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Prime Minister 4

Here is a report on the scientific work done under the auspices of the research councils. It makes interesting reading, despite being somewhat densely written.

WR 15/12

DEPARTMENT OF EDUCATION AND SCIENCE
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FROM THE SECRETARY OF STATE

Michael Scholar Esq
Private Secretary
10 Downing Street
LONDON SW1A 2AL

10 December 1981

Dear Michael,

I wrote to Tim Lankester on 13 October promising a paper for the Prime Minister on recent developments in science. I am now able to let you have that paper.

When giving it to the Prime Minister, it might also be helpful if she had the copy of my Secretary of State's letter of today's date to the Chancellor of the Exchequer concerning the SSRC.

You have already seen this.
WR

Yours sincerely

Pete Shaw

P A SHAW
Private Secretary

RECENT DEVELOPMENTS IN SCIENCE

Note by the Department of Education and Science: November 1981

THE AGRICULTURAL RESEARCH COUNCIL (ARC)

A Novel Approach to Vaccine Production

1. Research at the Animal Virus Research Institute and Houghton Poultry Research Station offers the exciting prospect of using harmless bacteria present in farm animals to produce a continuous supply of immunogens against virus diseases. At present vaccines to protect animals against virus diseases are costly to produce and stringent safety precautions are necessary. The new approach involves cloning the viral genes which control the synthesis of the proteins conferring immunity and incorporating these genes in harmless bacteria which inhabit the sites of infection in the respiratory and alimentary tracts of animals. The genes would then express themselves in their bacterial hosts by producing the required proteins, thus creating a continuous 'internal vaccination' of an animal by its normal microflora.

A Biotechnological Route to Ammonia Production

2. The reliance of British agriculture on artificial fertilizers from fossil fuels is a matter of concern. Fundamental research led by Professor W D P Stewart FRS, University of Dundee (who has won an international reputation for his research on nitrogen-fixing organisms) and supported by the ARC aims to study ways in which the nitrogen-fixing properties of cyanobacteria (blue-green algae) might eventually be exploited as a new source of nitrogenous fertilizer. The major alternatives are to recycle organic nitrogen in the form of manure and sewage and to exploit more fully biological nitrogen fixation. This latter process is carried out by certain bacteria which have an enzyme, nitrogenase, capable of converting nitrogen to ammonia. Of these bacteria, only the cyanobacteria are able to use sunlight as the energy source for the conversion. Professor Stewart has already shown that ammonia can be produced on a laboratory scale from cyanobacteria by sunlight, air and water. The new research will examine the possibilities of using modern biotechnological and genetic engineering approaches ultimately to produce nitrogen fertilizer from cyanobacteria.

Producing Protein from Waste using Earthworms

3. Work at Rothamsted Experimental Station has shown how earthworms might help in disposing of organic waste from farms and cities. Experiments on raising earthworms have demonstrated that they are very efficient at converting organic waste into protein suitable for supplementing animal and fish feed. The organic waste itself is converted into useful soil additives. Even if only 10% of the annual 100 million tons of animal waste and 30 million tons of human sewage were exploited for earthworm culturing, feed protein worth £300M-400M per year could be produced. Land wastage and dumping would decrease. The basic biological processes are now understood on a laboratory scale; further work is needed to develop the technology to a level suitable for on-farm pilot plants. There is good scope for commercial exploitation and industry is already showing an interest.

Expression of Chloroplast Genes from Higher Plants in Bacteria

4. Molecular biologists at the Plant Breeding Institute have recently achieved the first reported expression of plant genes in the bacterium E.coli. The breakthrough occurred in experiments with genes from chloroplast cells of wheat and maize which produce an enzyme essential in photosynthesis. Once the genetic material had been transferred, the plant enzyme became a major product of the bacterium's metabolism. This ability to manipulate chloroplast genes in bacteria opens up many new possibilities. It should now be possible to identify the products of unknown genes more easily and to synthesise and study them. These new opportunities are stepping stones towards the goals of understanding photosynthesis better, manipulating it in new ways so that plants might harness light energy more efficiently, and in the longer term more generally improving crop plants by manipulating a wide range of genes with desirable attributes. The work is part of the ARC's programme of genetic manipulation of crop plants and receives additional support from the British Technology Group (BTG), which was formed by the merger of the National Enterprise Board and the National Research Development Corporation.

