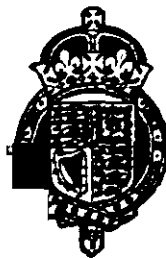


GOVERNMENT
SCIENTIFIC ORGANISATION
IN THE CIVILIAN
FIELD



LONDON: HIS MAJESTY'S STATIONERY OFFICE
JULY 1951

PRICE 1s. 6d. NET

GOVERNMENT SCIENTIFIC ORGANISATION IN THE CIVILIAN FIELD

A Review prepared for the Lord President
of the Council by the Advisory Council
on Scientific Policy

<i>Chapter</i>	<i>Paragraph</i>
I. Introduction	1-4
II. Historical Background	5-19
III. Post War Developments	20-28
IV. The Advisory Council on Scientific Policy	29-35
V. The Research Associations	36-38
VI. The Role of the Universities	39-40
VII. Scientific and Technical Information Services	41-47
VIII. Overseas Scientific Relations	48-51
IX. Colonial Research	52-56
X. Recent Developments	57-65
XI. Conclusion	66-70
 <i>Appendix</i>	
I. Government Machinery for Civil Science in Great Britain	<i>Page</i> 17
II. Government Expenditure on Scientific Research in the Civilian Field, 1900-1950	38
III. Estimated Government Expenditure on Scientific Research in the Civilian Field, 1950-1951	42

Government Scientific Organisation in the Civilian Field

I

INTRODUCTION

1. Science, today, affects every aspect of our affairs. Behind each technical achievement which contributes to greater industrial competence and higher levels of productivity lies a chain of discovery and development, starting with pure research in the universities and research institutes, and ending with the applications of the new knowledge in agriculture and industry.

2. Two separate but inter-related trends have brought about a rapid increase in the Government's interest in scientific work. The first is an ever-growing recognition of the value of scientific research, not only as an essential aid to defence but as the spearhead of continuous industrial advance. The second is the steady broadening of the area of Government interest and participation, especially in the country's economic affairs and, as part of this trend, the assumption by Government of responsibility for promoting certain aspects of industrial, including agricultural, development.

3. It has become a responsibility of Government to ensure facilities for the training of scientists; to encourage fundamental research; to guide applied research and development into channels which will allow the realisation of the opportunities and benefits of newly discovered knowledge; to finance certain kinds of research and, where appropriate, to undertake research directly. As a result, a system of collaboration has developed between universities, industry and Government which is of the greatest value to the community as a whole.

4. Appreciation of the widespread use of science owes much to its application to problems of defence in two world wars. While defence research and civil research are complementary, and necessarily co-ordinated in Government policy, this paper is concerned only with Government scientific organisation in the civilian field.

II

HISTORICAL BACKGROUND

5. Since its foundation by Royal Charter in 1662, the Royal Society has occupied a unique position in the country's scientific affairs. The Society has always been independent of State control and is not supported by grants from public funds, but its advice on scientific matters has been sought throughout its history by the Government. Today the Society's influence remains as strong as ever, and its Fellows serve on most, if not all, the Advisory Councils of Government Departments.

6. Active participation by Government in scientific effort is, for the most part, a twentieth-century development. At the turn of the century the Museums (the British Museum—including the Natural History Museum—founded in 1753 ; the Science Museum, originally established in 1853 under the aegis of the Department of Science and Art of the Board of Trade ; and the Museum of Practical Geology, first set up in 1837 and developed in new premises in 1851) were playing their part in promoting the spread of scientific knowledge. The Imperial Institute, founded in 1887, was available to give scientific and technical advice in the interests of the economic development of the natural resources of the Empire. A few Government Departments, the Admiralty, the Post Office, the Royal Observatory (founded in 1675—the first of all State-aided scientific institutions), the Geological Survey (founded in 1835), the General Register Office (established in 1837), and the Department of the Government Chemist (originally founded as a branch of Customs and Excise in 1842), were using scientific knowledge within the confines of their own spheres of interest. But there was little organised effort towards the application of the discoveries made by scientists engaged on fundamental research. Government scientific organisation, like most British institutions, evolved slowly and unevenly in response to the changing needs and circumstances of the times.

7. In 1900, the need for physical and engineering research and, in particular, research into methods of precise measurement, led to the establishment of the National Physical Laboratory under the control of the Royal Society, with a modest capital grant from the Treasury of £13,000 for equipment and an annual grant of £4,000.

8. In 1904, research activities on an organised basis were started by the Post Office to enable discoveries in physical science to be applied to the development of the telegraph and telephone systems. The Post Office Research Section was constituted as a distinct entity within the Engineering Department five years later.

9. Government may be said to have assumed responsibility for the encouragement and promotion of scientific research with the appointment, in 1909, of the Development Commission. The Commission was given a number of important functions, broadly in the field of agriculture, rural economy, rural industries and fisheries, and they were empowered to recommend to the Treasury that financial aid should be made available from the Development Fund provided (under the Development and Road Improvement Funds Act, 1909) for aiding and developing agriculture and rural industries by promoting scientific research and its application. They were also directed to give their attention to the development and improvement of fisheries. In 1911 the Commissioners, acting in close collaboration with the Agricultural Departments, framed, for the first time, a comprehensive scheme of agricultural research, advisory services, and post-graduate scholarships which led to the formation of most of the agricultural research institutes which exist in Great Britain today and provided the basis of the advisory services. In agricultural research the policy was deliberately adopted of assigning to independent research institutes, often connected with universities, all agricultural investigation, with the exception of research and inquiries bearing directly on the administrative responsibilities of the Agricultural Departments for the control of plant and animal

diseases, plant registration and economic botany. A few years later, the Commissioners appointed a Scientific Advisory Committee on Fishery Research which examined the whole field of fishery investigation and made recommendations which led to a substantial strengthening of the facilities for research. The Commissioners have, throughout, been responsible for the finance of the independent fishery research laboratories and for much of the more directly economic and deep-sea fishery investigations ; and they have been concerned with research affecting the use of the natural resources of the countryside and with investigations connected with the development of rural industries.

10. In 1913, the Government recognised the need for a central body to be responsible for promoting research into medical science as part of the National Health Insurance Scheme ; a Medical Research Committee was accordingly established under the National Health Insurance Joint Commission.

11. Up to the outbreak of the first World War, the Government contribution to the organisation of scientific research was made directly through the organisations described above, and indirectly through grants, administered on behalf of the Government by the Royal Society and by grants made to the Imperial College of Science and Technology, the Edinburgh Observatory, the Royal Geographical Society, and the Solar Physics Observatory. The total cost of this contribution was little more than £600,000 per annum.

12. Recognition of the importance of scientific research and of the application of scientific knowledge to trade and industry had been steadily growing, and in 1916, with the nation at war, the Government founded, in the Department of Scientific and Industrial Research, an organisation to serve the country when conditions of peace returned. The Advisory Council for Scientific and Industrial Research (responsible to the Committee of the Privy Council for Scientific and Industrial Research, presided over by the Lord President of the Council) was given responsibility :—

- (i) for instituting specific researches ;
- (ii) for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries or trades ;
- (iii) for the establishment and award of research studentships and fellowships.

The Advisory Council (to which all proposals for new work are referred by the D.S.I.R. in the first instance) was also given general responsibility for initiating proposals relating to the advancement of trade and industry by means of scientific research.

13. One of the first acts of the Advisory Council was to recommend a scheme in which the Government associated itself with groups of firms with similar interests to prosecute industrial research. A fund of £1,000,000 to be used for grants to such research associations, was announced in 1917. Industry responded immediately and by 1921, twenty-one associations had been formed. The Council recognised that in some fields, such as food, fuel and building, the scope of research extended

beyond the interest of any single industry and to serve the national needs in these fields they established research stations under the direct control of D.S.I.R.

14. In 1918, the Royal Society relinquished financial responsibility for the National Physical Laboratory to D.S.I.R., although the Lord President of the Council continued to receive the help of the Royal Society in the scientific direction of the Laboratory. The Geological Survey was transferred to D.S.I.R. from the Board of Education in 1919.

15. The Advisory Council for Scientific and Industrial Research, in interpreting the third of its terms of reference, recognised the need for encouraging research in universities both as a training ground and as the focus of the search for new knowledge, and drew up a scheme of maintenance allowances to enable students to receive post-graduate training in scientific research. Later, senior research awards were made available for investigators of promise.

16. Under the Forestry Act of 1919, the Forestry Commissioners were appointed with powers to undertake and aid research for the promotion of forestry.

17. In 1920, the Government established the Medical Research Council (responsible to the Committee of Privy Council for Medical Research) in place of the Medical Research Committee which had been set up in 1913. The Council was given full liberty, under its constitution, to pursue an independent scientific policy for the advancement of knowledge towards the relief of human suffering. Funds for its work were henceforth provided directly by Parliament in the form of a grant-in-aid.

18. The third of the Councils created by Government for the promotion of research, the Agricultural Research Council (responsible to the Committee of Privy Council for Agricultural Research) was established in 1931. The Council was given the responsibility of advising the Development Commissioners and the Agricultural Departments (for England and Wales, and Scotland) on matters affecting agricultural research, including the allocation of funds for that purpose. In addition to these advisory duties, the Council was given funds of its own from which grants could be made for special research projects. (In 1946, the Development Commission, feeling that they had fulfilled their function in relation to agricultural research, advisory and education services, themselves proposed that the cost of these services should no longer fall upon the Development Fund.)

19. During the second World War a Scientific Advisory Committee of the War Cabinet was created, with the object of providing the Government with the best scientific advice available, and of co-ordinating defence and civil research for the successful prosecution of the war. The Lord President of the Council, as the Minister responsible for the three Research Councils, and as the President of the Scientific Advisory Committee, came to be regarded as the member of the War Cabinet responsible for the oversight of the Government scientific organisation. This, however, did not derogate from the individual responsibility of other Ministers for the scientific organisations and establishments in their Departments, and for the application of scientific knowledge and method in the discharge of their duties.

III

POST WAR DEVELOPMENTS

20. For a second time, during the 1939-1945 war, the attitude of the Government towards science was profoundly influenced by the valuable experience gained by the Defence Departments. These had learned and demonstrated that scientific research was a vital element in the strategy of war; that it was essential to the efficient mobilisation of resources, to the development and production of new weapons, and to methods for countering the weapons employed by the enemy. The scientist was no longer a specialist in a narrow field, to be called into consultation on specific plans and kept aloof from the main stream of administrative and executive activity. He was a full partner in a total war effort which demanded the highest contribution that science could make.

21. Scientific research and development is now an integral part of defence planning and of military work generally. Appreciating, from the experience of the Defence Departments and from the advances made in such fields as food research and medical research during the war, that the lesson was equally applicable in the civilian field, the Government both intensified scientific research and application and expanded its scientific organisation.

Scientific Advisers to Departments

22. On the recommendation of the Advisory Council on Scientific Policy (Chapter IV), Scientific Advisers were appointed to a number of Departments, notably the Ministry of Agriculture and Fisheries, the Home Office, the Ministry of Food and the Ministry of Fuel and Power. This development was recommended by the Council so that Ministers could have at their disposal advice on the scientific aspects of departmental policy and on the definition of problems calling for research. The widening of the field of Government responsibility in the economic life of the nation and the burden of administrative action were such that it was not enough to rely entirely on central research councils. What was also needed was scientific advice within Departments to help bring scientific method to bear on the solution of national problems, and to help Departments maintain their liaison with the three Research Councils.

23. The Advisory Council on Scientific Policy recommended that the relations between Departments and the Research Councils should be guided by the following principles:—

- (i) The executive Department should be responsible for identifying problems requiring research, settling their order of priority, deciding where the various investigations should be carried out and applying their results.
- (ii) The Research Councils and particularly the various branches of the Department of Scientific and Industrial Research should, as in the past, be free to initiate background research where they think fit, free from administrative control of the executive Departments and consequently from considerations of day-to-day expediency. They should also undertake research at the request of the executive Departments.

24. A number of Departments, the Ministry of Agriculture and Fisheries, the Ministry of Civil Aviation, the Ministry of Fuel and Power, the Ministry of Works and the Colonial Office (Chapter IX), also created Advisory Councils to help Ministers in keeping in touch with scientific progress in the Universities and other institutions and to assist them in formulating the scientific policy of their Departments. In some cases the Departments themselves carry out research.

