SCIENCE, GOVERNMENT & INDUSTRY

A confidential report
prepared by Robert Maxwell, MC
as Chairman of a Committee of the Labour Party
on Science, Government & Industry
reporting to the then Leader of the Labour Party,
Harold Wilson, just prior to
Labour's victorious 1964 General Election

The Report was completed in October 1963

SCIENCE, GOVERNMENT AND INDUSTRY

Robert Maxwell

As is well known, Britain's economic growth rate over the past ten years has been lower than that of any other highly industrialised country. This is well demonstrated in the below given Table recently published by T. Balogh as part of his Fabian pamphlet "Planning for Progress: A Strategy for Labour".

Annual Rates of Growth of Gross Domestic Product and of Output in Major Industrial Divisions, 1950 to 1960 (Percentage)

Country	Gross Domestic Product	Agriculture	Mining	Manufacturing	Utilities
Japan	9.5	4.7	4.6	18.1	9.9
Germany (Fed. Rep.)	7.6	2.2	3.8	10.1	9.2
Italy	5.9	3.5	10.1	9.0	7.3
Austria	5.9	3.0	5.6	7.1	10.4
Netherlands	4.7	2.3	2.1	6.1	7.4
Finland	4.6	2.4	8.8	6.0	8.0
France	4.3	2.0	6.6	6.5	10.9
Australia	3.9	3.2	-	5.7	7.4
Canada	3.8	1.8	8.7	3.4	9.8
New Zealand	3.5	2.9	-	4.6	7.7
Norway	3.5	-	6.4	5.1	5.9
Denmark	3.4	1.9	-	3.3	8.4
United States	3.3	2.4	1.9	3.6	8.7
Sweden	3.2	-1.0	4.7	3.3	-
Belgium	2.9	2.1	-1.4	4.1	5.4
United Kingdom	2.7	1.7	-0.6	3.5	5.2

Many reasons have been advanced to explain this poor performance. It is, however, more than likely that Britain's failure to grow as quickly as some of its competitors can be traced to a number of

partial causes. The major ones being: an insufficient rate of investment to maintain economic growth; neglecting to expand sufficiently all forms of higher education; lack of effective use by British industry of new technology and scientific research, and to a lesser extent the dichotomy that exists in the government on science for defence and for civil purposes.

There is general public understanding and acceptance of the vital importance of new technology to weapons development but less appreciation of the role that science and technology play in economic growth, and of the need for special arrangements to ensure that new science becomes useful technology, that it spreads throughout industry and the country, and, most important, that people are educated and trained to develop and use it.

The relationships between science, government, technology and economic growth are not at all clear to most of those engaged in science or government or to those who participate in the business of growing the economy. The translation of science to use by society is not well understood nor practised.

It is accepted that economic growth is desirable and taken for granted that it is one of the Government's functions to foster it in so far as it is compatible with its other major policy aims. It is known that one of the major determinants of economic growth in an advanced society is the speed with which firms are willing and able to use the results of scientific discovery to develop technological innovation, to achieve greater efficiency and higher sales at home and abroad.

The considerable growth of the national scientific and technological effort since the end of the last war has naturally led to intensified discussion of the means by which this vast effort is planned and managed. It is now beginning to be realised that, while Government support for research and development expenditure represents a very small fraction of our national economic means, they engage a very large fraction of one of

Furthermore, it is now appreciated that points of growth in the national economy appear to follow closely research and development expenditures, to the extent that these are channelled by decision of Her Majesty's Government, the whole thrust of our economy is determined.

It is interesting to note that the NEDC report refers to accumulated evidence of a correlation between research, development and productivity. They say: "In the past decade the output of the science-based industries has been growing at twice the rate of manufacturing industries as a whole". While the volume of our exports generally during the last eight years has grown by 3.1%, for two science-based industries - chemicals and electronics - the corresponding growth rate has been 10.4% and 7.9%.

In sum, the social and economic leverage of the approximate three per cent of the Gross National Product which is expended on research and development by the government and industry is many times greater than the actual amount of money involved. Yet the extent of this leverage is only now beginning to be recognised and appreciated.

TENTATIVE OUTLINE ON THE ORGANISATION OF SCIENCE AND ENGINEERING TO ASSIST THE NEXT LABOUR GOVERNMENT IN RELATING SCIENCE AND TECHNOLOGY TO OUR NATIONAL NEEDS AND RESOURCES

The following are tentative suggestions for the organisation of science and technology. The various components that are involved in the overall picture include:

Ministry of Higher Education and Science

Ministry of Aviation

Directorate of Defence Research and Development (D.D.R.D.)

