Organization of Scientific Activities in Canada

The system avoids the dangers of changing political views and insures a high level of competence.

B. G. Ballard

The organization of science in Canada has been influenced throughout by an attempt to preserve the greatest possible flexibility. Certainly the system is less formal and less complex than that of the other countries discussed in this symposium. It is not suggested that the Canadian system would be suitable elsewhere or even that it solves all the problems peculiar to Canadian science. There are still weak points in the latter. The organization has evolved by adapting what was considered to be the best of the other systems and innovating where necessary to meet the conditions with which Canada is confronted.

Many factors affect such an organization. The population density and the area of the country are important. Even differences in governmental structure play a part. For example, the fact that the distribution of executive and administrative responsibility in the Canadian Government differs from that in the United States Government has probably influenced significantly the organization of science in the two countries. All countries actively engaged in science have charged their federal governments with the major responsibility for the development of science, and all have acknowledged the need for close integration between government science and the universities. Obviously, countries which delegate the responsibility for education to the federal government are likely to evolve systems different from that in a country like Canada where education is the responsibility of provincial governments and where there are in fact ten ministries of education.

In order to best understand the manner in which Canadian science has developed, it is well to review very briefly the historical events which contributed to its development.

The history of organized science in Canada really began in 1916. Prior to that time, scientific activity for the most part was sporadic and impoverished. The universities did not enjoy the generous endowments of some of their British and American counterparts, which would have enabled them to sponsor research on their own initiative, and industrial research was virtually nonexistent. Certain government departments had begun research in a limited way, but they devoted their efforts mainly to the solution of immediate problems in the fields in which they were held responsible. Basically they were handicapped because of lack of trained research workers. The need for science was not well understood. The value of research as an instrument for learning the secrets of nature as distinct from the application of known scientific laws and facts to the solution of immediate problems was not yet generally appreciated. Canada was still predominantly a pioneering country, and she was developing very effectively her mines and railways, her waterways and power systems. Her engineers had distinguished themselves with innovations which were most effective in solving problems peculiar to Canada, but, in the main, they relied for the supporting science on contributions from abroad.

It would be unfair to imply that there were no scientific achievements. Despite the difficulties, there were occasional noteworthy efforts. The Dominion Observatory, for example, which had been erected in 1904 primarily to provide a time service for the country, had facilities which made possible some fundamental research in astronomy. The staff of the observatory took advantage of the opportunity, and Canada has made significant contributions in this field, particularly in relation to the brighter stars. As a consequence, she has continued to play an important part in astronomical science and, for a time, had the largest telescope in the world. However, these cases must be regarded as exceptions rather than the rule.

It was not until World War I that serious consideration was given to making a nationally organized scientific effort, and even then the proposal was initiated in Great Britain. While England had made notable contributions in science prior to World War I, she had relied mainly on her universities and such institutions as the Royal Society and the Royal Institution of London for scientific advance. Government departments, of course, had their own laboratories, and the Armed Services were certainly well advanced scientifically as compared with the Canadian Armed Services. Nevertheless, there was little organized effort to promote scientific research, nor had the application of fundamental science to industry been promoted actively. Germany, on the other hand, had encouraged scientific effort by government support and had been extraordinarily successful in making use of science in her industries. By 1916, Great Britain was fully aware of the advantage that Germany enjoyed. As a consequence, she not only undertook to organize her own science program effectively but suggested that other members of the commonwealth should do likewise.

Accordingly, in the same year, the Canadian Government created a cabinet committee of six ministers to study the matter, and on their recommendation an Honorary Advisory Council for Scientific and Industrial Research was created. This was the parent body of the present National Research Council of Canada, and to the early research council must go most of the credit for the promotion and organization of scientific effort in the country. Briefly, its main purpose was to promote science in Canada, but that is an oversimplification. Certainly the original intention was not only that it should promote fundamental research but also that it should promote the application of this scientific effort to Canadian industry. The Advisory Council believed—and subsequent events confirmed the wisdom of this belief—that the immediate

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requirement was to encourage the best-qualified university students to pursue careers in research and to provide them with financial support. By 1940, the council had aided approximately 1000 of Canada's most brilliant students in science and had, as a consequence, a core of competent research men upon which to build when World War II began.