Scientific Civil Service

25. In September, 1945, the Government completely reorganised the Scientific Civil Service. Under the new scheme, scientists in Government service were given improved remuneration and better conditions of employment, conditions under which their own experimental research would be both facilitated and stimulated. Recruitment of scientists to the civil service, hitherto left to a large extent to the individual Departments, was centralised through the Civil Service Commission, and two new classes, the Scientific Officer class and the Experimental Officer class, serving all Departments, were set up.

26. Since 1900, the scientific staff employed by Government had grown from a mere handful of chemists, physicists, geologists and engineers to a great branch of the civil service employing some 15,000 men, all of them technically qualified, and including 5,000 whose professional qualifications represent every branch of science. While a high proportion of these scientists are employed in the defence research establishments of the Admiralty and the Ministry of Supply, large numbers are engaged on research for civil purposes.

27. The expansion of the scientific civil service and, by the same token, the steadily increasing participation by Government in the field of scientific endeavour, is illustrated by the growth of the expert staffs employed by the Department of Scientific and Industrial Research over the past twenty-five years:—

1925	...	...	...	...	...	473
1930	...	...	...	...	...	682
1939	...	...	...	...	...	918
1950	...	...	...	...	...	1,805

28. This trend of expansion and intensification of active Government interest in science is also to be seen in varying degree in other civil Departments employing scientific staffs. It is shown by the table of expenditure on scientific research by Government Departments 1900-1950 (Appendix II).

IV

THE ADVISORY COUNCIL ON SCIENTIFIC POLICY

29. At the end of the Second World War, the Government established an Advisory Council on Scientific Policy, to advise the Lord President of the Council in the exercise of his responsibility for the formulation and execution of Government scientific policy, and thus created a permanent machinery for ensuring that the country's scientific resources would be effectively utilised in the national interest.

30. The Advisory Council, appointed by the Lord President in January, 1947, consists of fifteen members—twelve eminent scientists from the universities, industry and Government service, and three senior Government administrators.

31. The appointment of the Advisory Council on Scientific Policy coincided with the establishment of the Defence Research Policy Committee, associated with the Ministry of Defence and linking the scientific organisations of the Defence Departments. The civil and defence aspects of research policy were linked by the appointment of Sir Henry Tizard as Chairman of both the Advisory Council on Scientific Policy and the Defence Research Policy Committee.

32. These two Committees replaced the Scientific Advisory Committee to the War Cabinet. The Advisory Council on Scientific Policy was given responsibility for surveying the whole of the civilian field of scientific policy. The following are typical of the matters with which it is concerned:—

- (i) In the field of scientific man-power, it maintains, in collaboration with the Technical Personnel Committee of the Ministry of Labour, a continuous review of the current and prospective position in regard to the supply of, and demand for, qualified scientists, and assesses from time to time the priority which the main types of demand should have upon the available supply.
- (ii) It advises generally on the organisation of Government civil scientific research and on the broad allocation of present and future resources.
- (iii) It brings to the notice of the Lord President spheres of research in which it is felt that the national effort is inadequate either from the standpoint of the advancement of pure science or the application of scientific research to industrial needs.
- (iv) It advises the Lord President on the maintenance of scientific information services.
- (v) It advises, in conjunction with the Defence Research Policy Committee, upon the maintenance of scientific relations with other countries.

33. To assist the Council to give adequate attention to each of the subjects within its wide range of interest it has established the following standing committees:—

The Committee on Scientific Man-power.

The Atomic Energy Committee.

The Scientific Library and Technical Information Committee.

The Committee on Overseas Scientific Relations.

34. The Council has also set up, as occasion demands, committees to deal with particular scientific matters which extend beyond the scope of any one Government Department, such as the Committee on Industrial Productivity, the Radioactive Substances Committee, the Committee on Toxic Substances in Consumer Goods, and the Committee on Biological and Allied Sciences.

35. The Natural Resources Committee, appointed by the Lord President of the Council in December, 1950, after consultation with the Chancellor of the Exchequer, advises the Lord President on technical problems of the development, use and conservation of natural resources arising from the United Kingdom import and investment programme. Its reports are considered, in the first instance, as to economic matters by the Chief Planning Officer of the Cabinet, and as to scientific matters by the Advisory Council on Scientific Policy.

V

THE RESEARCH ASSOCIATIONS

36. The productivity of the nation's industries depends on their technical efficiency. The Research Associations assist in promoting efficiency in the industries which they serve, (i) by investigations involving the provision of accurate data for design and manufacturing operations, and the technical control of materials and processes ; (ii) by assessing the potential industrial uses of new scientific knowledge ; as well as by contributing to scientific knowledge by pioneer work.

37. There are today forty Research Associations with a combined income of more than £3,000,000 of which approximately one-third is contributed by Government (through the Department of Scientific and Industrial Research). The revenue grants to Research Associations are related to the contributions made by the industries concerned. The Research Associations are autonomous bodies but D.S.I.R., through membership of their councils and in other ways, is fully informed of their activities and is in a position to contribute to the formulation of policy and to give general guidance.

38. The Research Association is essentially co-operative in design ; it is not only a joint effort by firms within an industry but is also a collaboration between industry and Government.

VI

THE ROLE OF THE UNIVERSITIES

39. Substantially more than half of the income of the universities comes from Government sources. There is no direct departmental control and

the method of administering the grants, through the University Grants Committee, ensures academic freedom. The total amount provided to the universities by the central Government in 1950 was £11,000,000, of which a considerable part was for scientific purposes. This figure does not include the considerable sums for specific investigations bearing on industry, agriculture and fisheries. In addition, £4,000,000 was contributed by the Government to meet capital expenditure on new buildings, some of them to allow for expansion of science faculties.

40. All universities have faculties of pure science and it has long been accepted that their functions include both teaching and research in their appropriate fields. Many universities also have faculties of applied science or technology. In the past, research in technology has been limited by the inadequacy of the equipment available, but with the expansion of student numbers in recent years certain universities have added to their facilities and are undertaking research in various branches of technology. Some universities also have faculties of agriculture and at six universities there are schools of veterinary science (two of which have been set up in post-war years, while three earlier colleges have been brought within the university organisation).

VII

SCIENTIFIC AND TECHNICAL INFORMATION SERVICES

41. An essential feature of any plan for industrial development is a system for the dissemination of information resulting from research. Scientific discoveries gain in value as they are applied to promote agricultural and industrial technology. New information resulting from research, recorded in scientific books and periodicals, must be made readily accessible to the user. But the enormous growth of scientific publication in recent years makes it impossible for any individual to do more than follow the advances in one or two narrow fields. Information must therefore be sifted and so presented that it can be rapidly used by the industrial technologist.

42. To this end, many industrial firms have appointed technical information officers, who have a dual function: first to ensure that newly published scientific information which may be of value in their firm's sphere of interest is brought to the attention of those responsible for research and development; secondly to search for information required in connection with specific development projects.

43. The chief instrument for disseminating research information is the scientific library—whether of the university, national institution, learned society, local authority, industrial firm, or research association. The use of the libraries of universities and learned societies, which often contain unique collections, is normally restricted to members. The libraries of the research associations serve the needs of the associations' technical staffs in their work of advising member firms and the staffs of the firms themselves.

44. Most municipal libraries maintain sections on science and technology. In the chief industrial centres they are providing an essential service to local industry by assembling valuable collections of scientific books and periodicals dealing with locally important technologies, as well as basic collections on general scientific subjects. These collections are freely available for reference by technologist and technician, and in this respect they serve the needs of industry by offering information at all levels. Some of the municipal libraries have appointed their own technical information officers who assist industrial users in their search for material. Others even provide specialist staff in library outposts on the premises of large industrial establishments.

45. All Government Departments concerned with industry maintain libraries of scientific works. The great national collections of scientific literature are those contained in the British Museum, the Science Museum and the Patent Office. The British Museum Library contains much current material and it is also the repository of scientific information of historical importance. The purpose of the Science Museum Library and the Patent Office Library is to maintain collections of basic works and of scientific books and periodicals of current significance, the Patent Office also housing the complete collection of patent specifications. The former has come to be regarded as the main scientific lending library, the latter serves principally as a reference library. It is part of the Government's plan for the new Science Centre (paragraph 64) to expand the Patent Office Library so that it will become a great national reference library of science and invention at the service of all scientific and industrial users.

46. In recent years the scientific libraries have acquired a new outlook, in the belief that it is no longer sufficient to fulfil a passive role by merely housing information for those who care to search. Most are taking the initiative in supplying to the industrial user a catalogue of the literature of which they are the custodians. Many are installing photo-copying devices, thus making it possible to provide selected material to research workers—a method which enables many to consult the same references simultaneously. Some of the libraries are installing micro-copy reading machines which enable users of the library to consult material which has been sent in this convenient and economical form from other centres in this country and from abroad.

47. The arrangements for ensuring the availability of scientific and technical information do not, however, end with the development of libraries. There are the further problems of selecting from the mass of published information that which is of particular value to industrial users, and of finding information which may be in unpublished documents or may even be unrecorded. D.S.I.R. assists in these matters by publishing abstracts of scientific information relating to building, food, fuel, radio, roads and water pollution, and the Department maintains a collection of unpublished documents containing scientific and technical information including those of the Technical Information and Documents Unit. Most of the D.S.I.R. stations and the research associations maintain information services and provide expert information to firms requiring it.

VIII

OVERSEAS SCIENTIFIC RELATIONS

48. A feature of the wartime pattern of scientific collaboration was the establishment by the Governments of the Dominions, and of the United States, of Scientific Missions in London ; and of the United Kingdom and Dominions Missions in Washington, which later joined together in the British Commonwealth Scientific Office in Washington. These Scientific Liaison Offices were responsible for the exchange of scientific and technical information necessary for the prosecution of the war and were important official centres of scientific representation. The success of this development was soon recognised, and the desirability of continuing our overseas scientific representation after the war, and even of augmenting it as an important part of the international transactions of science, was one of the major considerations which led to the British Commonwealth Scientific Conferences of 1946. As a result of recommendations made at these Conferences, the Washington Missions of the United Kingdom and Dominions Governments are being maintained on a permanent basis, and a British Commonwealth Scientific Office has been set up in London. A scientific attaché accredited to the British Embassy in Paris assists in maintaining scientific liaison between the United Kingdom and France, the Netherlands and Belgium.

49. A new aspect of overseas scientific relations emerged with the establishment of the various specialised agencies of the United Nations, many of which are responsible for considering problems of importance to this country. The international relations of science are so important that a Standing Committee of the Advisory Council on Scientific Policy was set up to provide for discussion of general policy on overseas scientific representation, scientific relations with Commonwealth and foreign countries, the staffing and administration of overseas scientific Missions, and scientific aspects of the work of the United Nations agencies.

50. The Committee includes among its members not only Departmental representatives but also the Foreign Secretary of the Royal Society, a representative of the British Council, two university scientists and a member appointed by the Conference of Research Associations. The Overseas Liaison Division of the Department of Scientific and Industrial Research is responsible for the executive work arising from the Committee's activities and for providing the secretariat. This Division is regarded as the general inter-departmental body responsible for overseas scientific liaison, and is placed within the Department of Scientific and Industrial Research for convenience of organisation.

51. Machinery exists in the Commonwealth Agricultural Bureaux for liaison in the field of agricultural science between countries of the Commonwealth. There are twelve Bureaux specialising in various branches of agricultural science and, in addition, the Commonwealth Mycological and Entomological Institutes. The Bureaux collect and disseminate to the member countries information resulting from agricultural research.

IX

COLONIAL RESEARCH

52. The problems of Colonial research and development are as diverse as the racial and climatic characteristics of the various parts of the Colonial Empire. There are some fifty separate political units covering more than 2,000,000 square miles of territory. The stages of political development range from protectorates over primitive peoples to virtually self-governing Crown Colonies. The territories include great areas of desert, tropical jungle and antarctic waste. The fundamental problem in many areas is the protection of health against such hazards as malaria. Before natural resources can be developed tsetse fly and locust swarms must be brought under control.