National Council for the Co-ordination of Science and Engineering (N.C.C.S.E.)

Defence Research Policy Committee (D.R.P.C.)

Inter Departmental Co-ordination Committee (I.D.C.C.)

University Grants Commission (U.G.C.)

United Kingdom Atomic Energy Authortiy (U.K.A.E.A.)

Department of Scientific and Industrial Research (D.S.I.R.)

Free Science and Engineering Advisory Service (S.E.A.S.)

Medical Research Council (M.R.C.)

National Research Development Corporation (N.R.D.C.)

Agricultural Research Council (A.R.C.)

Nature Conservancy Board (N.C.B.)

Advisory Council on Scientific Policy (A.C.S.P.)

Social Sciences Research Council (S.S.R.C.)

Central Scientific and Technical Register of Technical Manpower (C.S.T.R.)

The creation of a post in the government at Cabinet level for a Minister of Higher Education and Science is recommended. The transfer of the following votes is recommended: the United Kingdom Atomic Energy Authority (U.K.A.E.A.) (and to end its statutory semi-independent status), the Department of Scientific and Industrial Research (D.S.I.R.), the Medical Research Council (M.R.C.), the National Research Development Corporation (N.R.D.C.), the Nature Conservancy Board (N.C.B.) and the Agricultural Research Council (A.R.C.) as well as the proposed Social Sciences Research Council (S.S.R.C.) to this new Ministry, and also suggested is the transfer of the Central Scientific and Technical Register of Technical Manpower (C.S.T.R.) from the Ministry of Labour. It is proposed that the University Grants Commission and the other appropriate bodies responsible for Higher Education, i.e. the National Council of Technological Awards, be transferred to this new Ministry. The U.G.C. is to continue to act as Guardian of legitimate university freedoms.

The suggestions of the Taylor committee on the creation of a National University Development Council, whose responsibility it would be to plan for higher education, are supported. The National University Development Council should be an independent body appointed by the Minister of Higher Education and Science; its plans to be published and debated in Parliament.

It is universally agreed that our country is in need of a rapid

without this expansion our entire educational system will become distorted and starved of teachers and lecturers. The next Labour Government's plans for economic expansion cannot be carried out without a considerable increase in the number of highly skilled and professionally trained people. All our short and long term national objectives are unattainable without a continuing increase in the number of places available in higher education.

It is believed that the creation of the post of Minister of Higher Education and Science will be most beneficial in achieving the rapid increase in the number of highly skilled and professionally trained people to cut out waste and duplication, and to ensure that the nation gets value for the vast sums of money spent on higher education and scientific research.

United Kingdom Scientific and Engineering Manpower.

(Source United States Government publication)

Total Number

In 1959 there were 173,000 scientists and engineers in the United Kingdom, of whom 72,000 or 41.5 per cent were scientists, 101,000 or 58.5 per cent were engineers. Thus, there were about two scientists to every three engineers. This is a considerably higher proportion of scientists than in the United States, where the corresponding ratio is about one to two.

Table II.1 Scientists and Engineers in the United Kingdom

	1956		1959		1961	
	Number	Per cent	Number	Per cent	Number	Per cent
Number of scientists and engineers	145,000	100.0	173,000	100.0	186,000	100.0
Number of scientists	61,000	42.0	72,000	41.5		
Number of engineers	85,000	58.0	101,000	58.5		
Per cent of labour force		0.65		0.76		

The most recent survey indicates a significant slowing down of growth, as indicated in the above Table. In the three-year period 1956-59, the growth in number of scientists and engineers was 28,000; in the subsequent three-year period, 1959-62. the growth was 13,000.

Distribution by Sector

As shown in Table II.2, the proportion of scientists and engineers in the government sector is about the same as in the United States. The proportion in the industrial sector is less, and the proportion in the education sector correspondingly higher than in the United States.

Table II.2 Distribution of United Kingdom Manpower by Sector, in 1959

Sector	Per cent 100.0
Government	15.0
Industry, including nationalised sector	53.6
Education	24.0
Other	6.6

Research and Development Scientists and Engineers

The proportion of scientists and engineers in research and development is somewhat smaller, but comparable to the United States. In marked contrast to the United States, however, this proportion is decreasing. Thus (Table II.3) in 1956, 30 per cent, in 1959, 28 per cent, and in 1962, 27 per cent of all scientists were in research and development.