THE MEDICAL RESEARCH COUNCIL (MRC)

Molecular Biology and its Application

5. Dr Sanger and his team (Laboratory of Molecular Biology, Cambridge) have used his techniques to sequence mitochondrial DNA. Mitochondria are the 'powerhouses' of the cell and have their own genetic material. Surprisingly, the genetic code in this DNA has been shown to differ from that in nuclear DNA, hitherto believed to be universal.

6. Modern techniques of molecular and cell biology are being increasingly and profitably applied to the development of improved and novel vaccines against infections: important examples are malaria, schistosomiasis, herpes, poliomyelitis, Epstein-Barr virus, whooping cough, leprosy, rabies, hepatitis and cholera, and the bacteria that cause complications in burns and cystic fibrosis.

7. Techniques of genetic and molecular analysis are being used to provide 'libraries' of clones of human DNA for use, for example, as ante-natal diagnostic probes for inherited disease (Mammalian Genome Unit and Clinical and Population Cytogenetics Unit, Edinburgh). Some are already in use (eg for thalassaemia).

8. Recombinant DNA techniques have been used successfully to insert into bacteria both the leucocyte and fibroblast interferon genes (Professor D C Burke, Warwick). An anti-interferon hybridoma (Professor Burke and Laboratory of Molecular Biology) has aroused wide commercial interest and is being exploited through the MRC's relationship with Celltech.

Fertility and the Developing Child

9. That nursing mothers are less likely to become pregnant again has been often dismissed as incorrect, but has recently been confirmed when the baby is fed frequently 'on demand'. This has serious implications for the developing countries, where such frequent feeding - even during the night - is usual and where commercial pressures to bottle feed will lead to increased birth-rates. The nervous and endocrine mechanisms linking suckling and amenorrheoa are now being investigated in detail as a possible source of an improved contraceptive pill (Reproductive Biology Unit, Edinburgh).

10. There is renewed interest in the question whether blood lead levels in children correlate with deficiencies in the development of intelligence. A pilot study suggests a marginal correlation and a more extensive study is now being mounted.

11. The identification of effects of drugs and other chemicals on the developing fetus is of great public concern (eg thalidomide) and commercial importance; this subject of teratology is weak in this country and a major new programme is being planned as a joint venture of the Toxicology Unit and the Laboratory Animals Centre's new Director, Dr Whittingham.

Radiation and Medicine

12. A new Cyclotron Unit being built at the Clatterbridge Hospital, Merseyside, will be able to test whether neutron therapy offers benefits in common tumours. The cyclotron, which is being funded as to capital costs by private charitable institutions and as to running costs by the Council, will also make available in the North-West radioisotopes for medical and other purposes.

13. An alternative approach to cancer therapy is to use drugs to sensitise cancer cells to X-rays. Clinical trials using one such drug - misonidazole - show that the limiting factor is side effects on the nervous system. The mechanism is being analysed and related chemicals synthesised to reduce this toxicity; progress is promising.

14. The existing cyclotron at Hammersmith is increasingly used to make very short-lived isotopes for local use in emission tomography. This new technique allows biochemical defects, eg, in transmitter-binding in areas of the brain, to be localised in the patient and could be of great value in studying objectively and rapidly the effects of drugs on conditions such as schizophrenia.

15. The dangers of low doses of radiation are incompletely understood and are important in establishing safety standards both for the nuclear power industry and for clinical uses of radiation. A study of health and radiation records of all the workers (past and present: some 50,000) in the UK Atomic Energy Authority is well advanced and is to be broadened to include the workers in the Atomic Weapons Research Establishment. These data should establish whether existing safety standards, recently challenged, are significantly in error.

Safety at Home and Work

16. Concern for safety leads to searches for substitutes for those valuable materials, such as asbestos, shown by epidemiological studies to be dangerous. There is thus a need for tests predictive of any hazards associated with novel materials, whether used as substitutes or for new applications. It now seems likely that the hazards of fibrous materials can now be accurately predicted from a combination of their effects on certain cell-culture systems and of their physical properties (Pneumoconiosis Unit, Cardiff).