53. Research in every branch of science and especially in medicine and health, agriculture, animal health, forestry, fisheries, land and water conservation, and sociology is therefore an essential preliminary to the development of the Colonial territories. The bulk of this work is done locally, often on a regional basis, but much of it requires close collaboration with the research institutes and laboratories in this country.

54. The Colonial Office has set up a number of specialist advisory research committees consisting of experts in the various fields of research. One of these is a joint committee on medical research appointed by the Medical Research Council and the Colonial Office. The chairmen of these committees are members of the Colonial Research Council whose function is to advise on general questions relating to research policy, to co-ordinate the work of the specialist committees, and to give advice to the Secretary of State for the Colonies on research matters not falling within the province of any of the specialist committees.

55. The main contribution of central Government to research in the Colonies is made through the provisions of the Colonial Development and Welfare Acts, 1940 to 1949. These Acts provide funds up to £20,000,000 per annum for development in the Colonies and a maximum of £2,500,000 for research schemes. It is the policy of the Colonial Office (and of the Commonwealth Relations Office in respect of the South African High Commission Territories) to encourage Colonial Governments to contribute as much as they can from their own resources towards research schemes. Approximately £2,000,000 has been given by Colonial Governments or by industries in the Colonies to the approved schemes assisted from Colonial Development and Welfare funds. A number of research projects have been undertaken and paid for by Colonial Governments themselves.

56. In the ten years ended 30th September, 1950, some 425 schemes had been promoted under the Acts, involving a total net allocation of more than £8,000,000, of which rather more than £3,000,000 had been spent. Of the total sum, about 33 per cent. relates to agricultural, forestry and veterinary projects, 15 per cent. to medical research, 12 per cent. to fisheries research, 9 per cent. to sociological and economic investigations, and 20 per cent. to insecticides, locust control, tsetse research, etc.

X

RECENT DEVELOPMENTS

Atomic Energy

57. In October, 1945, the Government embarked on a great civil enterprise, creating, at Harwell, a research establishment to investigate all aspects of atomic energy. The establishment, which is under the control of the Ministry of Supply, has a four-point programme:—

- (i) The provision of scientific and technical information required for the production of fissile materials.
- (ii) The production of radioactive materials and separated isotopes to be used in scientific, medical and industrial research and for therapeutic purposes.
- (iii) The provision of facilities for research into atomic energy generally.
- (iv) The investigation of the applications of atomic energy to the generation of heat and power.

58. Considerable progress has been made in the first three parts of the programme and resources are now becoming available for the nuclear power programme. Radioactive materials and separated isotopes are now being supplied on a large scale from Harwell, for use in this country (on the advice of the Medical Research Council) and abroad for medical research and for the treatment of disease. They are also being used for agricultural and general biological research and in industry.

National Research Development Corporation

59. After scientific research has been undertaken, there is the further problem of ensuring that the resultant knowledge is applied to industrial needs as quickly as possible. Partly to help solve this problem, the National Research Development Corporation was set up by the Board of Trade under the Development of Inventions Act, 1948. The Corporation is an independent body being subject only to general direction by the Board of Trade and is given powers to borrow from Government funds up to £5,000,000 in the first five years of its life.

60. The function of the Corporation is primarily to develop and exploit, in the public interest, inventions resulting from research carried out by Government Departments or other public bodies, or from any other research for which financial assistance has been provided from public funds. The Corporation is, in general, required by the Act to entrust the exploitation of inventions to those engaged in the industry concerned. It does not as a rule finance the commercial production or marketing of an invention, but is concerned chiefly with its development to the stage at which it can be satisfactorily demonstrated to industry as a practicable project.

61. Government Departments and the Research Councils normally transfer to the Corporation patents resulting from research carried out in their establishments, with the exception of those in such categories as defence, atomic energy, gas turbines, and inventions which can best be exploited by a Department or Research Council in its own field.

Nature Conservation

62. In 1949, the Privy Council Committee for Agricultural Research was made responsible for nature conservation. In the same year, the Nature Conservancy was established under Royal Charter. The Conservancy has certain statutory powers and duties under the National Parks and Access to the Countryside Act which became law in December, 1949. The Lord President of the Council is the Minister responsible to Parliament.

63. The Conservancy's functions are threefold: to provide scientific advice on the conservation and control of the natural flora and fauna of Great Britain; to establish, maintain and manage nature reserves in Great Britain, including the maintenance of physical features of scientific interest; and to organise and develop the research and scientific services related thereto.

Science Centre

64. In November, 1950, the Lord President of the Council announced the Government's approval of a long-term plan for creating a Science Centre in London. The plan was conceived by the Royal Society and supported, among others, by the leading scientific societies now housed in the confined quarters of Burlington House, to which the Royal Society moved from Somerset House nearly 100 years ago. New premises will be opened at the Centre for the Department of Scientific and Industrial Research and other Government scientific organisations.

65. The Centre will be designed to improve facilities and contacts between scientists and users of science, both nationally and internationally. The traditional character and independence of the Royal Society, and its function as a focus of the scientific activity of the Commonwealth, will be maintained.

XI

CONCLUSION

66. It has been shown that Government, acknowledging its responsibility for the nation's social and economic progress, and for the health of the people, and recognising the great contribution that can be made by scientific research and development to these ends, has created, over the years, an organisation:—

- (i) for the encouragement of fundamental research in the universities;
- (ii) for the promotion of applied research and development in industry;
- (iii) for the promotion of research in agriculture and fisheries;
- (iv) for furthering medical research;
- (v) for ensuring that research necessary to the proper discharge of the executive responsibilities of Departments is carried out in departmental scientific establishments, and that these establishments undertake applied research which cannot appropriately be done elsewhere;

- (vi) for reviewing the adequacy of facilities for the training and supply of scientists and technologists ;
- (vii) for the dissemination of information resulting from research ;
- (viii) for maintaining scientific relations with Commonwealth Governments and with the Governments of foreign countries ;
- (ix) for promoting and carrying out scientific research as an aid to social and economic development in the countries of the Colonial Empire.

67. Ministerial responsibility for the formulation and execution of Government scientific policy is vested in the Lord President of the Council, advised by the Advisory Council on Scientific Policy, and by the Privy Council Committees for Scientific and Industrial Research, for Medical Research and for Agricultural Research and Nature Conservation.

68. The functions of the Advisory Council on Scientific Policy relate to the Lord President's general responsibility for Government scientific policy, as distinct from his special Ministerial responsibility for the work of the three Research Councils and the Nature Conservancy, which report to him through the Privy Council Committees. But as already observed, the Lord President's general responsibility for Government scientific policy does not derogate from the individual responsibility of Ministers for the scientific organisations and establishments in their own Departments.

69. The scientific responsibilities of Government Departments range from fundamental research to development work. In general, they are focussed on problems concerning the development and utilisation of resources, and the efficiency of public utility undertakings. There is a special responsibility for background and applied research for industries composed of small units but with an important public function, such as agriculture and building.

70. In Appendix I is a description of the Government organisation for civil science as it exists today. As has been shown in the preceding chapters, the pattern of this organisation has been shaped by the national needs and circumstances which have developed during the past 50 years. Like the machinery of Government of which it forms part, the scientific organisation is essentially flexible and it may be assumed that as new needs emerge from the changing circumstances of the future, so the Government scientific organisation will be adapted to meet them.

Office of the Lord President of the Council,
Great George Street, S.W.1.

6th July, 1951.

APPENDIX I

GOVERNMENT MACHINERY FOR CIVIL SCIENCE IN GREAT BRITAIN

1. This Appendix describes the Government organisation for scientific research and development in the civilian field. Detailed information about the extensive network of research stations, laboratories and other units which have been established by the Research Councils and by Government Departments will be found in the departmental publications that are included in the bibliography on page 37.

2. The principles underlying Government scientific organisation may be stated as follows:—

(i) The Lord President of the Council is responsible for the formulation and execution of Government scientific policy. He is advised by the Advisory Council on Scientific Policy on general questions which relate to the whole field of civil science, and by the Privy Council Committees for Scientific and Industrial Research, Medical Research, and Agricultural Research and Nature Conservation on questions which lie within the spheres of interest of these bodies.

(ii) The Lord President is the Minister responsible to Parliament for the Research Councils (and their establishments) which report to him through the Privy Council Committees, namely:—

The Advisory Council for Scientific and Industrial Research ;

The Medical Research Council ;

The Agricultural Research Council ;

The Nature Conservancy.

(iii) Other Ministers are responsible for the scientific establishments within their own Departments.

(iv) The advice of the Research Councils is at the disposal of the executive Departments and there is close liaison between them, but the Research Councils are not subject to departmental control. Their advice and their research programmes are, therefore, free from any influence resulting from departmental responsibilities.

3. For the purpose of this paper, the various parts of the Government organisation for science in the civilian field, apart from the Advisory Council on Scientific Policy, whose constitution and functions are fully described in the document to which the paper is an Appendix, will be grouped according to the following pattern:—

Agriculture, Fisheries, Food and related subjects

Ministry of Agriculture and Fisheries.

Department of Agriculture for Scotland.

Agricultural Research Council.

Scottish Home Department (including Fisheries Board).

Development Fund.

Ministry of Food.

Nature Conservancy.

Forestry Commission.

Industry

Department of Scientific and Industrial Research.
Admiralty.
Ministry of Supply.
Home Office.
Ministry of Fuel and Power.
Ministry of Transport.
Ministry of Civil Aviation.
Ministry of Local Government and Planning.
Ministry of Works.
Post Office.
Department of the Government Chemist.
Ministry of Labour and National Service.

Medicine and Health

Ministry of Health.
Department of Health for Scotland.
Medical Research Council.
General Register Office.

Education

Ministry of Education.
University Grants Committee.

AGRICULTURE

4. There are three principal authorities for agricultural research in Great Britain, namely:—

- (i) The Ministry of Agriculture and Fisheries.
- (ii) The Department of Agriculture for Scotland.
- (iii) The Agricultural Research Council.

5. The organisations established by these authorities touch at many points, and there are, in addition, various agencies which serve the Agricultural Departments in a research, advisory, development or executive capacity. These are the Agricultural Improvement Council for England and Wales, the National Agricultural Advisory Service and the County Agricultural Executive Committees; and, in Scotland, the Technical Committee of the Scottish Agricultural Advisory Council, the Advisory Services of the three Agricultural Colleges (Edinburgh, Glasgow and Aberdeen) and the Hill Farm Research Committee.

6. *The Ministry of Agriculture and Fisheries* conducts research directly in the Ministry's Veterinary Laboratory and Plant Pathology Laboratory.

7. *The Department of Agriculture for Scotland* maintains a plant pathology laboratory which includes research in entomology and helminthology.

8. The Minister of Agriculture and Fisheries is advised by a Chief Scientific and Agricultural Adviser and by the Agricultural Improvement Council for England and Wales. The Secretary of State for Scotland is advised by the Scottish Agricultural Advisory Council and the Hill Farm Research Committee. Both Ministers are also advised over the whole field of research (as indicated below) by the Agricultural Research Council.

9. *The Agricultural Research Council* is responsible to the Committee of Privy Council for Agricultural Research and Nature Conservation, of which the Lord President of the Council is Chairman, and the Minister of Agriculture and Fisheries is Vice-Chairman. The membership of the

Committee includes the Secretaries of State for the Home Department, Scotland, and the Colonies, and the Ministers of Education, and Local Government and Planning.

10. The Agricultural Research Council, established by Royal Charter, consists of fifteen members, of whom at least ten are appointed primarily for their scientific qualifications and the remainder for their practical knowledge of agriculture. Members are appointed by the Privy Council Committee after consultation with the Agricultural Research Council and, in the case of scientific members, with the President of the Royal Society.

11. The Council has the function of keeping under continuous review all research work, both fundamental and applied, likely in its opinion to contribute directly or ultimately to the improvement of agriculture and horticulture and to increased farming efficiency. The Council plans and co-ordinates the work over the entire field of agricultural research and is assisted in this task by three standing committees and a number of technical committees and conferences. The Council is responsible for promoting new research, and in order to ascertain the needs of agriculture it collaborates closely with the Agricultural Improvement Council for England and Wales, the Technical Committee of the Scottish Agricultural Advisory Council and the Hill Farm Research Committee. The Council advises these bodies when any research work reaches a stage at which the results are ready, in the Council's opinion, to be translated through the advisory services into agricultural practice.