Table II.3 Research and Development Scientists and Engineers in the United Kingdom

Year	Total Number of Scientists and Engineers	Scientists and Engineers in Research and Development	
		Number	Per Cent
1956	145,000	43,500	30.0
1959	173,000	48,500	28.0

This unhealthy drop in the proportion of scientists and engineers employed in research and development should be stopped and reversed by the new Ministry of Higher Education and Science.

The creation of a Technology Grants Commission is recommended to perform similar functions for the non-university institutions of higher learning as the U.G.C. does for the universities. The Chairman of the Technology Grants Commission shall be Deputy-Chairman of the University Grants Commission, thus helping to ensure close co-operation and collaboration between these two important Commissions.

NATIONAL COUNCIL FOR THE CO-ORDINATION OF SCIENCE AND ENGINEERING

This Council should be charged with the task of considering our future needs in the light of advancing technologies and changing economic and political circumstances and be responsible for formulating the main strategic lines for the overall Government policy on research and development; to settle the major preferences within the broad frame-work laid down by the Cabinet Defence and Economic Committees for both the defence requirements and the needs of the civilian economy.

The Chairman and its members are appointed by the Minister of Higher Education and Science to work in his Office on a full-time basis. Its members must be men and women of the highest quality and capability who shall be seconded, for a period of two to five years, from Universities, Industry and Government departments.

This Council shall replace the A.C.S.P., whose advisory role could best be taken over by ad hoc Committees to be appointed from time to time by the Royal Society at the invitation of the Minister

To give an idea of the size, specialisation and field of work of individual full-time members of the Council, I list below some of the subjects for which they might be responsible.

Defence

Education

Civilian Technology

Science Information

International Science

Physical Sciences

Life Sciences

Natural Resources

The Chairman shall be a scientist or engineer of international stature, and the Deputy Chairman a permanent civil servant who is scientifically qualified. In addition the following shall be members of this Council: the Chief Scientific Adviser to the Minister of Defence, the Chief Adviser to any new Ministry responsible for Central Planning, the President of the Royal Society, the Director-General of NEDC, the Chairman of the University Grants Commission, and the Chairman of the Technological Grants Commission.

The Council will appoint permanent or ad hoc panels as necessary, these specialist national advisory panels and committees to advise the Minister and the Council on detailed specialist problems that will arise from time to time. Members of these specialist advisory panels and committees will be drawn from universities, industry and government departments.

Merging of Defence and Civil Science Programmes

The administration of the defence and civil science programmes should be merged and put under the control of the Minister of Higher Education and Science. The Minister of Higher Education and Science shall be responsible, as agent for the Minister of Defence, for all matters of high policy affecting the some forty Government defence

research laboratories. The present practice of administering the defence and civil side separately is recognised to be highly unsatisfactory.

The abolition of the Ministry of Aviation is recommended and its functions and staff should be taken over as appropriate by the Ministry of Defence and the Ministry of Higher Education and Science.

The abolition of the D.R.P.C. is recommended and its policy functions be vested in the National Council for the Co-ordination of Science and Engineering.

A further possible advantage of this proposed merger could be that it would provide something that has been lacking for a long time, namely a sharp and independent means for recognising when the mission of a Government research and development establishment has lost its validity, and the practical means for re-directing the establishment into more productive channels either within or outside the Government Department that originally sponsored it. When the independent nuclear deterrent is abolished the problem of what to do with the Aldermaston Weapons Research Establishment is a good example of the kind of problem we have in mind.

The present system of awarding development contracts tempts private companies to talk their way into a development programme with promises of results which wise technical judgement would deem unattainable, i.e. Sky Bolt, and various other failed home produced missiles and weapons. The present arrangement does not provide for adequate penalties for failure to achieve promised results, nor does it give sufficient incentives for a high level of technical performance. It also offers incentives to contractors to make systems complex and expensive or to prolong the development work. All this is most wasteful of our vital scientific and engineering manpower as well as of tax ayers' money.

Finally the present defence research contract arrangement

with its built-in competitive incentives and inadequate penalties for poor technical performance leads to the proliferation of many research development groups in private industry of sub critical size or quality.

Insufficient long range planning and evaluation

Under current practices insufficient attention is given to the ultimate monetary costs, manpower and facilities implications of major development programmes at the time these are started.

The present state of mal-administration in sciences cannot be tolerated any longer. The un-balance between defence and civil research, of which the Advisory Council on Scientific Policy has so often complained, demonstrates that the present government does not have a method of dealing with this most vital problem.

