a further increase of £400 in the value of postgraduate studentships funded within the present Science Budget baseline.

64. But that increase will not in our view be sufficient to offer a standard of living which will attract an adequate supply of talented young people into research training. The Board considers that studentships need to be at least restored to their former level relative to average starting salaries for graduates. This would require a further increase of £300 in April 1991 - making a total increase at that date of £700 - and would cost the Councils an additional £4m which cannot be found within their present baseline allocations.

65. Increases in postgraduate studentships will not deal with all manpower problems; but we have been pleased to note that the Research Councils are also giving priority to this area of concern and envisage a number of small initiatives within their own baseline allocations. However, four small but important proposals on manpower are not covered by baseline spending plans or our bid to sustain UK science. These are:

a. the ESRC's intention to offer 4 rather than 3 years' studentship support in selected disciplines in order to enhance the quantity and quality of research training that can be provided;

b. the Royal Society's plan, as well as maintaining its target of 200 URF appointments, to enhance the research expenses which accompany these Fellowships;

c. the Royal Society's further proposal to increase its support for scientific exchanges with other countries. An increase in (short-term) exchanges with Eastern Europe would be particularly timely;

d. a complementary new scheme, coordinated by SERC, to provide 50 fellowships (for up to 3 years) for postdoctoral and more senior scientists from Eastern Europe to work in association with selected UK research initiatives being sponsored by Councils.

The Board supports all of these proposals which, in total, would require additional funds of around £2m a year.

REEQUIPMENT

66. The survey of research equipment in higher education institutions, which the former Board commissioned, revealed that whilst there is a substantial stock of high quality equipment available there are also considerable deficiencies in provision**. At the time of the survey the costs of additional equipment needed to support current research was estimated at £259m, with further items needed for new research being valued (perhaps more speculatively) at some £200m. Since then some additional equipment funds have been made available through both the Research Councils and the UFC. We see a need for further steps to alleviate continuing deficiencies and recommend that an additional £35m is made available through SERC over the next 3 years for this purpose.

67. Finally, the Board has considered a detailed report recommending enhancement of supercomputing facilities. Present facilities are working at theoretical capacity, which results in severe reductions in efficiency for users, and the memory capacity of the largest machine (the Cray X-MP/48 at RAL) is now barely adequate for the very large global environment models which are being developed. Other disciplines also require greatly expanded memory capacity. It has been proposed that the present system should be immediately upgraded as an interim step prior to the replacement of the RAL machine with a larger, state-of-the-art machine. This would restore the international status of British supercomputing at the top level, if not in overall capacity. We are also advised that significant investment is now appropriate in novel architecture, parallel supercomputers which are likely to offer much greater value for money in the future. The total cost of these recommendations is very substantial but the ABRC recognises the role which supercomputers now play in advanced research. We therefore recommend that additional funding of £5m a year would be appropriate to facilitate a significant increase in supercomputing capacity.

TRANSFERS OF FUNDING RESPONSIBILITY

68. We have not sought in this Advice to identify the financial consequences for the Science Budget of either:

** See "Survey of Academic Research Equipment in the UK" (ABRC 1989)

a. the Government's proposals to shift the boundary of the dual support system such that in future Research Councils will be responsible for funding a greater proportion of the costs of research projects which they sponsor in higher education institutions;

b. the Secretary of State's decision to transfer responsibility for national supercomputing services from the Computer Board to the Research Council system.

Our assumption in each case is that the transfer of funding responsibility will be accompanied in each case by a transfer of funds which matches the additional liabilities being assumed by the Science Budget.