12. The Council advises both the Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland on the programmes, estimates and scientific staffing of the Agricultural Research Institutes which function in nearly every case under their own governing bodies, but are almost wholly financed from State funds by means of annual block grants from the Agricultural Departments. These Institutes carry out a very large part of the agricultural research in Great Britain. There are fourteen Research Institutes in England and Wales, and six in Scotland, namely: Rothamsted Experimental Station; The Plant Breeding Institute, Cambridge; John Innes Horticultural Research Station; East-Malling Horticultural Research Station; Long Ashton Agricultural and Horticultural Research Station; Cheshunt Glasshouse and Experimental Research Station; the Welsh Plant Breeding Station; Research Institute in Plant Physiology, Imperial College; National Institute for Research in Dairying; Foot and Mouth Disease Research Station; Vegetable Research Station, Wellesbourne; Grassland Research Station, Hurley; National Institute of Agricultural Engineering (with a sub-station in Scotland); Poultry Genetics Station, Cambridge; Macaulay Institute for Soil Research, Aberdeen; Scottish Society for Research in Plant Breeding, Edinburgh; Animal Diseases Research Association, Edinburgh; Rowett Research Institute, Aberdeen; Hannah Dairy Research Institute, Ayr; Scottish Horticultural Research Institute.

13. Where research can best be pursued directly by the Council, or where it is desirable to supplement existing research, the Council establishes its own research institutes or units for the purpose. There are, at present, four of these institutes and nine units in England, Wales and Scotland, namely: Experimental Field Station, Compton, Berks; Animal Breeding and Genetics Research Organisation, Edinburgh; Institute of Animal Physiology, Cambridge; Poultry Research Centre, Edinburgh; Plant Virus Research Unit, Cambridge; Unit of Insect Physiology,

Cambridge ; Unit of Plant Biochemistry, Cambridge ; Unit of Animal Reproduction, Cambridge ; Unit of Experimental Agronomy, Oxford ; Unit of Biometrical Genetics, Birmingham ; Unit of Microbiology, Sheffield ; Unit of Soil Physics, Cambridge ; Potato Storage Investigation Team, Loughborough. In addition the Council uses some of its funds for financing special investigations by means of grants to one or other of the Agricultural Research institutes, to University Departments, to Advisory Centres, or to any other body concerned with agricultural research. The council also offers university research studentships, training grants and fellowships to assist in maintaining an adequate supply of trained research workers in the sciences relating to agriculture.

14. Agricultural improvement work in England and Wales is carried out by the Ministry of Agriculture and Fisheries through the National Agricultural Advisory Service, which acts on the general advice of the Agricultural Improvement Council. The Advisory Service is organised on an area basis. The staff in each area includes specialists in entomology, plant diseases, soil chemistry, animal nutrition, crops, grassland, livestock, milk production, farm machinery, poultry, glasshouse crops, fruit and vegetables. It is the function of these specialists to keep abreast with research in their subjects and to pass on the results of research to farmers and growers. The Advisory Service maintains close liaison with the County Agricultural Executive Committees in this work.

15. In Scotland, similar facilities for agricultural improvement work and advice to farmers are available through the agricultural colleges. The colleges are assisted in their work by statutory Agricultural Advisory Committees which are established broadly on a county basis. These Committees are distinct from the Agricultural Executive Committees which, in Scotland, have no responsibilities in the advisory or educational field.

16. An important part of the work of the National Agricultural Advisory Service is to test the findings of research workers under a wide variety of farming conditions, with the aim of assisting the speedy practical application of the results of research. The Ministry of Agriculture and Fisheries is establishing experimental husbandry farms and horticultural stations for fertiliser trials, experiments in soil fertility, grass seed mixture trials, and many other experimental purposes concerned with crops and stock.*

17. Until 1946, the Development Fund (administered by the Treasury on the recommendation of *the Development Commissioners*) was a source of grant aid for agricultural research. In that year, however, it was decided, in the light of changes in the structure of the agricultural research and advisory services and in the scale and character of agricultural education, that the cost of those services should be met by the Agricultural Departments and the Agricultural Research Council without appropriations from the Development Fund. The Development Commissioners were thus free to concentrate their attention on other matters affecting the economic and social life of the countryside, and on the promotion of fisheries.

18. Throughout its existence the Commission has paid attention to the development of those natural resources which could properly be assisted from the Fund. It has sponsored experiments with new crops, such as

* In Scotland, these facilities are available on farms attached to each of the Agricultural Colleges.

sugar beet, flax and tobacco, and has recently financed research bearing on the use of the constituents of seaweed, and the practicability of combining the burning of peat as a fuel in gas turbines with the reclamation for agriculture and forestry of peat bogs.

19. For the provision of technical advice and instruction and the undertaking of surveys and experiments with the aim of modernising, improving and creating rural industries, the Commissioners framed a scheme for establishing the Rural Industries Bureau for England and Wales and they recommend the funds needed to support a similar organisation in Scotland. In order to promote the well-being of the countryside and to improve opportunities for the employment and social life of country people, the Commissioners have encouraged economic and social investigations into such subjects as small industries in country towns, the economic prospects of certain rural occupations and the influence, both physical and social, of the country town on the surrounding area.

FISHERIES

20. The authorities and agencies principally concerned with fisheries research in Great Britain are the Ministry of Agriculture and Fisheries, the Scottish Home Department, the Development Commissioners and the independent, but grant-aided, marine laboratories. The cost of fisheries research is largely met by grants from the Development Fund, recommended to the Treasury by the Development Commissioners on the advice of their Scientific Advisory Committee.

21. The Fisheries Department of *the Ministry of Agriculture and Fisheries* maintains a laboratory for marine research, and research vessels for investigations in the Barents Sea, the North Sea, the Irish Sea, and coastal waters. In addition, a vessel for herring research is shared with the Scottish Home Department. The primary aim of this research is to acquire data for the formulation of a rational fishing programme, with the object of ensuring a constant supply of fish.

22. Fishery research is carried on in close co-operation with Scotland, and with European countries through the agency of the International Council for the Exploration of the Sea. The members of the International Council are France, Belgium, Holland, Denmark, Norway, Sweden, Iceland, Finland, Poland and the United Kingdom. The Council meets annually and its various scientific committees co-ordinate the research programmes put forward by the member countries.

23. Shellfish investigations, carried out at the Ministry's experimental stations, include experiments in oyster breeding and investigations into the restoration of derelict oyster beds. Investigations bearing on the salmon fisheries are carried out by a small inspectorial and scientific staff.

24. *The Scottish Home Department's* marine work, based on a programme which was drawn up in consultation with the Development Commission, has the same primary aim and general objects as that carried on by the Ministry of Agriculture and Fisheries, i.e. it is directed primarily towards assisting the commercial fishing industry in the rational exploitation of the sea fisheries, and towards providing the Department with the data upon which policy may be based. The programme comprises both fundamental research into the life histories of the species of fish of commercial importance in the North Sea and other waters off the Scottish Coast, and also applied or operational research designed to provide a running census of the stocks of fish in respect of abundance, distribution, size,

age, growth rate, and mortality. In addition, continuous observations are carried out on the effects of environment on fish, and attention is given to improved fishing methods and to measures for improving the quality of the fish on landing. For these purposes the Department maintains a laboratory at Aberdeen and four research ships. Marine research under the Department's control is carried out in close co-operation with the scientific staff of the Ministry of Agriculture and Fisheries. The Department is represented on the International Council for the Exploration of the Sea.

25. The Department also carries out research on salmon and fresh water fish. The main salmon scheme has for its object the reliable assessment of the productivity of salmon under natural spawning conditions and the comparison of the relative efficiency of natural spawning and artificial spawning in hatcheries.

26. The provision necessary for carrying out the Department's fisheries research is borne on the Fisheries, Scotland, Vote, but grants from the Development Fund are made towards particular items, including fresh-water fisheries research and the purchase of research vessels.

27. The Herring Industry Board has a statutory responsibility for carrying out research and experiments for the benefit of the herring industry. Grants from public funds are made to the Board for these purposes.

28. *The Development Commissioners*, with the agreement of the Fisheries Ministers and with the concurrence of the Treasury, have reconstituted their Advisory Committee on Fishery Research and extended its functions, so that all fishery research, and not merely that aided by the Development Fund, comes formally within the Committee's purview. The Development Commissioners are accordingly in a position to co-ordinate all fishery research.

29. On their advice, the entire organisation for fishery research has been materially strengthened, and the Development Fund bears a very large part of the cost of the fishery investigations of the Ministry of Agriculture and Fisheries, and a substantial proportion of the cost of developments of the research organisation in Scotland. A number of independent institutions receive grants for fishery research from the Development Fund, namely, the Marine Biological Association (Plymouth Laboratory), the University of Liverpool (Port Erin Biological Station), the Scottish Marine Biological Association, the Freshwater Biological Association and the Dove Marine Laboratory (Kings College, Newcastle). These institutions are not restricted to the study of fishery problems of immediate significance, but are free to investigate questions of general interest and importance. Their function is to extend, in co-operation with the universities, the general knowledge of conditions in the sea and fresh waters, which is essential for the understanding and elucidation of changes in the fish population. In addition, grants are made to the National Institute of Oceanography and to universities for specific investigations, and post-graduate training grants are awarded each year.

FOOD

30. *The Department of Scientific and Industrial Research* began its work on food research in 1917. The Food Investigation Organisation of D.S.I.R. now has six laboratories: the Low Temperature Research Station at Cambridge (associated with the University, and chiefly concerned with meat and vegetables) with a small associated laboratory at Smithfield

Market, the Torry Research Station, near Aberdeen (which studies the transport and storage of fish, and maintains a trawler for this purpose) with a subsidiary laboratory at Hull ; and the Ditton Laboratory situated in the fruit-growing district of Kent (its chief subject being fruit and vegetables) with a small associated laboratory at Covent Garden Market. The organisation has a two-fold purpose ; first, fundamental studies relating to the properties of foods ; secondly, examination of the possibilities of new and improved practical methods in the storage, processing and distribution of foods. Research undertaken in the laboratories contributes to scientific knowledge of such fundamental questions as the chemistry of fat rancidity, post-mortem changes in meat, and the biochemistry of plant food products. In the applied field, the organisation assists in the development of new methods for the storage and transport, refrigeration, canning, curing, and dehydration of various types of food including meat, fish and fresh fruit. The Food Investigation Organisation works in close touch with the Ministry of Food and the food industries' research associations.

31. *The Ministry of Food* is advised by its Chief Scientific Adviser on all questions relating to the composition and the nutritive value of food generally, and to the scientific problems involved in the procurement, processing and distribution of food. To this end, he is an *ex officio* member of all the committees which are concerned with the formulation and execution of the Ministry's policy. He is also Chairman of the Food Standards Committee, which is responsible for reviewing the composition of foods and includes in its membership representatives of the Health Departments, the Medical Research Council and the Government Chemist's Department ; and he represents the Ministry of Food on the Ministry of Health's Committee on Medical and Nutritional Problems.

32. The Chief Scientific Adviser identifies problems which call for scientific research, and maintains close liaison with the Research Councils and with the food industries' research associations. His Division collaborates with the Ministry's Statistics and Intelligence Division in extensive surveys undertaken to determine the adequacy of the diet in relation to the available supplies of food. For research on fundamental problems of human nutrition—and on special health problems within this field—the Ministry seeks the help and advice of the Medical Research Council. Other problems are investigated in the Ministry's experimental kitchens and laboratories in London and Grimsby. An experimental factory has recently been set up at Aberdeen to facilitate the development and application of the results of research to the commercial stage.

33. The Ministry has established, within the field of responsibility of the Chief Scientific Adviser, a number of co-ordinating committees on which other executive Departments, as well as the Research Councils are represented. The purpose of these committees is to investigate scientific problems relating to the production, handling and transport of various commodities and to promote the use of methods designed to improve the condition in which these commodities reach the consumer. The Ministry's Chief Scientific Adviser maintains a link with overseas food production through the advisory committees of the Colonial Office.

FORESTRY

34. *The Forestry Commission*, responsible for promoting forestry in Great Britain, undertakes experimental work on problems arising out of the establishment, maintenance and protection of plantations ; and

aids, by means of grants to universities and other institutions, research on fundamental problems such as those relating to forest soils, nutritional requirements of young trees, and mycorrhiza of forest trees.