The dichotomy between the use and control of scientific manpower for defence purposes and for civil research and development purposes must end.

DIRECTORATE OF DEFENCE RESEARCH AND DEVELOPMENT

There shall be created in the Ministry of Defence a Directorate of Defence Research and Development. This Directorate, acting on the policy decisions reached by the Cabinet Defence or Economic Committee in consultation with the National Council for the Co-ordination of Science and Engineering, will be responsible for allocating Defence Department resources between basic and applied research and development, the making of longer term grants and contracts for research, the delegation of management authority and responsibility for major defence research projects and facilities.

They will also be responsible for ensuring good organisation and administration in the some forty Government's defence research laboratories. In consultation and co-operation with the Ministry of Higher Education and Science they will ensure that the commercially useful bi-products of the defence research programme are identified and developed as quickly as possible.

The Department of Defence expenditures for basic and more

Ministry of Higher Education and Science for management and administration.

The Director-General of Defence Research shall be an eminent scientist or engineer seconded from University or industry for a period of five to ten years. In addition to fulfilling his co-ordinating and administrative functions relating to the management of the Government defence research laboratories he will also be the principal science adviser to the Minister of Defence and be a member of the N.C.C.S.E.

The Director-General of Defence Research shall have three Deputy Directors who also shall be eminent scientists and engineers appointed by the Minister of Defence in consultation with the Minister of Higher Education and Science, and the First Lord of the Admiralty, the Secretary of State for War, and the Secretary of State for Air.

THE INTER DEPARTMENTAL CO-ORDINATION COMMITTEE

The responsibility of this Committee shall be to deal with problems of organisation, administration and co-ordination of research in Government establishments and in the nationalised industries. It would further be responsible for relating the reports of the National Council for the Co-ordination of Science and Engineering to specific Government programmes.

The Chairman of this Inter Departmental Co-ordination Committee shall be the Chairman of the N.C.C.S.E. and the Deputy Chairman shall be the Director of the Directorate of Defence Research and Development. This Inter Departmental Co-ordination Committee shall have a strong Executive Secretary, with an adequate staff, to concern himself specifically with the follow-through on national science and development programmes and to monitor the development of plans and the implementation of the Inter Departmental Co-ordination Committee's decisions by its member departments. The three Deputy Directors

members of this Inter Departmental Co-ordination Committee together with the Secretaries and/or Directors responsible for research and development of the following organisations and departments: United Kingdom Atomic Energy Authority, Department of Scientific and Industrial Research, Medical Research Council, National Research Development Corporation, Directorate of Defence Research and Development, Nature Conservancy Board, Agricultural Research Council, Social Sciences Research Council, Central Scientific and Technical Register of Technical Manpower, the Ministry of Fuel and Power, Post Office, the Iron and Steel Board, the Gas Council, the National Airlines, the British Transport Commission.

This Inter Departmental Co-ordination Committee could also concern itself with the better utilisation of existing capabilities of one department by another when embarking on new or expanded programmes; allocation of responsibility for undertaking new research activities which do not fit clearly within the mission of any one department; to make studies and recommendations concerning long range research plans of the Government.

How can we best convey the results of research in a form which points the way to its practical applications

It is now well understood that the growth of our economy, welfare of our citizens, our national security, the aid that we can afford to give to under-developed countries, all depend to a growing extent on the effective use our industries make of new technology. In recent years the rate of increase in our Gross National Product per worker (a measure of productivity) and per capita (a measure of standard of living) has slowed down

and has been substantially less than those of almost all highly industrialised nations in the world, as shown on page 1 of this document.

Although there has been a rise in the standard of living, that rise has not been uniform throughout the population. The fact of the matter is that there are many areas in our country (particularly those which formerly depended on the exploitation of natural resources and old-fashioned industries such as ship-building, certain types of heavy engineering, textiles, etc.) where the standards of living have not risen and have actually declined. These areas have lacked the effective means to initiate new industrial development.

To improve our competitive position generally we must broaden the technical base of our economy, use technology more effectively and provide the basis for new and better products and services at lower cost. It is important that we decrease not only the direct costs of goods but their indirect costs as well, that is the costs of such services and facilities as transportation, building and construction, plant and machinery. These indirect costs make up a very significant proportion of the costs of all goods and services produced by the nation.

It is apparently not fully realised that scientific discovery followed by technological research and development produces nothing, other than knowledge, for society. They must be followed by their applications through the combined use of capital and equipment and human resources - labour and management - to produce an economic good.