17. In animals, nitrosamines are known to cause cancer: they are chemicals of common occurrence in foods and, it has been suggested, may be formed in the body, in dangerous amounts after some drugs (eg, cimetidine, used widely to treat stomach

ulcers). It has been found that cumulative exposure to such compounds can be measured by chemical changes they cause in haemoglobin and a study is being mounted to establish the effects of drugs and also to test chemicals (eg, vitamin C) that may block nitrosamine formation (Toxicology Unit).

18. Deep-sea diving is of great economic importance. A limitation is neurological effects of high pressure, but work supported by the MRC showed that some anaesthetic gases will ameliorate these effects while the high pressure itself reduces the effects of the anaesthetic. Nitrogen is used in practice, but the margin for error is small. Work at the Clinical Research Centre has recently shown that some analogues of non-inhaled anaesthetics are active in preventing neurological symptoms and are themselves not anaesthetics.

19. The Trauma Unit (Manchester) have shown that hypothermia is a serious complication in accident victims (especially in the elderly) and have demonstrated the benefits of wrapping patients in metallised blankets and giving them warmed and humidified air to breathe.

THE NATURAL ENVIRONMENT RESEARCH COUNCIL (NERC)

20. The sciences of the natural environment are buoyant because of the growing interest in discovering more about the resources of our planet and because of the new research tools that have become available in recent years, including remote sensing from satellites, deep drilling under deep oceans and advanced methods of data processing.

Earth Sciences

21. The theory of plate tectonics which governs all modern thinking on geology and geophysics arose from research in the deep oceans. Some of the most important work relating to such features as the mid-Atlantic ridge and hot vents at sea have been explored in the international phase of Ocean Drilling, carried out by one specially equipped ship under United States leadership with five other participating countries, amongst them the UK represented by NERC. A new drilling tool for investigating the sediments up to 200 metres deep on the floor of the oceans has greatly contributed to our understanding of the variations of climate during the past two million years. The continental areas of the world are not nearly so well understood and major enterprises in the UK (co-ordinated by NERC and involving universities and Institutes) are studying the exceptionally interesting areas of

Scotland where one of the main geological features (the Scottish Highland Fault, running from Inverness to Fort William) was discovered a century and a half ago but investigations of how it arose require studies of the deeper geology only now becoming possible.

22. NERC's expertise in defining areas where hydrocarbons might accumulate and where useful minerals might be found has sharply increased and is in use both in the UK and under contract elsewhere. Scientists have established unique new methods of analysing systems of fine cracks commonly found in the deep rocks (three thousand m. and below) which may hold valuable clues for earthquakes and their possible prediction as well as for the potential exploitation of geothermal energy from the universally-present hot dry rock. Much progress is also being made in studying the stability of underground layers, particularly its possible disturbance by radio-active waste with its associated heat production.

23. The geology of Antarctica is only now reaching the point where it can be studied in depth. This is important both for the early history of the continents and for exploitation of Antarctic resources. The British Antarctic Survey (BAS), a component of NERC, is active here.

The Marine Environment

24. Techniques have now become available for studying life in the deep ocean several thousand metres down. The work of the Institute of Oceanographic Sciences carried out from RRS Discovery has led to the discovery of new species and the unexpected occurrence of little known animals in great abundance. These include rare fishes, unusual sea squirts in thousands, and previously undescribed protozoons.

25. The relative infertility of much of the world's ocean has long been unexplained. The combination of incident solar radiation, warmth of water and the presence of nutrients is pretty rare; but in UK waters tidally stirred waters impinge directly on relatively still waters where the surface layer can get quite warm. The use of satellite images in conjunction with shipborne observations by NERC's Marine Biological Association has led to the discovery of complex physical boundaries in the ocean between areas of mixed and unmixed water where productivity is exceptionally high. A number of such boundaries or fronts have been mapped in the English Channel, the Western Approaches, and on the regions of the shelf break.