35. The Commission's experimental station in Surrey, and officers out-stationed in forests and nurseries in various parts of the country, are engaged on work relating to silviculture, studies of growth and production, pathology, entomology, ecology and genetics. A section dealing with mechanical development as applied to forestry operations has been established at the Commission's headquarters in London, and an organisation is being set up to deal with the utilisation of forest products.

36. The Forestry Commissioners are advised over the whole field of their responsibilities in respect of research by an advisory committee on forestry research. The Commission collaborates with the Ministry of Agriculture and Fisheries in the management of the national pinetum in Kent.

NATURE CONSERVATION

37. *The Nature Conservancy* is responsible for providing scientific advice about the conservation and control of the natural flora and fauna of Great Britain. The Conservancy is closely interested in questions of soil conservation, the use of marginal land, the improvement of grassland and the effects of deforestation.

38. The Conservancy has provisionally scheduled some 150 places in Great Britain as national nature reserves. Of these there are between 70 and 80 areas of biological or physiographical importance in England and Wales, and about 30 in Scotland (for the selection of which the Scottish Committee of the Conservancy is responsible) and some 40 features of geological importance. A few of these properties are now being acquired by negotiation. The proposed national nature reserves have been selected for one or more of the following reasons:—

- (i) because they are good representative samples of the various types of natural or semi-natural vegetation existing in this country ;
- (ii) because they include the habitats of particular groups of plants or animals which should be conserved ;
- (iii) because they display biological, physiographical, or geological features of special value to science and education.

39. The Conservancy undertakes research directly by experimental and observational work in the field and in the laboratory, and is now selecting premises for one or two research stations. It also promotes research through grants to universities and other institutions and awards maintenance allowances for the post-graduate training of specially selected students at universities. Responsibility has been given to the Conservancy for notifying local planning authorities of all places of special scientific interest (other than nature reserves) in each authority's area.

INDUSTRY

40. *The Department of Scientific and Industrial Research* has as its principal function the promotion and organisation of scientific research, with a view especially to its application to trade and industry. The Minister responsible for the Department is the Lord President of the Council. He is advised by an Advisory Council for Scientific and Industrial Research, established by Order in Council, which includes in its

membership eminent scientists and leading industrialists (usually prominently associated with industrial research), two members closely connected with organised labour, and assessors appointed by Government Departments.

41. With the exception of medicine and agriculture, the D.S.I.R. includes in its scope all branches of natural science and their application to industrial processes. Its activities fall into three main groups:—

- (i) Scientific research in the national interest, and to meet the needs of Government Departments.
- (ii) The encouragement of research and the application of scientific knowledge in industry.
- (iii) The encouragement of fundamental research at universities and elsewhere, and the maintenance of an adequate supply of trained research workers for laboratories of all kinds.

42. The first of these three functions is discharged through the national research laboratories which are under the direct control of D.S.I.R. and are financed from its own Vote.

43. The principal means adopted by the Department to encourage industrial research is through the Research Associations which have been set up on a co-operative basis in many branches of industry, financed by the industries themselves, and assisted by grants from the Department.

44. The general provision from Government funds for research at the universities is the responsibility of the University Grants Committee, but D.S.I.R. makes grants to individual research workers in support of specific investigations. The Department provides grants to post-graduate students training as future research workers in the universities, and awards to senior students who are outstanding in various fields of research.

45. The research organisations established by D.S.I.R. are each under the immediate control of a director of research who is advised by a Board appointed by the Lord President, and composed of independent scientists and industrialists, with assessors representing Government Departments and, in some instances, Commonwealth Governments. The only exception to this arrangement is the National Physical Laboratory where the scientific work is supervised by an executive committee appointed by the Royal Society and accepted by the Lord President as a Committee of the Department.

46. The National Physical Laboratory is the largest of the Department's establishments. Its main divisions are concerned with aerodynamics, electricity, engineering, light, mathematics, metallurgy, meteorology, physics, radio and electronics. The Laboratory carries out the accurate measurements of quantities necessary for maintaining the national standards of mass and length, the various electrical standards, the temperature scale and the photo-metric scale. A large part of its work consists of research into methods of precise measurement, upon which apparatus for research and for the control of industrial processes must ultimately be based. The Laboratory also determines the value of fundamental physical constants to the accuracy required by science and industry, and investigates the properties of materials.

47. The following are the other principal establishments of D.S.I.R., together with a short description of their fields of research:—

The Building Research Station carries out research on the strength and stability of buildings, their thermal and sound insulation, architectural acoustics, lighting, fire resistance, etc., and on new and

traditional building materials and methods. These investigations are supplemented by full scale experiments on specially erected houses and flats, including comparative studies on heating, cooking and water systems. The Station's activities also extend into the field of civil engineering and include work on the stability of earth dams, river banks, retaining walls, excavations, and on the strength of bridges. In 1950 the Station took over responsibility for the research previously carried out by the Ministry of Works on the economic and sociological aspects of building, including the study of building costs and the factors affecting productivity. Particular attention is being given to the use of mechanical plant in building operations.

The Chemical Research Laboratory undertakes investigations for Government departments and carries out chemical research of general basic importance to industry where this is not adequately covered elsewhere. Its programme includes work on the conservation of essential materials, concentration of low grade material and waste products, the investigation of new methods and techniques, new processes and materials.

The Fire Research Organisation was established jointly by D.S.I.R. and the Fire Offices Committee (an association of fire insurance companies). The cost of the Organisation is shared equally by the two sides. Its aim is to study the scientific problems of fire fighting, fire prevention and the safety of life in fires. Its laboratories are equipped to provide data on the fire resistance of building materials and structural elements such as walls, floors, etc. Its activities also include the study of fires to determine the factors contributing most to the causes of outbreaks.

Food Investigation Organisation—see paragraph 30.

The Forest Products Research Laboratory carries out research on the structure and strength of wood, its seasoning and preservation, on the manufacture and properties of plywood, wood bending, etc. The aim of the work is the more effective and more economic use of timber, including the utilisation of lesser known Colonial species as a possible means of reducing the scarcity of timber.

The Fuel Research Station is a national centre for the study of fuel problems. Its work, in addition to basic research on the constitution of coal and the chemistry of fuel processes, is concerned with the more efficient use of coal for steam raising and domestic heating, and its conversion into gaseous and liquid fuel, oils and chemicals. In collaboration with local authorities and other bodies, the station studies atmospheric pollution.

The Geological Survey studies the geology of Great Britain, recording and publishing its results in the form of maps and explanatory memoirs. In addition to field work, palaeontological, mineralogical, petrological and chemical work (the last under the direction of the Government Chemist) is carried out in its laboratories both for ensuring the accuracy of the geology represented in the maps, and for extending knowledge in these sciences. Ordinary geological survey methods are supplemented by the use of geophysical methods and by a programme of boring. Special attention is being given by the Survey, in collaboration with the National Coal Board, to coalfield geology, and to the study of

underground water resources throughout the country. In connection with the latter, a special unit has been set up which maintains close contact with the Ministry of Health. The Survey also provides geological and mineralogical services for the Ministry of Supply in connection with the discovery and evaluation of raw materials for atomic energy plants. In this field, most of the investigations are concerned with the exploitation and development of uranium mines overseas. The Survey provides information and advice to industry on the supply of iron and other ores, and on minerals, and is usually consulted before any large scheme of civil engineering is undertaken.

The Hydraulics Research Organisation is concerned with civil engineering research relating to marine work, such as docks and harbours, rivers, canals and other waterways. The Organisation undertakes model experiments and basic research into the problems of coast erosion and accretion as affected by wave action and tidal currents; the effect of dredging on flow in estuaries and rivers; the design of dock and harbour entrances to prevent silting; the control of rivers, etc.

The Mechanical Engineering Research Organisation undertakes basic and general research on problems of importance to engineering development. The programme includes investigations on the properties and strength of materials; the mechanics of solids, stress analysis and vibration; the mechanics of fluids; lubrication and wear; mechanisms; noise control; the mechanics of formation and the machine shaping of materials; heat transfer and applied thermodynamics.

The Pest Infestation Laboratory carries out research on the infestation of stored foodstuffs, especially grain, by insects, mites, and fungi, and devises methods for its prevention and for the destruction and control of pests, including domestic insects. The work includes studies of the life history of insects and of the physiology of grain; research into the effect of fumigants, sprays, etc., on insects and stored products. Close contact is maintained with the Infestation Control Division of the Ministry of Agriculture and Fisheries, which is responsible for the inspection of imported foodstuffs and the application of measures for insect control.

The Radio Research Organisation undertakes research on the problems of radio communication. A major part of the programme deals with the propagation of radio waves of all frequencies through the upper and lower atmosphere. Other work includes the study of radio disturbances from thunder storms and lightning flashes, which are of common interest to the meteorological and radio scientists; the elimination of other types of "radio noise"; research on the properties of materials used in the manufacture of radio equipment; and problems arising from the development of radio navigational aids.

The Road Research Laboratory carries out research on the materials and methods of road construction, including their behaviour under traffic and weather conditions; the problems of road safety and traffic, including the effect of the layout of the roads and methods of regulating the movement of vehicles on traffic flow

and accidents ; and on the use of machinery in road construction, including its performance in relation to the properties of materials and economy in operation. The Laboratory's investigations are supplemented by trials on road surfaces laid on public highways with the co-operation of the Ministry of Transport and local authorities. Research on the effect of brakes and steering in relation to road safety are undertaken in consultation with the Motor Industry Research Association. The broad objective of the Station's activities is to enable all kinds of traffic to move expeditiously and with greater safety, and to reduce the cost of road construction and maintenance. The Station is assisted with statistical investigations, which are vital to a great part of its work, by the Ministry of Transport, the police and local authorities.

The Water Pollution Research Laboratory carries out research on the development and improvement of methods for the treatment of water, sewage and industrial wastes, and investigates the effect of the discharge of polluting substances into rivers, estuaries, etc., and ways in which these effects can be reduced.

48. The close contacts maintained between D.S.I.R. and other Government Departments, Research Associations and other bodies help to ensure that the scientific resources of the Department are applied to the solution of problems which are of most importance to the national economy and are used to make the maximum contribution to improving industrial efficiency.

49. *Admiralty* research and development is almost exclusively directed to meeting the requirements of the Royal Navy, but a substantial amount of this work has important civil applications. There are, moreover, certain research activities wholly or preponderantly devoted to civil ends, but under Admiralty administration. Examples are the Royal Greenwich Observatory (now in process of being transferred to Hurstmonceaux Castle, Sussex, where the projected 100 inch Isaac Newton Telescope will be housed) ; the Observatory at the Cape of Good Hope ; and the National Institute of Oceanography.

50. In the field of marine engineering, much of the development conducted by the Admiralty serves, not only the Royal Navy, but the national need as a whole. The Admiralty, for example, takes a leading part in the development of high pressure boilers and advanced types of engine (steam, diesel and gas turbine) for marine propulsion ; and it actively promotes developments designed to improve the performance and ease the manufacture of large reduction gearing.

51. Charts and other publications issued by the Hydrographic Department of the Admiralty meet a world-wide civil need. Compass development and calibration for merchant ships is undertaken at the Admiralty Compass Observatory. The Admiralty sponsors the development and manufacture of optical glass and the development of synthetic crystals for both Service and civil use.

52. Under the aegis of the Admiralty Ship Welding Committee, whose Chairman is also the Chairman of the Shipbuilding Conference, and whose membership comprises experts from the Classification Societies, various Research Institutes or Associations and the Universities, a comprehensive study has been undertaken of the detailed structural engineering characteristics of rivetted and welded cargo ships, including a thorough study

of the theoretical and practical problems of fabricating welded merchantmen. The arrangement mentioned in paragraph 66, whereby the Admiralty conducts research work on radio aids to marine navigation on behalf of the Ministry of Transport, provides a channel through which valuable radio techniques developed for defence purposes can, if appropriate, be made available for civil application. There are many other by-products of Admiralty research and development which are of value in civil life as, for example, in the development of radio valves, and in the evaluation of improved diving techniques, particularly for great depths.

53. It is the normal practice to publish in the organs of the learned societies and professional institutions and in trade papers all results of value which can be disclosed. Knowledge is also disseminated through the Admiralty's normal contacts with the organisations of industry engaged in research, development and production.