It is commonly accepted that management in British industry, both private and nationalised, by and large has failed badly to make use of science and technology as an aid to increased productivity and profitability. For example, for the first 50 ethical drugs prescribed by doctors under the National Health

were discovered and developed in this country - ordinary penicillin, the new Beecham penicillins, Broxil and Penbritin. Many other examples of similar nature can be given, such as computer components, automated office equipment and systems, and certain types of machine tools, etc.

It is generally agreed that one of the major obstacles preventing the wider application and use of science and technology in British industry is that there does not seem to be, at present, an effective organisation or method to convey to individual companies, their management and foremen, the new technology in a form which points the way to its practical applications.

The other major problem seems to be the great gulf and lack of communication that exists between the pure scientists and the applied scientists, the universities, the technical colleges, the trade research associations, industry and Government, and, finally, the gap that exists between management and scientists in individual firms.

The whole issue may therefore be summed up as being a problem in communication of information and the need to change attitudes of mind.

FREE SCIENCE AND ENGINEERING ADVISORY SERVICE

The creation of a Free Advisory Service is recommended for technical work and the dissemination of technical information; this should be integrated with the existing services of the research associations. This new service should be most helpful in getting the medium and small firms to use new technology and to introduce innovations that increase productivity.

The service shall be based eventually in the some sixty D.S.I.R. selected universities, colleges of advanced technology and regional technical colleges. It shall be financed through D.S.I.R. grants direct to the chosen institutions. The service will not be concerned with proprietary problems unique to a

first-rate applied scientists, who understand and appreciate the significance of what their colleagues in pure science are trying to discover and who keep in close touch with local industry and interpret firms' needs to scientists and engineers in the teaching and research institutions, as well as bringing to the notice of firms, through personal visits, plant demonstrations and seminars, technological developments that will benefit their productivity.

This service could provide the missing link in the communications network between universities, technical colleges, industry, trade research associations and Government. It is estimated that the total number of scientific and engineering staff needed to give this effective free advisory service would be between six to seven hundred, and, together with their supporting staff, we believe that the total annual expenditure would be £2 millions. This service will involve the interaction of people interested in science, technology, economics and related fields.

The D.S.I.R. should invite applications from universities, and technical colleges to perform this service. The staff of the Free Science and Engineering Advisory Service could also encourage in their region their colleagues in universities and technical colleges and in Government research laboratories to carry out industrial orientated basic research, thus helping to increase the supply of technical people experienced in industrial problems.

Finally they can also be very useful in encouraging firms to support basic technical work both within these firms and outside them either in trade research associations or in some other institution of higher learning or research laboratory.

As a measure of how little use British industry is making of new technological information, the following facts may be of value. There are approximately 90,000 firms in the United Kingdom, of these it is reliably estimated that some 15,000 are members of the various trade research associations. (ASLIB), the Library Association in the United Kingdom, records that only 800 industrial firms in the United Kingdom have technical libraries to assist management and staff to keep up-to-date with the latest technical information.

D.S.I.R. - Development Contracts - Industry

The Department of Scientific and Industrial Research should be given by the Ministry of Higher Education and Science an expanded role in the planning, manage ent and support of basic research including programmes of research, which are a blend of basic and applied research.

The Ministry should provide through the D.S.I.R. some 50 million pounds per annum to devote to financing the very substantial growth needed in civilian applied research and development. This money should be expended to finance jointly with industry or alone in universities, technical colleges, research associations or Government research laboratories basic technological problems of importance to industry, i.e. projects likely to have a major effect on industrial productivity contributing significantly to increasing our Gross National Product and Exports.

The Government should support the placing of Civil Development Contracts with industry for carrying out applied research of a development character under the following circumstances:

a) where the work is recognized as needing to be done in the national interest;

b) where it is too big an operation for a single firm, or a consortium of firms, to undertake it alone; and

c) where the development is too speculative for private enterprise alone.

The FBI recommendations of a target increase of one hundred million pounds per annum in the field of research and development, whereby fifty per cent is financed by industry and fifty per cent by the Government are supported.

The expenditure of substantial amounts of public funds for development contracts in civilian research and development requires that positive arrangements be made for effective accounting, and, wherever possible, for the recoupment, by the government, of the expended public funds and, where possible, to share in any profits resulting from its support.