The council members did not confine themselves entirely to the problem of providing support for a potential body of scientists. They decided that they should survey existing research facilities. Their conclusion was that "these were pitifully inadequate," but that even more disturbing was the fact that there was an almost complete lack of public appreciation of the practical value of research. Most Canadian industries were subsidiary to foreign parent firms, and they relied on these foreign parent firms for their research, and even for their design. There had been no notable example of success in Canadian research to fire the imagination of the public. The Advisory Council believed not only that research workers should be supported in the universities but that government laboratories should be created which would stimulate the effort. Not only should these laboratories engage in fundamental research but they should also offer a service to industry so that it would be better prepared to meet the problems with which it was confronted in developing products.

It was not until 1928 that the Government agreed to proceed with the erection of a National Research Council laboratory, and in 1932 this was opened. Unfortunately, the early depression years were not propitious for an effective use of this new facility, but by 1938 the troubled situation in Europe revealed clearly the need for developing our scientific resources and, from that time on, the National Research Council laboratories grew rapidly. By the time war began, these laboratories had a competent core of scientists to meet the challenge.

At that time, the Canadian Armed Services were not well equipped with scientific facilities and, as a result, the National Research Council was named as the official defense laboratory for all three Armed Services, and for the duration of the war the laboratory worked under heavy pressure. Inevitably, the effort was devoted to applied research, and it was not until the end of the war that more fundamental research could be resumed on a satisfactory scale.

At the end of the war it became very apparent that the National Research Council could not discharge the duties for which it was created if it were required to meet the demands of the Armed Services for pure and applied research, and, accordingly, the Defence Research Board was created, with the responsibility of fulfilling these requirements for all three Armed Services.

Since the National Research Council and the Defence Research Board are by far the most important elements of organized science in Canada, I will discuss them first.

National Research Council

The name National Research Council has been used rather loosely and in the public mind applies either to the council which governs the laboratories or to the laboratories themselves, and the ambiguity persists throughout this article.

The council itself consists of 21 members, of whom only four are paid officials. The remaining 17 members are selected mainly from universities and, to a lesser extent, from industry. They are recruited from among the outstanding Canadian scientists across the country.

The term of appointment is three years but may be extended for an additional three years. As a matter of policy, members do not ordinarily serve for more than six successive years; this insures an adequate opportunity to provide, over a period of time, suitable representation from all interested groups and insures, also, a continuing replacement to bring fresh viewpoints into the organization. These men serve without remuneration, except to the extent that they are reimbursed for expenses in attending meetings.

The four paid officials of the council are the president and the three vice presidents, all of whom are statutory appointees—that is, the positions are laid down in the Act of Parliament under which the National Research Council operates. For reasons which are given below, the character of the Research Council is so completely nonpolitical that there has not been any attempt on the part of any government party to make political appointments to these offices. The president not only presides over the council but also is in charge of the laboratories. The three vice presidents are responsible to the president for administration, medical research, and science, respectively.

Perhaps the most unusual feature of the National Research Council is that it is not a government department, nor is it associated with a government department. Policy is determined by the council itself, most of whose members, as noted above, are completely independent and never under any political pressure. Moreover, unlike the situation in government departments, the selection of laboratory staff is approved by the council, and staff-members are not engaged through the offices of the Civil Service Commission. Purchasing also is administered by the council, and the arrangement provides somewhat more freedom in financing than is normally possible in a government department. Revenue earned by government departments normally is credited to "consolidated revenue" and does not accrue directly to the department earning it. The National Research Council, on the other hand, may retain its revenue and even carry it over beyond a fiscal year, in a so-called "special fund."