Virology

26. Viruses offer new possibilities for the control of insect pests, as the NERC Institute of Virology has demonstrated in trial controls of the Pine Beauty Moth and Pine Sawfly in Scottish forests. The next stage is the development of insect cell lines and testing systems for the bulk reduction and quality control of such viruses. New work on the nature of latent virus infections suggests that means may be found to activate them as pest control mechanisms.

Ionosphere

27. The Halley Base in Antarctica, operated by BAS, is ideally suited for studies of the ionosphere and the interaction between the solar "wind" and the earth's magnetic field. An understanding of the phenomenon associated with this interaction is of basic scientific interest and of value in communications. An Advanced Ionospheric Sounder has recently been installed at Halley and is now providing a complete description of ionospheric echoes as a function of frequency and time for study by scientists from BAS and universities.

Land Use

28. A number of techniques have come together, partly depending on remote sensing from satellites and partly on refined instruments developed by the NERC Institute of Hydrology, to study water in the ground and its evaporation. The effect of afforestation on the use of upland areas for water catchment is an active research topic leading to new possibilities for multi-purpose land management. The Institute has developed a system for the rapid characterisation of vegetation and land use which is now finding wide application in land use planning, classification of soils, and forestry development. The methods are also used by NERC's Institutes under contract to study foreign regions.

THE SCIENCE AND ENGINEERING RESEARCH COUNCIL (SERC)

Particle Physics

29. Perhaps the most intellectually exciting of contemporary scientific developments is the move towards a unified theory uniting the four fundamental forces now known to exist in Nature - gravitation, the electromagnetic force of Faraday and Clerk Maxwell, and the "strong" and "weak" nuclear interactions identified by modern physics. A development in that direction was the formulation of a theory uniting the "weak" force with electromagnetism for which Professor Salam of Imperial College

shared a Nobel Prize in 1979. Particle physics owes much to the close interaction of theory and experiment, and the demands of experimental particle physics have now reached a stage at which equipment is so costly and so complex that it can only be provided on an international scale. At CERN UK physicists are heavily involved in the quest for the quantum of the weak nuclear force, the parallel to the photon of electromagnetism; and the Super Proton Synchrotron, CERN's most powerful accelerator, will be used to produce this quantum directly in proton - anti-proton collisions. The Large Electron Positron collider (LEP) which among other things will permit detailed study of the weak quantum, is expected to be commissioned in 1987. UK scientists from universities and the SERC's Rutherford Appleton Laboratory are extensively involved in its planning. UK workers are also active at European laboratories in testing the predictions of quantum chromodynamical theory that strongly interacting particles like the proton are made of simpler entities called quarks and gluons.

Astronomy and Atmospheric Physics

30. UK astronomers are studying space from the bottom of the earth's atmosphere to the most distant limits of observation, studying celestial phenomena throughout the electromagnetic spectrum. Because the earth's atmosphere is opaque to much of the spectrum, spacecraft and balloons are essential to their work.

31. The United Kingdom Infra-red Telescope in Hawaii, which recently became operational, is the largest instrument in the world dedicated to infra-red observations. Its size, coupled with the high sensitivity of its detectors, have made it possible to observe the most distant galaxies and quasars known in the infra-red band. Rapid variations have been observed in the intensity and polarisation of extreme active galactic nuclei which has provided fundamental information about physical conditions close to what is probably a massive black hole. Studies of compact binaries have enabled the primary component of dwarf novae to be detected and give information on the dynamics of matter as it accretes from the cool star to the compact object. Infra-red observations of faint stars have led to the reliable determination of the numbers of the faintest stars, and have resulted in the discovery of the faintest star known.

32. The SERC plays an important part in the European Incoherent Scatter Scientific Association, whose headquarters are in Sweden, which has installed and recently begun to operate an incoherent scatter facility, consisting of two high powered radar installations, in the study of the scattering of radio waves from free electrons in the upper atmosphere. Last July the first measurements of signals scattered from

different heights were received, and electron densities, temperatures and ion temperatures are now being measured.