Industry itself must find ways and means of redeploying its present scientific and engineering manpower, so as to ensure that fully qualified scientists and engineers are relieved of doing menial jobs that technicians can do for them. The Government should provide tax incentives to industry in order to encourage it or increase its expenditure on research and development. The Government should increase the amount of money available to the D.S.I.R. for research grants and fellowships and establish fellowships and research grants tenable at technical colleges.

Trade Research Associations

It is recommended that a commission be appointed to report on the value and function of trade research associations and how and in what way they can be made more effective, better used and better supported by industry. Our Research Assosications, together with the Free Science and Engineering Advisory Service, should be made a vehicle of information in those industries where the small and medium firms predominate.

Research Associations should be enabled to carry out pilot plant development and financing should be done jointly by the Government and industry. Industry and trade associations should be strongly encouraged to appoint consultants from universities and technical colleges.

Compulsory Levy

Most directors of research associations seem to spend a great

on the problems of raising funds. The introduction of a compulsory levy on industry is recommended wherever this is possible. The advantages of such a levy are that the director and some of his staff will be able to spend their time on research and development instead of raising funds; secondly, there would be a considerable saving on the administrative expenditure; and thirdly, a statutory levy on a horizontally based sector of industry will give the research associations a useful basis to extend vertically.

Patents

Everybody agrees that our Patent Act is very out of date and that our patent system is in need of a radical overhaul. It is recommended that the next Labour Government looks into the position and examines whether new legislation to prevent the prior assignation of rights in a patent might not be a good way of stimulating innovation in industry. A patent system based on this principle has been working very satisfactorily to all concerned in Germany.

The Social Sciences Research Council

It is strongly recommended that this Council be established to perform the same services for the nation in the social and behavioural sciences as the D.S.I.R. does for the physical sciences and engineering. The social scientists of this country can make a significant contribution to the national welfare and help the country to achieve a faster rate of economic growth.

The establishment of this Council will help to restore a little the unbalance that exists between the resources available for doing research in the physical sciences and the social and behavioural sciences.

It is proposed that this Council shall receive its vote and be answerable to the Ministry of Higher Education and Science.

Science Adviser to Secretary of State for Foreign Affairs

The creation of this new post is recommended. Science and technology play an increasing role in the formulation of foreign policy. Unfortunately this too often is not fully appreciated by policy-makers, thus the primary function of the science adviser

be to indicate to top policy-makers when and how scientific and technological considerations bear on foreign policy as it is evolved. The science adviser should be a scientist or engineer or be highly literate in science or technology and should have some appreciation and understanding of foreign affairs. He must be in a position to engage as consultants on specific problems the best technical minds in the country. His staff should be of sufficient size and competence so that he may initiate and provide the guide lines for technical studies important to the Foreign Office and evaluate and interpret for the Foreign Office studies made in other Government departments.

A good example are the scientific problems relating to the nuclear weapons test monitoring requirements. A further function of the science adviser to the Secretary of State for Foreign Affairs would be to stimulate relations between British and foreign scientists in furtherance of our foreign policy objectives, a function in which the Foreign Office needs to assume stronger leadership.

Finally, the science adviser should assume authority over the duties of science attaches abroad and assist them in achieving the status of policy advisers on scientific matters to their Ambassadors.

Interchange of Personnel Between Universities Industry and Government

It is strongly recommended that urgent and positive steps be taken to bring about the development of an interchange of personnel between the universities, industry and the government. Such interchange will be of considerable benefit to

creating the right climate in producing better informed Government policies and bring about closer Government, industry and university co-operation which is indispensable to success in scientific economic policies.

Science and Planning

The chairman of the National Council for the Co-ordination of Science and Engineering shall be a member of the Council of NEDC or any other senior advisory committee that may be set up by the Ministry responsible for central planning. The Secretariat of NEDC should have a strong technico-economic section which should work in close co-operation with the N.C.C.S.E. In this way the scientific and engineering point of view would take its place easily as part of the wider national planning body.

Science Information

The Ministry of Higher Education and Science could centralize most effectively the important activities relating to science information.

Scientific and Economic Staff in Central Position in Each Ministry

Each Ministry should set up its own scientific/economic department so that in this way science can increasingly help influence policy and action in government. This forward planning staff with a strong technical bias can be responsible for relating the long term policy plans of the department to the scope for technological development in the industries on which this department relies. This staff should be given a central position in each Ministry.