As indicated above, the council assumes responsibility not only for the operation of the laboratories but also for assistance to the science and engineering departments of Canadian universities in pursuing research work. This assistance takes the form of grants in aid of research, scholarships, and postdoctoral fellowships. It should be emphasized that the aid is confined entirely to research, as distinct from teaching, and thereby any possible conflict with provincial jurisdiction over education is avoided. Grants in aid of research to universities are made available only to individuals on the staff or, in some cases, to departments, and scholarships are available only to students who have already obtained their bachelor's degree.

One notable advantage of the special fund mentioned earlier is that the council may provide support to universities even though the Government's vote for the annual operation of the council may be delayed—a circumstance which is not unusual. When such a delay occurs, government departments are voted interim funds on a month-to-month basis, but the monthly amount is proportional to the estimate for the year, and therefore it is impossible to pay for large items of equipment which might be purchased in the early part of the fiscal year. It should be noted that the flexibility enjoyed by the Research Council applies only to its grants-in-aid program. The National Research Council laboratories are still subject to the same restrictions as government departments in this respect. The council's accounts are subject to normal government accounting practice and auditing, and funds may not be transferred

from operating votes to capital votes or vice versa, but otherwise there is relative freedom to use available funds in the most effective manner. The advantage becomes very apparent when council grants are compared with grants awarded by other bodies which are subject to a much more rigid control—sometimes so rigid that the effectiveness of the grants and development contracts is substantially reduced.

While the money obtained through revenue is not inconsiderable, the major portion of the money for the operation of the National Research Council is voted by the Government, and naturally the Government must exercise some control over the expenditure of the taxpayers' money. Accordingly, the council reports, not to a cabinet minister as such, but rather to a committee of the Cabinet, and it is the chairman of the committee who presents the council's budget to Parliament.

In one respect, Canada is very fortunate. Despite the fact that the per capita effort devoted to civilian scientific research by the Government compares favorably with that in the United States, the relatively smaller population makes it possible for all grants in aid of research and for scholarships to postgraduate students to be reviewed by a single body of men, thereby assuring a satisfactory relative assessment. These men are assisted in this work by the permanent staff of the laboratory, who undertake to provide the essential information in assessing the applications and proposals, but the final decision is made by the council itself. The aid from the National Research Council for research is substantially greater than that from any other Canadian body and is devoted to the promotion of both pure and applied research. Not only is money made available for research projects, including the equipment which may be essential for the specific projects, but special capital grants are made for the purchase of equipment which may be generally useful for research. Capital grants are usually made for equipment costing in excess of $5000.

However, every effort is made to avoid unnecessary red tape. Equipment purchased through grants, except in very special cases, becomes the property of the university, and the council makes no claim for patent rights on inventions which may result from the grants. A minimum of accounting is required. The restrictions imposed are designed mainly to insure that the money is spent in such a way as to benefit the maximum number of researchers to the greatest possible extent. For this reason, limits are imposed on the salaries which may be paid to graduate students, and, in particular, graduate students are not permitted to earn more than National Research Council scholarship holders. Money from grants may, through special permission, be made available for travel, and special travel grants are available to enable Canadian scientists to travel abroad.

Scientific Divisions

The laboratories of the National Research Council in Canada have eight scientific divisions, which devote their attention to applied biology, pure physics, applied physics, pure chemistry, applied chemistry, building research, mechanical engineering, and radio and electrical engineering, respectively. The council does not operate laboratories devoted to medical research, but the vice president in charge of medical research devotes his effort mainly to the support of medical research in universities and other institutions. He presides over a medical committee which recommends the award of scholarships to be made in the medical field. The final decision is, of course, still the prerogative of the National Research Council. In addition to the divisions mentioned above, which are located in the city of Ottawa, the council also has two regional laboratories, both devoted to biological problems. The one is located on the East Coast in the city of Halifax, Nova Scotia; the other, in the prairie region in the city of Saskatoon, Saskatchewan. There are also other stations located in other parts of the country for specific purposes, including some in the Canadian North.