33. It is now well established that there are large holes in the distribution of galaxies in the Universe which have been found both by plotting the distribution of galaxies on the celestial sphere and by measuring the recession velocities of bright and faint galaxies. The pattern of their distribution is akin to filamentary structures, with very little between the filaments: the structure could be thought of as roughly resembling a large sponge. This picture of the distribution of galaxies imposes new restraints on admissible theories of galaxy formation. UK workers at Durham University and the Royal Observatory, Edinburgh are pursuing these studies to observations of much larger regions of the Universe than have previously been studied.

Atomic and Molecular Structure Studies

34. The SERC's synchrotron radiation source at Daresbury was commissioned in August 1981 and has already provided data on the surface structure of semi-conductors, the structure of platinum-based anti-cancer drugs and the topography of silicon, diamond, beryl and other crystals. At the SERC's Central Laser Facility at the Rutherford Appleton Laboratory, recent work on laser-plasma interaction and laser compression has included the development of X-ray shadowgraphy techniques and their use in the study of the dynamics of imploding targets. The extension of laser studies to shorter wavelengths would open up important new areas, and work at the University of Hull is directed towards the development of an X-ray laser. Much remains to be done before an engineered instrument can be made, but good progress has been made towards the demonstration of laser action at wavelengths much shorter than have previously been achieved.

35. Nuclear magnetic resonance (NMR) spectroscopy has long been an essential tool for the chemist, and now provides a non-destructive, non-invasive way of studying at the molecular level the biochemistry of living systems of interest to the MRC as well as the SERC. Work by Dr G K Radda and his colleagues at Oxford involves the study by NMR methods of the muscle, brain, heart and kidneys of intact laboratory animals. The development of the high-field spectrometers necessary for this work has been carried out in association with a local company, the Oxford Instruments Group, and because of its clear potential for clinical applications a new company, Oxford Research Systems, has recently been formed, with the assistance of BTG specifically to market these instruments for biological and clinical applications.

36. Another striking example of the study of biological systems by physical methods is the work of Sir David Phillips and his colleagues at Oxford on X-ray studies of enzyme action. The aim of this work is to gain a fuller understanding of the function of proteins through a precise definition of their structure. The information obtained is not confined to the static arrangement of atoms: evidence on the apparent motion of the atoms is also derived which can be interpreted in terms of the dynamic properties of the molecules. In 1980 the structures of eight proteins were resolved by Professor Phillips's team to resolutions as high as 1.7Å. The molecule of one protein studied, phosphorylase b, contains 7000 independent atoms and the process of structure refinement involved 35000 reflections. Thirty years ago the Annual Reports of the Chemical Society referred to the X-ray analysis of a structure containing 100 atoms made possible by the computational techniques then becoming available. Professor Phillips's work of today makes extensive use of the vector processing computer now installed at SERC's Daresbury Laboratory, a machine embodying recently developed computer architecture which he regards as having opened up new possibilities for the calculation of accurate models of proteins and their ligand complexes.

Technological Applications of Science

37. Current studies of Langmuir-Blodgett monomolecular films provide an example of the application of classical work to contemporary technology. In carefully controlled conditions, perfectly-formed insulating Langmuir-Blodgett layers may be deposited on the surface of semiconductors. Silicon is effective in microelectronic devices because of the natural oxide which forms an insulating layer. The use of Langmuir-Blodgett films opens up the possibility of many other, more efficient semiconductors in applications that might include transducers and solar cells.

38. The SERC has recently initiated a new programme of robotics research, which has led to the development at Nottingham University of prototype software for the computer simulation of industrial robot installations. Work at Sussex University aims at the construction of computational models of language understanding, including fundamental perceptual studies of the interaction between speech and rhythm, and the automatic generation of highly intelligible speech. It is a striking example of the way in which the development of computing equipment and computing software has in recent years made entirely new areas accessible to the methods of exact science.

38a. To help to exploit scientific and engineering developments for biotechnology the SERC has established, jointly with DOI, a new Biotechnology Directorate whose Director took up his full-time post last week; and the Research Councils have established a Co-ordinating Committee to draw together their numerous activities in this field.