An example of how valuable this kind of arrangement can be has been reported to the Gibb-Zuckerman Committee, when it was stated that without the work of the development group in the Ministry of Education on the educational building programme carried out since 1949, the achieved saving of some three hundred million pounds on the schools built since then would not have

New and Powerful Social Tool to Raise the Quality and Standards of Life of the Nation

The Ministry for Higher Education and Science and our scientific and engineering community should make it one of their major joint tasks to employ our new found ability to combine the great diversity of scientific and engineering skills and disciplines to make a massive assault on very large scale national problems. The effectiveness of employing this new Government tool has been demonstrated during the last war and in the present massive USA - USSR space programmes

The social innovation and use in peace time of this new Government tool is of even greater consequence in the long run than the scientific and technical innovations on which most of our attention is presently focussed. This is the 'spill over' from defence of the greatest national and social consequence and we, as a country, have so far failed to use this instrument in peace time. There can be no doubt that the development of this new capability has endowed us as a nation with great new powers. The new Labour Government should use this social invention for peaceful purposes and not just confine it to the defence sector.

The Government should show the way how to use research and development in the modern inter-disciplinary way through industry to improve and to raise the quality and excellence of the environment in which we work and live.

Familiar examples of the material waste and erosion of the aesthetic environment which are very complex and which can only be solved on a multi-disciplinary basis are congestion and air and water pollution.

Healthy Growth of British Higher Education and Science

The creation of the Ministry of Higher Education and

effective monitoring and management of the science and development problems of the Government. This new Ministry can help to ensure the continued healthy growth of British higher education and science.

The recommendations made here for strengthening the present organisation and government at policy level can achieve substantial improvements in the organisation and inter-relation of various government departments and agencies supporting science and technology, and provide an overall focus and leadership for their activities. This leadership will reside in the Ministry of Higher Education and Science where the Minister, supported by the National Council for the Co-ordination of Science and Engineering and the Inter-Departmental Co-ordination Committee, can ensure the preparation and review of analyses and plans and the review of the role and responsibilities of the various government departments in science and technology.

Accordingly the allocation of government support for science would reach up to the Cabinet by orderly examination of needs and aims of both departmental missions and national goals, would include consideration of government priorities and urgencies and would permit a comprehensive balancing of government resources.

In making these tentative recommendations we must emphasize that the strength of British science depends on the initiative, imagination and intelligence of individual working scientists and engineers.

The best possible programme formulated at the top can be made entirely ineffective by the people who are carrying it out. The purposes of organisation for science and engineering in the Government must be to ensure quicker identification and support of new ideas and maintain support for basic research

and development to guarantee that the most important national technological jobs are tackled by the most able people.

These proposals are tentative and do not answer all the questions relating to these important problems. Listed below are problems to some of which this memorandum has tried to give tentative answers.

(i) What steps can and need be taken to provide the climate and the support for work in universities and colleges of technology related to the broad practical needs of our civilian economy and society?

(ii) How can we best ensure that bi-products of the defence research programme, once identified, should be developed quickly and exploited?

(iii) What is the best role that government can play in the encouragement of applying the results of science and engineering to economic growth?

(iv) How can we best get British industry to employ development personnel who may also be working for their competitors and to encourage them to have forward planning for research and development?

(v) What changes are needed in the machinery of government to fit its action in detail to the need for (a) proper scientific development in industry, and (b) making certain that the administration of the government's own expenditure on science is organised to secure full value for money in the light of our needs and resources?

(vi) Should there be established in every government department dealing with industry a scientific/economic staff to act as a forward policy planning unit, advising the Minister on the technical and industrial implications of the department's future policy plans,

to gather economic and technical information from the relevant industries, and generally provide a technical intelligence service to the department?

(vii) How can we best encourage the establishment of the institutions and the environment that most effectively puts science to practical use, diffuses the results of technology throughout the society and encourages even higher levels of innovation activities.

(viii) Should there be greater interchange of staff in the Civil Service itself, and between the service, industry and the universities; should civil servants be recruited from industry and the universities on temporary contracts or seconded?

(ix) How can we best convey the results of research in a form which points the way to its practical applications?

(x) How can we use science more effectively to aid underdeveloped countries?

(xi) We need new ways to improve government university relationships and in the conduct of research and development in private industry.

(xii) How far should the Government go in establishing new research facilities separate from universities and how far should it go to finance them as part of universities proper?

(xiii) Is it possible to formulate general policies for the support of science and to institutionalise a long-range planning system? This is perhaps especially necessary for the support of special fields of research requiring large and costly facilities, i.e. radio-astronomy, astronautics, oceanography, high energy physics, etc.