Almost from their inception, the laboratories of the National Research Council were keenly interested in aerodynamics and aeronautics. The mechanical engineering section of the Division of Physics and Engineering constructed a wind tunnel in 1930, and from that time on, interest in the subject increased rapidly. By 1940, the mechanical engineering section was separated from the Division of Physics and became the Division of Mechanical Engineering. It began the construction of a new and larger wind tunnel, and as time went on it added further facilities for research in aerodynamics and in the development of aeronautics. The value of this service is inestimable, and as a result, some distinctive Canadian types of aircraft emerged. The Division of Mechanical Engineering provided the major aeronautical facility in the country; later it was formed into the National Aeronautical Establishment, operated by the National Research Council. The work has been carried on in close collaboration with the Armed Services, the Defence Research Board, the Department of Transport, and industry. Government interests are represented on the National Aeronautical Research Committee, which is the policy-making body for aeronautical research. Industry is represented through advisory committees.

While the Defence Research Board, as mentioned above, was created to assume responsibility for scientific work in connection with the Armed Services, the National Research Council still plays an important part and assists in several phases of defense. The work of the National Aeronautical Establishment is only one example of this defense activity on the part of the National Research Council.

While the council has a strong group engaged on fundamental research, slightly more than 50 percent of its effort is devoted to applied research. This work may be undertaken on the initiative of the laboratory, subject always to the general control of the council, or at the request of industrial or other organizations, in which case a charge is made. In addition, the council operates a Technical Information Service, which will provide industrial or other organizations with available technical information without charge. The Technical Information Service is generally operated in connection with provincial research organizations, to which reference is made below.

The council is charged with the responsibility of providing and maintaining the legal primary standards of the country.

The council's library is the most complete in the country in the technical field and is really a national scientific library for Canada. Its services are available to all persons having a need for technical information, and in addition to lending books and periodicals, it provides, where necessary, a photostatic and microfilm service.

An important factor in the council's operations is the system of postdoctoral fellowships which has been created. This makes it possible for a scientist at doctoral level to pursue work in a field of his choice and in association with a scientist of established competence in that field. The scholarships are tenable in universities and in certain government departments. They are awarded by the

National Research Council and, in the case of postdoctoral fellows in universities, are paid for by the council. The council maintains close control over these fellowships, to make certain both that a high standard is maintained and that fellows are placed in organizations having facilities that will enable them to develop intellectually. These fellowships are available, of course, to graduates outside Canada as well as inside and, in the case of Canadian students, may be held in foreign laboratories.

Shortly after the National Research Council was formed, it instituted a system of associate committees for the purpose of planning programs of research in various fields of activity, bringing into these committees representatives of interested government departments, universities, and industry, as well as individuals in a special position to make a personal contribution to the problem being studied. There are now 28 associate committees.

Nuclear Research

No résumé of science in Canada would be complete without some reference to nuclear science. Early in World War II Canada embarked on a study of nuclear physics, aided by many scientists from abroad, some of whom had escaped from Europe just before the German invasion. This work developed rapidly, and it was encouraged by the discovery of large deposits of uranium in the country. Security restrictions demanded that the work on nuclear physics should be well isolated, and it was absorbed by a separate branch of the council. The branch quickly assumed a position of special importance, and, of course, its annual budget grew accordingly. The production of radioactive isotopes became a significant item in its operations. With the advent of this commercial aspect of research, the branch reached a size which warranted separation from the National Research Council, and a Crown company was created which continued to distribute radioactive isotopes and also continued research in the nuclear field. This organization is the major center of nuclear research in Canada, although there is increasing development of nuclear research in Canadian universities.

The Atomic Energy Control Board, which controls the distribution of radioactive materials in the country, also awards grants in aid of research through the National Research Council, generally in the nuclear field. More recently, Atomic Energy of Canada, the Crown company mentioned above, has collaborated with industry and utilities in the development of an atomic power plant.