CONCLUSIONS

69. The substantial increases in the Science Budget in the last two years have helped to restore confidence within the scientific community and have enabled some important new initiatives to be started. Our detailed scrutiny of funded bodies' current spending plans has revealed, however, that these positive steps may be severely eroded by 1994. Largely because of the increase in prevailing and expected rates of inflation, the Government's plans for the Science Budget now imply a marked reduction in its real value. Unless this is made good, cost increases on continuing priority programmes will absorb a large part of the resources which the Research Councils' review processes make available each year for redeployment in support of new scientific opporunties. As a result, important new initiatives for research on stem cells, Eastern Europe and terrestrial aspects of global environmental change are unlikely to proceed, and the funds available for curiosity-motivated responsive mode support of "small-science" will be constrained. The Board recommends most strongly that additional funds - amounting to £39m in 1991-92, £60m in 1992-93 and £74m in 1993-94 - should be made available to sustain high quality UK science and to avoid such damaging consequences.

70. Additionally, the Board has identified a range of new research programmes which it considers merit increased national investment in science. These offer distinct promise for the future - in terms both of scientific outcomes and of potential exploitability for the UK's economic and social benefit. However, neither these programmes, nor the small extra expenditure we recommend to help sustain an adequate supply of highly trained research manpower, nor necessary spending on selective enhancement of Britain's stock of academic research equipment, could be afforded from the Science Budget at its present level - even if this were to be maintained in real terms.

71. In total, therefore, we recommend that funding for the Science Budget should be increased by £95m in 1991-92, £133m in 1992-93 and £154m in 1993-94. A more detailed summary is in Annex B. These amounts will do little more than maintain the country's investment in the science base as a proportion of GDP. Certainly they will not match the growing proportion of national wealth which other major European countries are investing in science. But the Board is very conscious of the other priority demands on public spending in the UK, and we have thus limited our recommendations to the minimum additions we believe necessary if the outstanding record of achievement of Britain's science base is to be maintained to the country's future benefit.

ANNEX A

SCIENCE BUDGET: REVISED PLANNING ALLOCATIONS*

£ million

	1990-91	1991-92	1992-93	1993-94
By Funded Body				
AFRC	85.9	91.6	88.1	88.4
ESRC	36.0	35.7	36.3	36.3
MRC	185.7	196.4	201.5	202.5
NERC	135.2	121.8	117.6	117.1
SERC	438.6	441.9	448.7	450.4
Royal Society	13.9	15.3	15.4	15.4
Fellowship of Engienering	1.2	1.4	1.4	1.4
ABRC (incl CEST)	0.4	0.5	0.5	0.5
Flexibility Margin	-	-	17.4	38.3
TOTAL	896.9	904.6	926.9	950.3
Research Councils' Allocations by Activity				
Studentships	102.3	116.1	121.0	123.1
Responsive Mode Grants	152.6	151.2	151.7	152.6
Pro-active Programmes	124.9	123.5	127.9	130.6
Units within HEIs	60.0	60.9	66.7	72.1
Institutes	183.3	197.0	206.6	210.1
International Subscriptions	100.2	103.1	105.2	104.4
Capital	98.7	72.0	47.6	35.5
Administration	59.4	63.7	65.4	66.4
TOTAL	881.4	887.4	892.2	894.7

Further detail is in the table overleaf.

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* Takes account of EuroPES "charge" of £7.7m a year, and of proposed Flexibility Margin allocations in support of an increase in the value of postgraduate studentships and the MRC's Clinical Research Initiative.

BASELINE SPENDING PLANS - BY COUNCIL (£M and %)