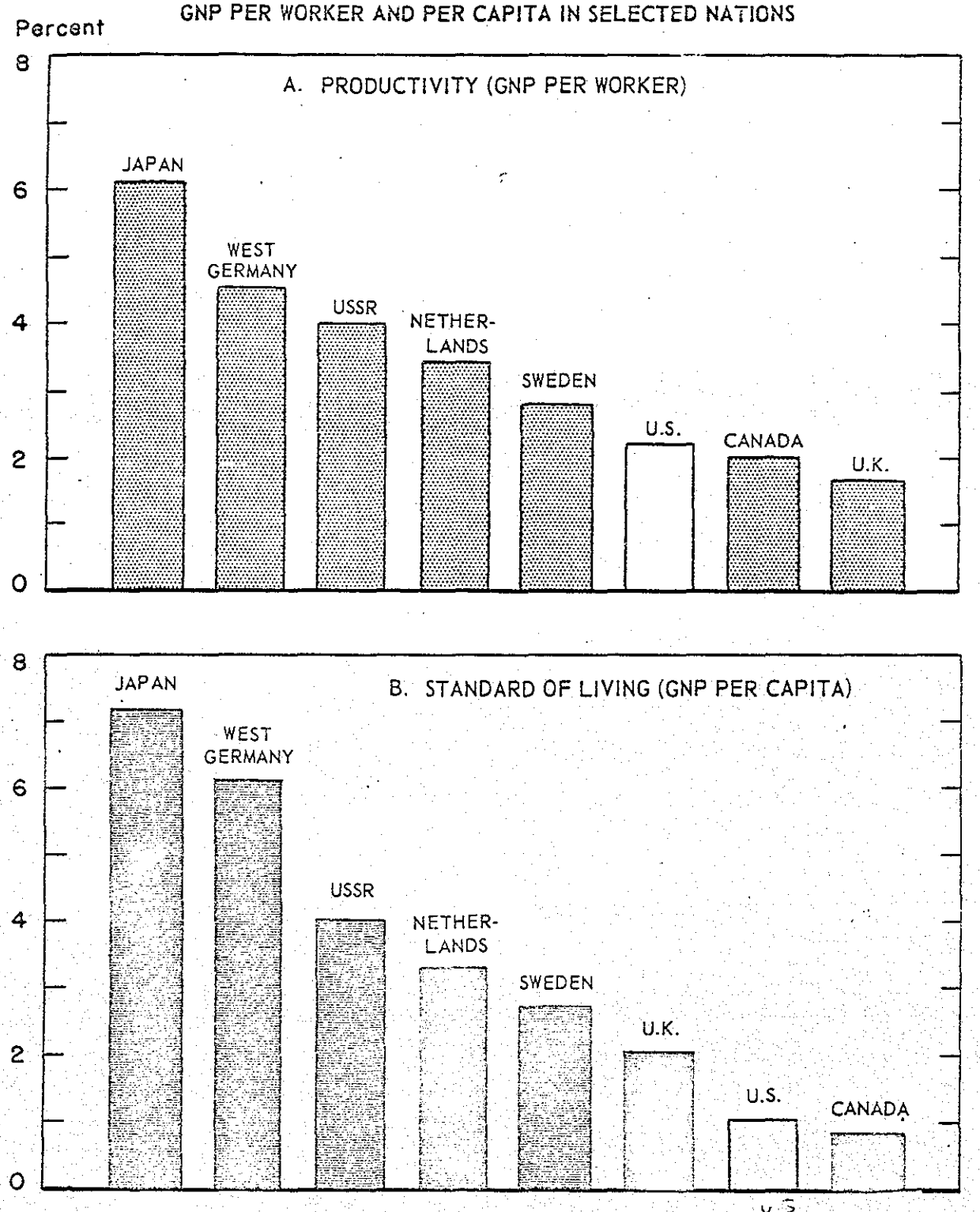
(xiv) How can we raise the status of engineering in this

(xv) Can trade research associations, if given the resources, be relied upon to disseminate technical information and encourage their member firms to use technical innovations, and should they be provided with funds for research and training by a compulsory levy on industry?

Government and science are now completely joined together in an indispensable partnership. Government is dependent on science as an essential resource for national security and welfare while science cannot flourish without government support.

FIG. 1

AVERAGE GROWTH RATE (1950'S)
GNP PER WORKER AND PER CAPITA IN SELECTED NATIONS



Source: "National Institute Economic Review" as quoted in "Economic Report of the President, 1962."
"National Accounts Statistics, 1961," United Nations.