54. The Admiralty has not set up a formal scientific advisory body, but it has established panels of expert advisers in all fields. These advisers, all of high professional standing, from the universities and industry, act continuously as advisers to the Admiralty's departments and experimental establishments and thus ensure, not only that the best external advice is directly applied to Admiralty research and development, but also that its potential application to other fields is constantly under review.

55. *The Ministry of Supply* carries out research and development needed to meet the technical requirements of the Army, Royal Air Force, and Fleet Air Arm. It is also responsible for research and development in three major civilian fields, namely, Atomic Energy, Industrial Gas turbines and civil aviation. The Ministry's programme is carried out partly in its own laboratories and testing establishments, and partly by industry. Some of the fundamental research is carried out in the research associations, in the universities, and in the laboratories of other Government Departments, notably D.S.I.R.

56. The Ministry's work for the Armed Forces is of very wide scope, covering the development of all types of weapons and munitions, aircraft, vehicles, communications, equipment, etc., and much of this work has a substantial value in the civilian field. For example, work on aircraft, air navigation, radar and tele-communications carried out initially for military purposes often has direct civil application. Much of the military work that does not have so clear a connection with civilian requirements is nevertheless of value outside the military field because the scientific and technological advances that are made in solving the military problems are of general application. Examples in this class are work on measures for the protection of military equipment against deterioration in extreme climatic conditions, and the development of materials and designs to secure the maximum reliability of equipment in conditions of severe usage. The need for mass production of complicated military equipment also has its influence on manufacturing methods applicable to production for civilian purposes.

57. The Ministry of Supply plays a leading part in fostering, at both national and international levels, standardisation of engineering practice relating to the production of warlike stores. The benefits of standardisation, essential for the production of armaments, apply in many cases to production for civilian purposes, and since the need for standardisation is

usually more compelling for military than for civilian purposes, the contribution made to standardisation by the Ministry of Supply tends to be large in proportion to the amount of production for which it is responsible.

58. The Minister of Supply is advised on scientific matters by the Advisory Council on Scientific Research and Technical Development, the Aeronautical Research Council and the Inter-service Metallurgical Research Council (which advises the Admiralty and Ministry of Supply jointly). These Councils and their associated committees comprise eminent men of science from the universities, industry and other Government Departments and not only ensure that the Department has the benefit of the best scientific advice available, but also keeps scientists outside the Department aware of the Ministry's work. This provides yet another channel of exchange, at the highest academic level, between the fields of military and civilian science.

59. *The Home Office* has a Chief Scientific Adviser, who is responsible generally for giving scientific advice to the Department, for formulating problems requiring investigation and for arranging for research to be undertaken on behalf of the Department by the appropriate Research Council or by the Ministry of Supply. The Home Office is also responsible for the supervision of six Forensic Science Laboratories, half the cost of which is borne by the Exchequer and half by local authority funds. The function of the laboratories is to assist the Police in the detection of crime.

FUEL AND POWER

60. The responsibility of the *Minister of Fuel and Power* for the development of supplies of fuel and power has, to a great extent, been delegated to the nationalised industries, but the Minister remains directly responsible for the co-ordinated development of all sources of fuel and power and for promoting their economical and efficient use.

61. In those scientific matters which affect policy, the Minister is advised by a Chief Scientist; and by a Scientific Advisory Council including among its members the Chief Scientist, the Chairman of the Fuel Research Board of D.S.I.R., representatives of the three nationalised fuel and power industries, and independent experts.

62. The scientific work of the Ministry falls into three main sections, namely:—

- (i) the co-ordinated development of sources of fuel and power;
- (ii) safety in mines research;
- (iii) the promotion of new and improved means of using fuel efficiently.

63. The nationalised fuel industries are responsible for research in their own fields, their programmes being arranged in consultation with the Minister. This procedure helps to co-ordinate their own scientific work with that undertaken by Government establishments and by industrial research associations. The Ministry of Fuel and Power plays a direct part in research and development on coal-consuming gas turbines, underground gasification and total gasification.

64. The Minister is directly responsible for promoting research into the safety and health of persons employed in coal mines. This research comprises investigations into safety problems connected with coal dust and fire damp explosions, the use of electricity underground, mining explosives and shot firing, rescue apparatus, fire hazard and metallurgical defects in mining apparatus and equipment. Work on dust suppression and the

qualitative and mineralogical examination of airborne dusts is carried out in collaboration with the Medical Research Council and other scientific bodies. Research into the problem of pneumoconiosis is carried out by the Medical Research Council by arrangement with the Ministry.

65. There is full collaboration between the Chief Scientist and the Scientific Departments of the National Coal Board, the British Electricity Authority and the Gas Council. The Chief Scientist also keeps in close touch with D.S.I.R. and certain of its research stations, and takes part in the deliberations of the Advisory Council, certain of the Research Boards and the Councils of some of the Research Associations.

TRANSPORT

66. *The Ministry of Transport* is concerned with two main fields of scientific research, (a) radio aids to marine navigation, and (b) road research. Research and development work on radio aids to marine navigation is conducted by the Admiralty Signal and Radar Establishment and the cost, so far as it concerns the Merchant Navy, is borne by the Ministry of Transport. An interdepartmental advisory committee advises the Ministry about policy on this subject and about the projects which call for research. The Ministry maintains a close liaison with the D.S.I.R. ; and undertakes operational research work on the effectiveness of radio aids in promoting the efficiency of British shipping.

67. The Ministry also collaborates with D.S.I.R. on road research, especially on such matters as soil stabilisation, construction of soil bases, road surfacing materials, road foundations and systems of construction ; and it is in close touch with the research work of industry in these fields. The Ministry carries out practical experiments in connection with road safety. It is represented on all committees of the Road Research Board.

AVIATION

68. *The Ministry of Civil Aviation* relies on the Ministry of Supply for all basic research concerning aircraft, telecommunications (including navigation) and other technical matters. There remains a relatively small but important field of research which lies between laboratory investigation on the one hand and the full operational use of aircraft and ground technical services on the other. For such research, the Ministry of Civil Aviation maintains two small scientific branches. One deals with requirements for civil aircraft and with questions of design, performance and employment which are, or may become, matters for research and development. The other branch carries out research into matters relating to operational technique, e.g. the design and use of aerodromes, air traffic systems and control. Close liaison is maintained with the Ministry of Supply, the Air Ministry and the air operating concerns engaged on analogous work and, as need arises, special investigations are carried out by such establishments as the National Physical Laboratory and the Royal Aircraft Establishment.

LAND USE AND PLANNING

69. *The Ministry of Local Government and Planning* is responsible for the formulation and execution of policy in England and Wales relating to the use and development of land. A Technical Services Directorate of the Ministry deals with technical planning, geographical, geological, economic and sociological matters. Similar arrangements have been made by the *Department of Health for Scotland*, which is responsible for the formulation and execution of policy relating to the use and development of land

in Scotland. Investigations are undertaken by the Ministry into the mineral resources of England and Wales, and kindred subjects as they relate to physical planning. Collaboration is maintained with other Departments, e.g. D.S.I.R., the Geological Survey and the Ordnance Survey, on matters with their specialist fields.

70. The Ministry is also responsible for the central control of water supplies, including direction and co-ordination of planning and for policy in respect of sewerage, sewage disposal and prevention of pollution. The Ministry does not undertake scientific research on these subjects directly, but it collaborates with D.S.I.R., particularly with the Water Pollution Research Laboratory and the Geological Survey, on scientific questions such as the effects of radio-active effluents on water supplies and sewage disposal works and methods of detecting the extent of contamination by radio-active substances, methods of treatment of sewage and purification of water supplies. Technical investigations which are proceeding, in collaboration with the Department of Health for Scotland, include an inland water survey. Detailed surveys of water resources and requirements in areas with common problems have been made by the Ministry's Engineering Inspectors.

BUILDING

71. *The Ministry of Works* is responsible for reviewing the whole field of building research and the technical development of the building industry ; for identifying problems requiring further research ; for determining the relative priorities attaching to these problems ; and for securing the use by industry of the results of research and technical development.

72. The Minister of Works is advised by an Advisory Council on Building Research and Development consisting of scientists, of representatives of both sides of the industry and the associated professions, and of assessors from Government Departments. The Council has established two committees ; the first to review the whole field of research and development, and the other to advise on methods for securing the use by industry of the results of research and development. The Ministry is closely associated in all its scientific work with D.S.I.R., and, in particular, with the Building Research Station, and maintains contact with research bodies in the building industry.

RADIO AND TELECOMMUNICATIONS

73. *The Post Office* undertakes scientific research on a wide range of subjects relating to telephone, telegraph and radio systems. Most of the Department's research is carried out by the Research Branch of the Engineering Department, and although the Branch is chiefly concerned with apparatus and systems, such as those for the long-distance transmission of speech, some effort is devoted to fundamental work such as electro-acoustic research, and to investigations on materials of particular application in telecommunication equipment. Similar work in industry is co-ordinated through various committees on which the Engineering Department and the telephone manufacturing companies are represented.

74. In addition to the work in its research laboratories, the Post Office undertakes the experimental development of radio transmitters and receivers for Post Office services, for other Departments, and for the distribution of broadcasting and television programmes. The Post Office collaborates with D.S.I.R. in its research on basic problems of radio communication which are of common interest to a number of Government Departments, and is represented on the Radio Research Board.

ANALYTICAL CHEMISTRY

75. *The Department of the Government Chemist* is responsible for providing analytical services to all Government Departments as may require them. A large part of the Department's work is concerned with analyses required for the assessment of revenue on certain dutiable goods and with the maintenance of standards for foods, drugs and agricultural products. The Department has a statutory function as official analyst or referee in case of disputed analyses under Acts of Parliament such as the Food and Drugs Act, the Fertilisers and Feeding Stuffs Act and the National Health Service Act. Research is undertaken by the Department in three main fields :—

- (a) the development and improvement of methods of analysis ;
- (b) special investigations for other Departments, such as the nutritional and physiological surveys conducted by the Ministries of Food and Health ;
- (c) fundamental research related to the general work of the Department, such as research in infra-red spectrography, chromatography, and the X-ray study of crystals.

INDUSTRIAL HEALTH AND MAN-POWER

76. *The Factory Department of the Ministry of Labour and National Service* is not a research department, but in the course of its administrative duties, it carries out field investigations of a technical or scientific character which sometimes lead to the identification of problems which call for research. The Department maintains a close liaison with the Department of Scientific and Industrial Research, the Medical Research Council, the Government Chemist's Department, and with other organisations such as the Safety in Mines Research Establishment. The Department's Industrial Health Advisory Committee advises the Minister of Labour on technical and scientific matters arising from the work of the Factory and Welfare Department of the Ministry and it maintains standing advisory panels of experts on dermatological, ophthalmological, radiological and other problems.

77. *The Ministry's Technical and Scientific Register* is intimately concerned with scientific man-power. It has a staff of qualified scientists and it functions, in this field, as a State employment agency. From time to time, with the assistance of committees drawn from the professions concerned, it conducts enquiries into the future supply and demand position of the various categories of scientists and technologists.

MEDICINE AND HEALTH

78. *The Ministry of Health* has a responsibility under the National Health Service Act for conducting and promoting research into the cause, prevention or treatment of illness. It confines its research activities to such investigations as can best be promoted within the framework of the health services and in particular by Hospital Boards and Committees. It is concerned especially with the practical application of knowledge in the sphere of public health and the medical services. The Medical Research Council is responsible for the wider, and long-term, problems of medical research, and the Council is, therefore, consulted by the Ministry before the latter undertakes or assists investigations in this field. A Public Health Laboratory Service, to investigate problems of infectious disease and outbreaks of bacterial food poisoning in England and Wales, is directed for the Ministry by the Medical Research Council.

79. *The Department of Health for Scotland* has similar responsibilities under the National Health Service (Scotland) Act to those of the Ministry of Health in England and Wales. The Department is advised by the Advisory Committee on Medical Research in Scotland, and it co-operates closely with the Medical Research Council, which nominates two members of the Advisory Committee. The Department's responsibility for pathological and bacteriological investigations are entrusted to the Regional Hospital Boards, which provide an integrated laboratory service for this purpose. A Joint Committee on Laboratory Services, comprising representatives of the Regional Hospital Boards and of the University Medical Schools, advises and assists the Boards in the operation of this service.