Occupational Stress

39. It has been reported from a number of studies that different occupational groups show different levels of mental and physical health. However, in these studies it is difficult to distinguish between effects associated with pre-existing differences between those who enter different occupations, and effects due to the nature of the work environment and job demand in different occupations. Hence it has not been possible to establish definitively that the work environment to which individuals are exposed can influence well-being. This difficulty was eliminated in the design of a study (Occupational Stress - A Longitudinal Approach, by Drs Katharine Parkes and Michael Argyle of the Department of Experimental Psychology, University of Oxford) based on the systematic pattern of ward allocations undertaken by student nurses, which provided an unusual opportunity to compare the effects of different work environments on the same individuals.

40. The results showed that differences between medical and surgical wards significantly affected several measures of well-being, especially depression, anxiety and work satisfaction; while male and female wards gave rise to differences in work satisfaction and in anxiety. Further analysis indicated that these differences in well-being were associated primarily with differences in the extent to which the work was perceived as skilled, creative and allowing opportunities for decision-making, and with differences in the level of social support in the work environment. This study thus demonstrates that the work environment can influence mental health and well-being, and identifies some important mediators of these effects, which have general implications for job design and work organisation.

Population Forecasting

41. When the number of births in a population changes sharply, this may be due to a move towards larger or smaller family sizes or to alterations in the intervals between births. The Centre for Population Studies at the London School of Hygiene, whose work SSRC supports, has just devised an effective method of distinguishing between these two factors by using the series of births by order in the family per year, and measures of first and second births by marriage duration. The measures come from routinely published registration data.

42. The most important practical application of this method is the forecasting of future births from the series of past births per year by birth order, which takes account of family size and of changes in the interval between births (factors whose

longer term effects are very different). The issue is critical for population forecasting in this country at present.

Decision Analysis

43. Decision Analysis aims to organise and systematise thinking about different courses of action that can be pursued in a complex decision. It seeks to do this around three dimensions: assembling and defining the available options, assessing the levels of uncertainty about the possible outcomes from each possible action, and deciding the value or worth to be put on the various outcomes. When decisions become complex people find it difficult to grasp them comprehensively. Decision Analysis provides a framework within which this can be done.

44. Its procedures have been used in a wide range of problems. In the private sector a motorcar company had to decide whether or not to move out of a particular market; the choice was whether to introduce a new product to replace an old one or to continue with the old product which was threatened by competing technology and a possible legislative ban. A service company wanted to decide where, and at what level, a new service should be test marketed. An oil company had to decide whether or not to bid for drilling rights in a certain area of the North Sea, and the size of its bid, taking into account future uncertainties about costs, yields of oil, future prices and taxation arrangements.

45. In the public sector alternative methods for safeguarding the security of raw nuclear materials and by-products have been appraised. Other examples include looking at water supply problems, contingency reserves planning, and weapons procurement.

THE BRITISH MUSEUM (NATURAL HISTORY) (BM(NH))

46. The BM(NH), which celebrates its centenary at South Kensington this year, is one of the world's major taxonomic institutions, housing a unique collection of reference items, approximately 50 million in number and increasing at the rate of 1% per annum. Its naming and classification work help to underpin development of the agricultural, environmental and medical sciences.

47. The major part of the Museum's resources (80%) support its scientific work, of which the following examples are of special significance:

(a) The disease schistosomiasis, caused by a worm-like parasite, affects approximately 200 million people in Africa, Asia and South America. A clear understanding of the taxonomy of the parasite is a prerequisite

to its control. Scientists at the Museum, designated a 'Collaborative Centre' by the World Health Organisation, are using a range of biochemical techniques including the separation of enzymes by electrophoresis to elucidate the taxonomy of the parasite and its snail intermediate host.

(b) BM(NH) scientists are also studying some non-parasitic groups of worm-like animals, namely nematodes, which are of world-wide importance in the breakdown of organic material. This study is typical of the traditional approach to taxonomy, ie the detailed microscopic study of external characters. The first priority is the production of a British marine nematode handbook, needed by ecologists.