Defence Research Board

As indicated above, the Defence Research Board was created shortly after the close of World War II, and the board itself is selected in very much the same manner as that of the National Research Council; however, it comprises a greater percentage of paid officials, largely because a representative of each of the three Armed Services sits on the board. Of the 16 board members, seven are ex officio and are paid government officials. At the present time three other members are appointed from government organizations and are paid officials. Often there is an interlocking of membership between the Defence Research Board and the National Research Council, and at all times there is the closest collaboration between the two bodies. There is one major difference, however, and that is that the Defence Research Board operates within the framework of the Department of National Defence.

As in the case of the National Research Council, the Defence Research Board gives grants in aid of research, and the board's assistance to universities has become an important factor in the development of science in Canada. It operates, of course, an extensive system of laboratories. Most of the effort is devoted to applied research of direct interest to the Armed Services, and even the more fundamental research supported by the board is selected with a view to its potential defense application. The Defence Research Board enjoys a much greater freedom in the selection of staff than do government departments in general, being comparable with the National Research Council in this respect. However, purchasing is more restricted than it is in the Research Council, and the essential security regulations do impose other restrictions. For example, it is not practicable to introduce the postdoctoral fellowship scheme in the Defence Research Board because of security problems. The laboratory staff is civilian, and the chairman of the board enjoys a status equivalent to that of a chief of staff and attends meetings of the Joint Chiefs of Staff.

Despite the obvious emphasis which must be placed on applied research, the Defence Research Board has found it possible to devote a significant effort to more fundamental research, and encouraging results have emerged. Its major establishments are the Pacific Naval Laboratory at Esquimalt, British Columbia; an experimental station at Suffield, Alberta; a northern laboratory at Fort Churchill, Manitoba; a medical laboratory in Toronto; a series of chemical, electronics, and radiophysics laboratories in Ottawa; an armament research and development establishment outside of Quebec City; and a naval research establishment at Halifax, Nova Scotia. There are, of course, in addition several stations in various parts of the country devoted to specialized investigations.

Because of the smaller scale of military operations in Canada as compared with those in the United States, it is possible to have a single organization to assume responsibility for the scientific efforts of all three Armed Services. Some of the work is undertaken under contract with industry and universities, and some is undertaken by the National Research Council.

Obviously, it would be inappropriate to outline the applied fields in which the Defence Research Board is active, but it is of interest to note that the more fundamental fields embrace oceanography, physics, chemistry, the ionosphere, electromagnetic propagation, and so on.

Other Government Research

Several other government departments have research establishments, but they operate on a much smaller scale than either the National Research Council or the Defence Research Board, and they devote their efforts largely to practical problems with which the departments are confronted. Nevertheless, as in the case of the Dominion Observatory, most of these departments do undertake some fundamental work. Because of the very intimate responsibility of each government department for scientific developments in its particular field, there has never been a suggestion that the scientific work of the various departments should be consolidated in a single laboratory. While these activities may not be regarded as "organized" science, it is important to recognize their existence and the fields of activity covered.

The Department of Agriculture operates extensive laboratories in various parts of the country, and there is some very effective fundamental research in progress under the auspices of the Science Service Division. This division con-

cerns itself with bacteriology, botany and plant pathology, chemistry, entomology, and forest biology.

The Department of Northern Affairs and National Resources operates a Forest Research Division and a Forest Products Laboratory. The latter laboratory concerns itself mainly with the properties of wood and timber and their application.

The Department of Mines and Technical Surveys operates an extensive Mines Branch Laboratory, which deals with fuels (mainly fossil fuels), industrial minerals, and metallurgy.

The Fisheries Research Board, originally organized in 1912 as the Biological Board of Canada, was reorganized in 1938 under its present name, and its laboratories are operated by the Fisheries Department. It has stations on both the Atlantic and Pacific coasts as well as an inland station in the Province of Quebec. It studies fishing techniques as well as processing, preservation, and conservation.