80. *The Medical Research Council* is responsible to the Committee of Privy Council for Medical Research, of which the Lord President of the Council is Chairman, the Minister of Health is Vice-Chairman, and the Secretaries of State for the Home Department, Scotland, Commonwealth Relations, and the Colonies are members.

81. The Medical Research Council, incorporated by Royal Charter, consists of twelve members. Nine of these members are appointed for their scientific qualifications; and of the other three, one must be a Member of the House of Lords and one a Member of the House of Commons. The members are appointed by the Privy Council Committee; the scientific members are appointed after consultation with the Medical Research Council and the President of the Royal Society.

82. The main function of the Medical Research Council is to undertake or promote scientific investigations for the acquisition of new knowledge likely to be of value for the better diagnosis, prevention and treatment of disease, and for the maintenance of normal health and full human efficiency. In addition, the Council undertakes specific investigations for Government Departments, and advises Departments on questions involving the use of the latest knowledge in medical science.

83. The programme of research work maintained or assisted by the Council covers the whole field of curative and preventive medicine. The Council undertakes research in its own laboratories and research units and attaches members of its scientific staff to universities and hospitals. It also promotes research in these institutions by making temporary grants to individuals for specific purposes, and it awards fellowships and studentships to suitably qualified graduates for training in research methods in medical science.

84. The Council's principal research establishment is the National Institute for Medical Research, where work is undertaken in biochemistry, chemotherapy, physiology, pharmacology, experimental biology, bacteriology (including virus diseases), bacterial chemistry, immunology and biophysics. In addition, the Council maintains, as part of its staff organisation, more than forty research units, departments or groups attached to university or hospital institutions; some of these are concerned with clinical research, and others with laboratory studies. Among the subjects covered are clinical medicine, neurology, ophthalmology, otology, blood transfusion and blood grouping, tuberculosis, the radiotherapy of cancer, and various aspects of nutrition, as well as subjects in the basic fields of physiology, biochemistry, biophysics, cytology and microbiology. A substantial part of the Council's programme is concerned with problems of environmental and occupational health and well-being; subjects dealt with by special research units in this field include industrial medicine, toxicology, pneumoconiosis, environmental physiology, climate and working

efficiency, applied psychology, occupational psychiatry, medical statistics and social medicine. The Council also undertakes much work in the field of personnel research for the three fighting services. Research in the bacteriology and epidemiology of infectious diseases forms an important function of the Public Health Laboratory Service, which is directed by the Council for the Ministry of Health, as mentioned in paragraph 78.

85. The Council has full liberty to pursue an independent long-range policy towards the advancement of knowledge for the relief of human suffering. It is unrestricted by departmental considerations, but its official position, together with the organisation which it has created and the scientific contacts which it has established, enables it to give immediate effect to requests for special assistance to Government Departments. In promoting research on tropical diseases and other health problems of the Colonies the Council works in co-operation with the Colonial Office.

86. Research is carried out by the *General Register Office* for England and Wales in five main fields: (a) Analysis and interpretation of statistics of causes of death; (b) a statistical enquiry into the treatment of cancer and its results; (c) a Survey of Sickness in the Population; (d) Morbidity as revealed in Hospital Statistics; and (e) Mental Health.

87. The main purpose of the cancer enquiry is to obtain fuller information about the effectiveness of various forms of treatment as measured by recovery and survival rates. Information about every new case is derived from individual hospitals, from centres acting for groups of hospitals, or from area organisations responsible for all registrations within their areas. The resulting analysis and interpretation is published from time to time and generally made available to those concerned with scientific research in the field of cancer.

88. The object of the survey of sickness in the population is to assess the quantity of minor ill-health which does not receive medical attention, as well as ailments sufficiently severe to require it. In this work, the General Register Office collaborates with the Social Survey Unit of the Central Office of Information, the latter collecting the information for the General Register Office which analyses and interprets the material and publishes the result.

89. In order to obtain, on a national scale, much needed information about more serious illness in the community, a start was made in 1949 towards deriving statistics of the nation's health from records kept in hospitals. This work continues and the results are published from time to time.

90. The General Register Office, by arrangement with the Ministry of Health and the Board of Control, receives information about patients in all mental hospitals and mental deficiency institutions. In addition to administrative and medical particulars, the returns include some demographic and genetic information. The enquiry is designed to fill gaps in present information and to provide data needed for research into various aspects of mental health.

EDUCATION

91. *The Ministry of Education* is actively concerned in the spread of scientific knowledge through the work (including research) of the Technical and National Colleges, and is responsible for the Science Museum and Library.

92. The Universities carry the main responsibility for the pursuit of fundamental research in pure science, and for the education of research workers. Some Universities also provide for education and research in various fields of applied science, including engineering and other branches of technology, agriculture and veterinary science. The Universities receive for these and other purposes grants from the Exchequer through the University Grants Committee.

93. The University Grants Committee is appointed by the Chancellor of the Exchequer after consultation with the Minister of Education and the Secretary of State for Scotland. The following are the Committee's terms of reference :—

“To enquire into the financial needs of University education in Great Britain ; to advise the Government as to the application of any grants made by Parliament towards meeting them ; to collect, examine and make available information on matters relating to University education at home and abroad ; and to assist, in consultation with the Universities and other bodies concerned, the preparation and execution of such plans for the development of the Universities as may from time to time be required in order to ensure that they are fully adequate to the national needs.”

BIBLIOGRAPHY

- The Annual Reports of the Advisory Council on Scientific Policy.* (1947-48.) Cmd. 7465 (London, H.M.S.O.).
 (1948-49.) Cmd. 7755 (London, H.M.S.O.).
 (1949-50.) Cmd. 7992 (London, H.M.S.O.).
- Agricultural Research in Great Britain.* Cmd. 6421 (London, H.M.S.O.), 1943.
- D.S.I.R. A Description of the Work of the Department of Scientific and Industrial Research.* (London, D.S.I.R.), 1949.
- The Annual Reports of D.S.I.R.* (1948-49.) Cmd. 8045 (London, H.M.S.O.), 1950.
 (1949-50.) Cmd. 8169 (London, H.M.S.O.), 1951.
- Medical Research Council. Report for the Years 1945-48.* Cmd. 7846 (London, H.M.S.O.), 1949.
- Ministry of Health. Report for the year ended 31st March, 1949.* Cmd. 7910 (London, H.M.S.O.), 1950.
- Expenditure on Research and Development—Third Report from the Select Committee on Estimates (Session 1946-47).* (London, H.M.S.O.), 1947.
- The Post Office—Fourth Report from the Select Committee on Estimates (Session 1950).* (London, H.M.S.O.), 1950.
- The Nature Conservancy. A Description of the Work of the Conservancy.* (London, The Nature Conservancy), 1950.
- Scientific Man-power. Report of a Committee appointed by the Lord President of the Council.* Cmd. 6824 (London, H.M.S.O.), 1946.
- The Scientific Civil Service. Re-organisation and Recruitment during the Reconstruction Period.* Cmd. 6679 (London, H.M.S.O.), 1945.
- Thirtieth Annual Report of the Forestry Commissioners for the year ending 30th September, 1949.* (London, H.M.S.O.)
- The Government Chemist's Annual Report for the year 1949-50.* (London, H.M.S.O.), 1950.
- The Annual Reviews and other publications of the Registrars General.* (London and Edinburgh, H.M.S.O.)

APPENDIX II

GOVERNMENT EXPENDITURE ON SCIENTIFIC RESEARCH IN THE CIVILIAN FIELD 1900-1950

This statement does not take account of expenditure by the Ministry of Supply and the Admiralty (other than that shown) on scientific research which is preponderantly in the field of defence but which has a significant application to the needs of civil industry.

	1900	1910	1920	1930	1939	1950-51 (Estimated)	NOTES
	£	£	£	£	£	£	
38 (A) <i>Agriculture, Fisheries, Food and related Subjects.</i>							
Ministry of Agriculture and Fisheries	1,200	5,400	150,600	481,000	463,000	1,512,650	
Department of Agriculture for Scotland	—	—	4,000	65,000	78,000	609,698	
Scottish Home Department (Fisheries)	2,770	1,000	2,000	5,000	7,800	103,430	
Agricultural Research Council Development Fund	—	91,050	173,392	330,891	66,190 610,000	1,210,000 484,633	
Ministry of Food	—	—	—	—	—	11,000	
Nature Conservancy	—	—	—	—	—	172,000	
Forestry Commission	—	—	4,700	10,800	14,600	147,000	
TOTAL (A) ...	3,970	97,450	334,692	892,691	1,239,590	4,250,411	

Development Fund: In addition, the Development Fund contributed, in the 1950/51 Estimates, £50,000 to the National Institute of Oceanography, included in the total for the Admiralty.

	1900	1910	1920	1930	1939	1950-51 (Estimated)
(B)	£	£	£	£	£	£
<i>Industry</i>						
Admiralty	15,800	18,000	25,000	32,000	32,000	261,000
Board of Education	18,650	43,500	150	—	—	—
Air Ministry	—	16,750	106,000	135,000	357,000	243,000
Ministry of Civil Aviation	—	—	—	—	—	24,000
Home Office	—	20	3,500	—	—	—
Department of Scientific and Industrial Research	—	—	463,226	651,365	964,262	4,977,384
Ministry of Fuel and Power	—	—	—	6,000	18,000	676,200
Ministry of Transport	—	—	—	14,600	71,000	159,110
Ministry of Works	—	—	150,620	138,790	109,790	650,580
Post Office	1,000	3,000	15,000	70,000	131,000	575,000
Government Chemist	1,000	1,200	14,000	20,000	30,000	43,500
TOTAL (B) ...	36,450	82,470	777,496	1,067,755	1,713,052	7,378,360

Admiralty: These figures relate only to observatories and the National Institute of Oceanography.

Board of Education: The amount shown in 1910 was composed of three grants:—£21,200 to the Geological Survey; £2,300 to Solar Physics Research; £20,000 to the Imperial College of Science and Technology. The sum of £150 in 1920 was the amount of a grant to the Chelsea Physic Garden (for botanical research).

Air Ministry: The amount shown against the Air Ministry in 1910 was carried on a separate Meteorological Office Vote. The figures in respect of 1920-1939 represent the total amounts spent on meteorological services; the figures relating to meteorological and other research in these years cannot be separated.

Home Office: The expenditure in 1910-1920 was for research into safety in mines, a responsibility which passed to the Mines Department and thence to the Ministry of Fuel and Power.

Department of Scientific and Industrial Research: In this table the expenditure by the Department of Scientific and Industrial Research on food research is included in the figures in Section (B). It is shown separately in Part III of the Appendix.

Post Office: This does not include the expenditure on experimental development.