(c) Detailed taxonomic accounts of bloodsucking flies that carry human disease, eg mosquitoes and blackflies, have been produced by Museum staff. Some of these flies are now known to be complexes of species that look alike but that differ in their biology. Diagnosis and identification of the members of such complexes is a prequisite to an understanding of their roles in disease epidemiology. Current work is concentrated on sandflies that carry leishmaniasis in Central and South America, and blackflies that carry 'river-blindness' (onchocerciasis) in Brazil and West Africa.

48. Twenty per cent of the Museum's resources support the presentation of natural history to the visiting public, now numbering approximately three million each year. The BM(NH) was given (i) the National Heritage Museum of the Year Award for 1980 - the first time the Award has been given to a national museum, and (ii) a special commendation in the competition for European Museum of the year 1980.

CSF Hd of for X

Parliament

DEPARTMENT OF EDUCATION AND SCIENCE

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FROM THE SECRETARY OF STATE

Tim Lankester Esq
Private Secretary
10 Downing Street
LONDON SW1

13 October 1981

Dear Tim,

HOUSE OF LORDS SELECT COMMITTEE SUB-COMMITTEE ON SCIENCE AND GOVERNMENT.

When Mr Macfarlane talked recently with the Prime Minister about Science he undertook to let her have notes on the work of this Committee and on recent developments in science.

On the former I enclose a short summary of the main themes covered in the published evidence. May I stress that we do not claim it to be authoritative. It was prepared originally for our own internal briefing. Moreover there is a volume of written evidence, possibly large, given to the Committee in response to the circulated questionnaire (copy also enclosed) which is not available to us, not having been published.

Mr Shelton has been invited to appear before the Sub-Committee on 21 October with Sir James Hamilton; they have sent us a number of questions (copy also enclosed) which show something of the drift of their thinking.

We are preparing for you a short paper on recent developments in science which I will send as soon as possible.

Yours sincerely

Peter

P A SHAW
Private Secretary

HOUSE OF LORDS SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

(SUB-COMMITTEE I - SCIENCE AND GOVERNMENT)

BRIEF SUMMARY OF MAIN POINTS EMERGING FROM EVIDENCE TO THE SUB-COMMITTEE

1. MACHINERY OF GOVERNMENT

About half of those giving oral evidence favoured the reconstitution of some form of Central Science Committee (CSC); and most supported the re-creation of a Chief Scientific Adviser (CSA) post, to advise the Prime Minister and Cabinet specifically on scientific matters and to co-ordinate policy formulation and oversight. They did not see a need for a change in Ministerial responsibilities for science, or for the creation of a Minister for Science and Technology; but several witnesses qualified their support for a CSA and CAC upon evidence of their acceptability to Government and the Prime Minister. The adviser should work closely with (if not actually within) CPRS and should be of at least Deputy Secretary rank: this person and the CSC should be involved in the co-ordination of general Science and individual Departments' policies, the identification of priority areas in R and D and the allocation of resources. Several witnesses felt that a new CSC might be based on a previous body such as the Central Advisory Council on Science and Technology or ACSP; this would need to be privy to confidential Government matters if it were to be effective.

2. CHIEF SCIENTISTS

Apart from the need identified above, it was generally felt that the Chief Scientist post at CPRS should be retained, but preferably, and along with all other Chief Scientist posts, at Deputy Secretary level. The problems that Chief Scientists face in reconciling their roles as research budget managers with their policy advisory duties were noted, but most of those interviewed felt that Chief Scientists should be more fully involved in policy formation and implementation within their Departments than they appeared to be. Occasional meetings between Chief Scientists of different Departments to discuss mutual and overlapping policies were recommended. (CVCP suggested a panel of part-time consultants from industry and the universities who could supply Chief Scientists with up-to-date technological advice.) The idea of part-time Chief Scientists was put forward.

3. ABRC

ABRC was seen to be preoccupied with the division of the Science Budget; it had not devoted sufficient attention to the broader aspects of civil science. It was suggested that ABRC's terms of reference might be extended to enable it to play a

fuller role in advising Government and that it should work more closely with ACARD. It was also felt that the Chairman (and members) should devote more time to ABRC business, and that more industrial representation on the Board was needed.