The Department of National Health and Welfare maintains laboratories, mainly for the protection of the public rather than as instruments of research.

Several other government departments, including the Department of Public Works, the Post Office Department, the Department of Justice, and the Department of Transport, operate small laboratories for the study of specific departmental problems, but these activities could hardly be regarded as organized science in the sense in which the term is considered in this article.

Where coordination of effort is required, there is an advisory panel composed of the deputy ministers of those government departments most actively engaged in science. The chairman is the president of the National Research Council.

Provincial Research

Because of local problems with which they are confronted, some of the provinces of Canada have created research organizations; these are devoted mainly to applied research, but some of them undertake a limited amount of fundamental research. Some of the latter receive financial assistance from the National Research Council. In general, the provincial research organizations concern themselves with the development of provincial industries, and they work very closely with industry. Somtimes they are self-supporting, except for very minor grants. In all cases, research is under the direction of a board or council, and some of the organizations operate locally in a manner very similar to that in which the National Research Council operates on a national scale. The provinces of British Columbia, Alberta, Saskatchewan, Ontario, and Nova Scotia have such facilities.

University Research

As indicated above, university research is supported largely by the National Research Council and the Defence Research Board, but other organizations make important contributions. The Industrial Foundation on Education was organized in 1956 by some of the major Canadian industries. The main purpose of the foundation is to foster scientific education both in secondary schools and in universities, although its effort is not confined entirely to science. It has undertaken to provide financial support without limiting in any way the freedom of the universities and to assist the teaching staff as well as support research. Industry frequently gives local assistance.

Within the last two decades the purer sciences have developed markedly in Canadian universities, and most science departments have built very effective research teams and are making significant contributions to the world's science.

Through the generosity of various agencies, some of the universities have been able to install expensive equipment to provide research facilities for staff and students. An atomic reactor is being installed at one university, and particle accelerators are available at others. The engineering departments have not advanced so rapidly, but very recently there has been encouraging activity. Whereas a few years ago most of the engineering staff engaged in consulting practice during the summer, many are now remaining in the universities to pursue research.

Industrial Research

Industry still relies very extensively on foreign parent firms for research, development, and design. The chemical industries are an exception, and there is a growing tendency for other industry to become more independent. It seems likely that this trend will accelerate. A number of firms have set up research laboratories, although some have done so not so much for the benefit of their own products as for the purpose of undertaking development contracts for the Government or other bodies. There has been an increasing record of achievement in the industrial laboratories, and a number of new products have been developed which have enjoyed outstanding commercial success. Some industrial laboratories are handicapped by the fact that they must sell their services to the other divisions of their respective companies, which, because of their ties with parent firms, have little interest in laboratories except for control purposes or to insure that either the purchased materials and components or the finished products comply with specifications, and opportunities for speculative research are inadequate.

Research associations have not been as popular in Canada as in Great Britain, probably for the reason mentioned above. Nevertheless, at least two industries have formed associations, and one in particular has achieved an encouraging degree of success.

There are no privately endowed, self-supporting research institutes of the type which has developed so successfully in the United States.

Conclusion

While the per capita effort devoted to government civilian science in Canada compares favorably with that in most other highly industrialized countries, the relatively small population makes possible a much more compact scientific organization, and there is a corresponding reduction in the problems associated with the organization of science. It is possible to have one organization which in large measure performs the functions of the National Science Foundation and the National Bureau of Standards in the United States. To a lesser extent, portions of the National Research Council, acting in collaboration with the Defence Research Board and the Department of Transport, serve a purpose similar to that of the National Advisory Committee on Aeronautics in the United States and its successor, the National Aeronautics and Space Administration. Nevertheless, aside from the advantages that Canada enjoys because of the reduced scale of operation, the organization has avoided many of the difficulties which arise because of restrictions necessarily imposed upon government departments. It is believed that the Canadian system avoids

the dangers of changing political view and at the same time maintains an effective control to insure a high level of competence.