	1900	1910	1920	1930	1939	1950-51 (Estimated)	Notes
	£	£	£	£	£	£	
(C) <i>Medicine and Health:</i> Ministry of Health (Local Government Board)	1,900	3,900	1,200	2,000	1,800	31,000	<i>Ministry of Health:</i> The expenditure in 1910 included £2,000 for laboratory expenses of the Medical Department and £1,900 for scientific investigations on causes of diseases. The Ministry's laboratory became part of the Public Health Laboratory Service in 1940.
Department of Health for Scotland	—	—	—	—	—	20,000	
Medical Research Council ...	—	—	125,000	148,000	265,000	1,775,524	<i>Medical Research Council:</i> The figures given do not include the cost of the Public Health Laboratory Service, which is borne on the Ministry of Health vote.
General Register Office ...	1,000	1,500	2,500	2,500	2,500	35,000	
TOTAL (C) ...	2,900	5,400	128,700	152,500	269,300	1,861,524	
(D) <i>Overseas</i>							
Colonial Office ...	—	—	15,800	812,000	750,000	2,200,000	<i>Commonwealth Relations Office:</i> The expenditure in 1930 was in respect of grants from the Empire Marketing Fund and administered by Government Departments for research purposes.
Commonwealth Relations Office (Dominions Office)	—	—	—	247,000	—	61,265	
TOTAL (D) ...	—	—	15,800	1,059,000	750,000	2,261,265	

	1900	1910	1920	1930	1939	1950-51 (Estimated)
(E)	£	£	£	£	£	£
<i>Grants to Learned Societies</i>						
Royal Society	16,000	20,500	15,000	10,000	12,000	52,000
Royal Geographical Society ...	500	500	1,250	1,250	1,250	2,000
Royal Society of Edinburgh ...	300	600	600	600	600	2,000
Royal Scottish Geographical Society	200	200	200	200	200	200
TOTAL (E) ...	17,000	21,800	17,050	12,050	14,050	56,200
(F)						
<i>Grants for other Scientific Purposes</i>						
Edinburgh Observatory ...	1,540	1,518	2,566	7,269	3,194	9,659
North Sea Fisheries	—	9,490	1,250	1,150	1,000	2,100
Scott Polar Research Unit ...	—	—	—	—	—	4,000
Solar Physics Observatory ...	—	700	3,000	3,000	3,000	3,000
1910 Antarctic Expedition ...	—	20,000	—	—	—	—
Imperial Mineral Resources Bureau	—	—	10,700	—	—	—
TOTAL (F) ...	1,540	31,708	17,516	11,419	7,194	18,759
Total Government Expenditure on Scientific Research in the civil field, excluding grants to Universities through the University Grants Committee	61,860	238,828	1,291,254	3,195,415	3,993,186	16,057,933

APPENDIX III

ESTIMATED GOVERNMENT EXPENDITURE ON SCIENTIFIC RESEARCH IN THE CIVILIAN FIELD 1950-1951

This statement does not take account of expenditure by the Ministry of Supply and the Admiralty (other than that shown) on scientific research which is preponderantly in the field of defence but which has a significant application to the needs of civil industry.

(A) AGRICULTURE, FISHERIES, FOOD AND RELATED SUBJECTS	£	£
<i>Ministry of Agriculture and Fisheries*</i>		
Grants and grants-in-aid of colleges, institutions, etc., engaged on agricultural research	1,450,000	
Ministry's Veterinary Laboratory	85,000	
Ministry's Plant Pathology Laboratory	1,000	
Fisheries Research	97,900	
Shell fish research and development	25,100	
Salaries and travelling expenses, etc.	55,800	
Less estimated receipts	202,150	
	1,512,650	1,512,650
<i>Department of Agriculture for Scotland*</i>		
Agricultural research; Seed Testing Station; peat investigations		609,698
<i>Scottish Home Department*</i>		
Fishery research and development		103,430
<i>Agricultural Research Council</i>		
Research Organisations and Units (Institute of Animal Physiology; Unit of Insect Physiology; Unit of Plant Biochemistry; Poultry Research Centre; Plant Virus Research Unit; Unit of Animal Reproduction; Animal Breeding and Genetics Unit; Potato Storage Investigation) ...	914,050	
Grants-in-aid of special research schemes (e.g. animal and poultry diseases; animal and poultry nutrition and breeding; ecological studies; plant nutrition; physiology and breeding; soil pro- blems; insecticides, fungicides and herbicides)...	180,000	
Interdepartmental Insecticide Standing Conference; and Research and Development Co-ordinating Committee	21,800	
Award of Scholarships and studentships and grants for visits of scientists abroad	43,450	
Administrative expenses	50,700	
	1,210,000	1,210,000

* These figures do not include grants from the Agricultural Research Council or appropriations-in-aid from the Development Fund.

	£	£
<i>Development Fund</i>		
Peat investigations (by Department of Agriculture for Scotland, North of Scotland Hydro-Electric Board and Ministry of Fuel and Power) ...	73,000	
West Highland Survey (Department of Agriculture for Scotland)	500	
Fisheries research (by Ministry of Agriculture and Fisheries and Scottish Home Department) ...	236,815	
Fisheries research at independent research institutions	140,318	
National Institute of Oceanography (for the present this grant (£50,000) is made to the Admiralty for the purposes of the National Institute and is included under (B) below)		
Scottish Seaweed Research Association	34,000	
	<hr/>	484,633
<i>Ministry of Food</i>		
Research in the technology of food storage and treatment; and in the nutritional value of food		11,000
		<hr/>
<i>Department of Scientific and Industrial Research</i>		
Food Investigation Organisation		174,414
Nature Conservancy		172,000
<i>Forestry Commission</i>		
Direct research and experiment	85,000	
Grants to colleges and institutions engaged on forestry research (e.g. Rothamsted—for nutrition and biology, £2,500; Macaulay Institute, £1,500; Aberdeen University, £1,000)	9,000	
Salaries	53,000	
	<hr/>	147,000
		<hr/>
TOTAL (A)		£4,424,825
<hr/>		
(B) INDUSTRY		
<i>Admiralty</i>		
	£	£
Royal Observatory, Greenwich	127,000	
Observatory at Cape of Good Hope	24,000	
National Institute of Oceanography	50,000	
(In addition, the Development Fund contributes £50,000 and the Colonial Office £10,000 to the National Institute of Oceanography))	60,000	
	<hr/>	261,000
		<hr/>
<i>Air Ministry*</i>		
Meteorological research		186,000
		<hr/>
<i>Ministry of Civil Aviation</i>		
Operational research	14,500	
Aircraft research	9,500	
	<hr/>	24,000
		<hr/>

* See also entry in Section (C). The total estimated expenditure by the Air Ministry on scientific research in 1950/51 is £243,000.

	£	£
<i>Department of Scientific and Industrial Research*</i>		
Maintenance allowances, senior research awards and grants for special researches, including nuclear physics research	712,000	
Grants to Research Associations and other bodies engaged in industrial research (including grants for capital expenditure)	1,366,750	
National Physical Laboratory	635,244	
Building Research Station	675,432	
Chemical Research Laboratory	111,679	
Fire Research Organisation	47,996	
Forest Products Research Laboratory	103,102	
Fuel Research Station	227,242	
Hydraulics Research	47,482	
Mechanical Engineering	172,879	
Pest Infestation Laboratory	41,878	
Radio Research	125,825	
Road Research Laboratory	276,932	
Water Pollution Research Laboratory	56,352	
Geological Survey and Museum	208,630	
Headquarters Administration	235,668	
Provision for research stations (not yet allocated)... ..	217,200	
Less estimated receipts for work carried out for other Government Departments and for test work	459,321	
	<hr/>	<hr/>
		4,802,970
 <i>Ministry of Fuel and Power</i>		
(a) Research into development and economical utilisation of fuel and power	535,400	
(Coal consuming gas turbines, underground gasification, †peat burning open cycle gas turbines, heat pumps (Festival of Britain), firedamp gas turbines (operating on firedamp from coal mines), windpower, total gasification, centrifugal compressors for gas turbines).		
(b) Fuel Efficiency	41,500	
(purchase and maintenance of testing appliances and equipment, grant (£5,000) to British Coal Utilisation Research Association for work on firing of shell type boilers, experiments in the use of fuels and appliances).		
(c) Safety in Mines Research Establishment	99,300	
	<hr/>	<hr/>
		676,200

* See also entry in Section (A). The total estimated expenditure by D.S.I.R. on scientific research and development in 1950/51 (less estimated receipts) is £4,977,384.

† Grant from Development Fund.

	£	£
<i>Ministry of Transport</i>		
(a) Research in radio aids to marine navigation (Radar; application to various navigational uses and to harbour supervision. Decca Navigation System. Development of official monitoring, analysis of lane identification data.	72,110	
<i>(b) Road Research:—</i>		
Testing of skid-resistance of trunk roads ...	4,000	
Bridge testing—for new methods of design ...	3,000	
Tests on bridge decking for design of Severn Bridge	5,000	
Full-scale experiments on typical road speci- fications for trunk road scheme	11,290	
Full-scale experiments relating to road materials, methods of design and construc- tion, traffic and road safety	42,000	
Experiments relating to concrete surfaces ...	1,210	
Aerodynamic research on suspension bridges...	15,000	
Testing of concrete tunnel linings, and tunnel ventilation tests	5,500	
	<hr/>	159,110
<i>Ministry of Works</i>		
Provision of accommodation for research organisa- tions	505,080	
Experimental building	104,500	
Research and development services... ..	41,000	
	<hr/>	650,580
<i>Post Office</i>		
Research relating to line telephone and telegraph systems, radio-telephones, and mechanisation of postal services; research on materials used in telecommunication equipment and on electronic devices, electro acoustic research and work for other Departments such as the development of hearing-aids for National Health Services ...		575,000
<i>Government Chemist</i>		
Improvement and development of methods of analysis	20,000	
Special chemical investigations for Government Departments	20,000	
Fundamental research related to the work of the Government Chemists's Department	3,500	
	<hr/>	43,500
TOTAL (B)		<hr/> <hr/> £7,609,774

	£	£
(C) MEDICINE AND HEALTH		
<i>Ministry of Health</i>		
Expenses in connection with research arising out of the National Health Service		31,000
<hr/>		
<i>Department of Health for Scotland</i>		
Expenses in connection with research arising out of the National Health Service		20,000
<hr/>		
<i>Medical Research Council</i>		
National Institute for Medical Research ...	318,929	
Research units, including Department of Clinical Research, Clinical Research Unit; Department of Experimental Medicine; Blood Transfusion and Blood Group Research Units; Radiobiological Research Unit; Radiotherapeutic Research Unit; Neurological Research Unit; Ophthalmological and Vision Research Unit; Otological Research Unit; Human Nutrition Research Unit; Dental Research Unit; Department for Research in Industrial Medicine; Industrial Medicine Research Unit; Pneumoconiosis Research Unit; Tuberculosis Research Unit; Applied Psychology Research Unit; Social Medicine Research Unit; The Serum Institute; Antibiotics Research Station; and other establishments	773,429	
Temporary Research Grants, including grants for clinical medicine; surgery and anaesthetics; obstetrics and gynaecology; paediatrics; nutrition; dental disease; psychology and mental disorders; radiology; chemotherapy; anatomy and physiology; biochemistry; pharmacology and therapeutics; pathology; bacteriology and immunology; tropical diseases; social medicine and industrial health	164,794	
Research into industrial productivity (general scientific purposes)... ..	55,000	
Administration and new projects	132,622	
Provision for capital expenditure on new buildings and special equipment	330,750	
	<hr/>	1,775,524
<hr/>		
<i>Air Ministry*</i>		
Medical Research		57,000
<hr/>		
<i>General Register Office</i>		
For research into: morbidity generally; morbidity due to individual diseases; morbidity in relation to sociological factors; for cancer, in particular, the study of the effectiveness of treatment ...		35,000
		<hr/>
TOTAL (C)		£1,918,524
		<hr/>

* See also Section (B).

	£	£
(D) OVERSEAS		
<i>Colonial Office</i>		
For research schemes relating to development and welfare in the Colonies, including:—		
agriculture, animal health and forestry;		
fisheries, insecticides; anti-locust research;		
medical research, products research, tsetse and trypanosomiasis research; industrial and engineering research; social science and economic research		2,200,000
		<hr/>
<i>Commonwealth Relations Office</i>		
Contributions to Commonwealth economic and research services; loan to Commonwealth Agricultural Bureaux; research schemes in the South African High Commission Territories		61,265
		<hr/>
TOTAL (D)		£2,261,265
		<hr/>
(E) GRANTS TO LEARNED SOCIETIES		
<i>Royal Society</i>		
Scientific investigations; scientific publications; expenses in connection with international research associations and scientific congresses; visits of scientists to laboratories overseas		52,000
		<hr/>
<i>Royal Geographical Society</i>		2,000
		<hr/>
<i>Royal Society of Edinburgh</i>		2,000
		<hr/>
<i>Royal Scottish Geographical Society</i>		200
		<hr/>
TOTAL (E)		£56,200
		<hr/>
(F) GRANTS FOR OTHER SCIENTIFIC PURPOSES		
<i>Edinburgh Observatory</i>		9,659
		<hr/>
<i>North Sea Fisheries Investigation</i>		2,100
		<hr/>
<i>Scott Polar Research Unit</i>		4,000
		<hr/>
<i>Solar Physics Observatory</i>		3,000
		<hr/>
TOTAL (F)		£18,759
		<hr/>
Total Estimated Government Expenditure on Scientific Research in the Civilian Field (addition of Sections (A) to (F))		£16,057,933
		<hr/>