4. DUAL SUPPORT SYSTEM - SUSR

While expressing support for the dual funding arrangements whereby the basic facilities for research are provided by the universities and the Research Councils offer selective support for specific research projects, the CVCP and UGC (and Sir Alec) expressed concern about the viability of the system in the light of recent reductions in university funding: serious damage would be caused because of the rapid time scale of the cuts. It was emphasised that both parts of the system needed to be adequately funded: it was not enough simply to protect the Science Budget. Reference was made to the Joint ABRC/UGC Working Party on the dual support system, and the awaited report of its findings.

5. ACARD

Witnesses thought that although ACARD had produced reports of a very high quality, Government response to and action on these reports had on the whole been disappointing.

6. ADMINISTRATION

The need for more scientific civil servants to move into administration and policy making was identified; improvements in the career development and training of scientific civil servants were required. Freer traffic of staff between the Service, the universities and industry was advocated.

7. INTERNATIONAL SCIENCE

It was generally felt that more scientific counsellors and supporting staff were needed in our embassies.

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I - SCIENCE AND GOVERNMENT

SOME QUESTIONS FOR WRITTEN EVIDENCE

A. Machinery of Government

1. Should scientific advice and/or research procurement be a distinct function of Government separate from the existing Departmental structure?

2. How successful is the system of Departmental Chief Scientists in procuring advice, managing research and influencing policy.

3. How well supported are Ministers when judging scientific priorities in decision making, particularly if Government Departments are not in agreement?

4. How far is the scientific advice sought by Government geared to supporting predetermined objectives?

B. Finance

1. How satisfactory is the division of financial responsibility between the Research Councils (as a group) and Government Departments funding research on the customer/contractor principle?

2. Is any research which could be of real value to Government being neglected for lack of identified customers or because it is peripheral to the interest of several customers; if so, what changes could rectify this?

3. Are any changes in research budgets desirable?

C. Machinery of Science

1. How adequate are the channels of communication from the scientific community to Government, and vice versa?

2. Is there satisfactory contact between those administering science in higher education, industry, the Research Councils and Government?

3. How could statutory procedures for consultation by Government in scientific matters be improved?

4. Are existing sources of advice adequate to ensure that the UK gains all it can from EEC and international research programmes?

D. Scientific Manpower

What manpower constraints are there on the provision of scientific advice to Government?

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

SUB-COMMITTEE I - SCIENCE AND GOVERNMENT

Questions for the DES

1. Is "Department for Education and Science" something of a misnomer? Is the Department more a Ministry for the Research Councils?

2. What part does DES play in Departmental coordination of scientifically-based policy? How do you ensure that the policy of Government as a whole, or other Departments, takes account of the contribution of

a) basic science
b) Research Councils
c) universities and polytechnics

3. One of the terms of reference of ACARD is 'the articulation of applied R & D with scientific research supported through DES'. On the other side of the coin, how does DES articulate scientific research which it supports with applied R & D?

4. Do you agree with Sir Alec Merrison's description of the ABRC as a huge torpedo not being launched at anything very much? Do you have any proposals for making it more active?

5. What is the staff supporting ABRC?

6. The following appears in the DES press release announcing the Expenditure White Paper 1981/82 to 1983/84: "The plans allow for provision for science to be held broadly at the current level throughout the period. It should thus be possible for the Research Councils ... to maintain their selective support for research in universities and polytechnics at broadly the current level at a time when provision generally for higher education is planned to decrease".

a) Do you agree that this indicates a failure to appreciate the importance to basic science of the dual support system?

b) Ought not the Chairman of the ABRC to have been consulted before the cuts were made?

7. Why does DES have no Chief Scientist?

8. Who is Head of Profession for scientists in DES?

9. Does DES take people on secondment from universities, Research Councils, research institutions etc.?

10. a) What are your proposals for increasing science in the school curriculum? Are they likely to produce more scientists and technologists?

b) Are there any plans for extending the arts element in the education of scientific and technical specialists?

11. Particularly at a time of cuts in educational expenditure, how does DES assess industry's need for trained manpower? Does DES or DoI have the prime responsibility for ensuring that universities etc. are producing the requisite manpower?