Canada possesses a wealth of natural resources, and their development will make heavy demands on science. Progress has been encouraging, particularly in the fundamental sciences, but there are still areas in which greater effort is required. Undoubtedly, increasing population and increasing university effort will introduce greater complications in organizing effectively for the future scientific activities of Canada. It seems likely that the trend will be a growth of the National Research Council to a point at which some portion becomes disproportionate in size to the remainder, and that this portion will then be separated and embodied in a new organization, in much the same manner that Atomic Energy of Canada achieved separate status.

Organization of Science Here and Abroad

Varying national patterns for support of science result from basic constitutional differences.

Don K. Price

In considering the merits of various forms of government, and particularly of the various patterns of government organization for the support of science, it is a great temptation to think in conventional mechanical terms. The organization chart has bemused us into believing that we have a simple choice to make between various clear-cut alternatives; as one author recently put the matter, political science is a much simpler subject than any of the natural sciences, because there are basically only a few different forms of government and the problem is simply to select one of them.

But this general symposium, I am glad to see, has not fallen into this way of thinking, which is as obsolete in the 20th century world as Newtonian physics. Hiscocks, in describing a system in which the status of science is intertwined with the rich historical traditions of the Privy Council; Ballard, who looks on government organization in Canada in its complex interconnection with the structure of great international business corporations; and Major, whose account of similar problems in Norway leads us into the background of three Scandinavian dynasties, the future complexities of European integration, and the contemporary arrangements for diverting football pools into the support of research—all of them have illustrated the fascinating complexity of our problem.

But I do not think I can follow their example and give you, with respect to the United States, a summary outline of our scientific organization. My assignment is rather to draw comparisons. This, I think, can be done best not by looking closely at organization charts but by trying to trace some of the main threads of similarity and difference that mark our several systems. And if I note some of the unique points in the American system, no one should take me to mean that I consider them points which other countries should imitate. Hiscocks, for example, was quite right in suggesting that in many ways an ideal pattern would lie somewhere between the British and the American extremes.

I am tempted to define those extremes by comparing the official role of science in British society with the way in which American scientists actually operate. Hiscocks quoted Hooke as defining the role of the Royal Society thus, in the 17th century: "To improve the knowledge of all natural things . . . by Experiment (not meddling with Divinity, Metaphysics, Moralls, Politicks, Grammar, Rhetoric, or Logick)." Science, like administration, has always in the United Kingdom dutifully acknowledged its subordination to, or at least its separation from, politics. If we are to contrast our classic traditions, I would like to recall the chief of the Patent Office in the days of John Quincy Adams who was discharged not for lack of scientific ability but because he grossly neglected his duties in order to spend his time in stirring up republican revolutions in Latin America.

But this is an unfair contrast. Much more to the point is Hiscocks' observation that the British are traditionally strong on the side of basic science; the Americans, on applied science and engineering. We may note a parallel tendency with respect to the type of interest that natural scientists typically take in governmental affairs. For in recent decades it has been the British and European scientists who have shown their interest in governmental affairs by theoretical writings on the relation of science to politics, while in politics, as in science and technology, the interest of leading American scientists has been channeled into participation in specific program fields. For some reason it is we, rather than the British, who are working things out in this business by a pragmatic rather than an abstract philosophy.

If we are to search for an explanation, I am tempted to follow up on Ballard's cue. He noted that "the fact that the distribution of executive and administrative responsibility in the Canadian Government departs from that in the American Government has probably influenced significantly the organization of science in the two countries." For what he says of the Canadian government applies, I believe, to the Norwegian as well, and even more to the British.

Mr. Price is dean of the Graduate School of Public Administration of Harvard University. This article is adapted from an address delivered 27 Dec. 1958 at a symposium, "Moving Frontiers of Science: Comparative Patterns of Scientific Organization," held during the Washington meeting of the AAAS. This article and the preceding one, by B. G. Ballard, were presented during part 2 of the symposium. The papers presented during part 1 of the symposium appeared in last week's issue.