	£ MILLIONS				% OF SPEND			
	1990-91	1991-92	1992-93	1993-94	1990-91	1991-92	1992-93	1993-9
AFRC								
Studentships	1.5	1.8	1.9	1.9	1.7	2.0	2.2	2.
Responsive mode grants	8.8	11.8	12.5	14.0	10.2	12.9	14.2	15.
Pro-active programmes	9.2	11.0	13.6	14.7	10.7	12.0	15.4	16.
Units within HEIs	9.0	9.0	9.4	9.3	10.5	9.8	10.7	10.
Institutes	26.7	28.8	29.2	29.5	31.1	31.4	33.1	33.
International subscr.					0.0	0.0	0.0	0.
Capital	15.3	10.2	1.7	-.8	17.8	11.1	1.9	-.
Administration	15.4	19.0	19.8	19.8	17.9	20.7	22.5	22.
TOTAL	85.9	91.6	88.1	88.4	100.0	100.0	100.0	100.
ESRC								
Studentships	8.8	9.7	9.7	9.8	24.4	27.2	26.7	27.
Responsive mode grants	7.0	8.0	8.6	8.8	19.4	22.4	23.7	24.
Pro-active programmes	13.7	14.5	14.5	14.2	38.1	40.6	39.9	39.
Units within HEIs								
Institutes								
International subscr.	.1	.1	.1	.1	.3	.3	.3	.
Capital	2.9	.1	0.0	0.0	8.1	.3	0.0	0.
Administration	3.5	3.3	3.4	3.4	9.7	9.2	9.4	9.
TOTAL	36.0	35.7	36.3	36.3	100.0	100.0	100.0	100.
MRC								
Studentships	10.5	13.0	15.4	16.7	5.7	6.6	7.6	8.
Responsive mode grants	35.7	34.5	31.7	28.9	19.2	17.6	15.7	14.
Pro-active programmes	25.0	26.0	27.0	28.0	13.5	13.2	13.4	13.
Units within HEIs	43.6	43.9	49.5	54.8	23.5	22.4	24.6	27.
Institutes	37.2	43.9	44.2	44.4	20.0	22.4	21.9	21.
International subscr.	3.8	3.9	4.2	4.4	2.0	2.0	2.1	2.
Capital	18.6	19.7	17.2	12.4	10.0	10.0	8.5	6.
Administration	11.3	11.5	12.3	12.9	6.1	5.9	6.1	6.
TOTAL	185.7	196.4	201.5	202.5	100.0	100.0	100.0	100.
NERC								
Studentships	8.4	9.5	9.7	9.9	6.2	7.8	8.3	8.
Responsive mode grants	9.9	11.6	12.8	13.1	7.3	9.5	10.9	11.
Pro-active programmes	2.2	2.1	2.0	2.1	1.6	1.7	1.7	1.
Units within HEIs	7.4	8.0	7.8	8.0	5.5	6.5	6.6	6.
Institutes	46.4	48.8	54.2	56.6	34.3	40.1	46.1	48.
International subscr.	1.7	1.9	1.8	1.9	1.3	1.5	1.6	1.
Capital	50.9	31.0	20.2	16.4	37.6	25.4	17.2	14.
Administration	8.3	9.0	9.0	9.2	6.1	7.4	7.7	7.
TOTAL	135.2	121.8	117.6	117.1	100.0	100.0	100.0	100.
SERC								
Studentships	73.1	82.1	84.3	84.8	16.7	18.6	18.8	18.
Responsive mode grants	91.2	85.3	86.1	87.8	20.8	19.3	19.2	19.
Pro-active programmes	74.8	69.9	70.8	71.6	17.1	15.8	15.8	15.
Units within HEIs								
Institutes	73.0	75.5	79.0	79.6	16.6	17.1	17.6	17.
International subscr.	94.6	97.2	99.1	98.0	21.6	22.0	22.1	21.
Capital	11.0	11.0	8.5	7.5	2.5	2.5	1.9	1.
Administration	20.9	20.9	20.9	21.1	4.8	4.7	4.7	4.
TOTAL	438.6	441.9	448.7	450.4	100.0	100.0	100.0	100.
RC totals	881.4	887.4	892.2	894.7				
Science Budget	897.0	904.6	926.9	950.3				

ANNEX B

INCREASED FUNDING REC0MMENDED BY THE ABRC

	£ million		
	1991-92	1992-93	1993-94
Sustaining UK Science	39.0	60.3	74.4
New Scientific Opportunities			
- Global Environment Change	9.9	13.4	13.7
- Other Areas	16.9	31.3	34.4
Research Grants	3.0	7.1	10.3
Manpower	5.8	6.1	6.4
Selective Re-equipment	20.0	15.0	15.0
TOTAL	94.6	133.2	154.2