

able dimensions. There is no question that the Council has had a decisive influence in aiding the development of science in Canadian universities.

"One result has been to produce a reverse flow of students of great magnitude. Forty years ago it was almost unthinkable that a bright student in science, engineering or medicine should take his post-graduate education in Canada. His basic training was taken here, but he was always 'finished off' in Europe. Today there is far more movement in the opposite direction, and very large groups of foreign students 'finish off' in Canadian universities. They come to many government laboratories as well. The National Research Council, for example, has at all times post-doctorate scientists from 20 or more countries completing their education in research in its laboratories. In fact in its pure science divisions the Council has a more cosmopolitan group of younger research workers than could be found in any European university. The traditional isolation of Canadian scholars is long past, especially in science.

LABORATORIES

"The second major function of the National Research Council is the operation of laboratories. These form by far the largest industrial research laboratory in Canada. The general organization is complex and very much decentralized. Since governments tend to centralization, this presented many problems. Decentralization has, however, been accomplished because of two main factors. The first of these is the development of an administration whose main function is the protection of the scientist to the greatest possible extent from the red-tape inevitable in government operations. The second factor has been the very far-sighted attitudes of successive governments in leaving the Council free of many hampering restrictions. In every field the problems differ and each scientific division thus has special features of its own. Nothing could be worse than the 'Big Organization' point of view, which regards uniformity of administration as an end in itself. Financial control is, of course, essential. The balance sheet, however, is no more the criterion of efficiency for a scientific organization than it is for a charitable one.

"The activities of the laboratories cover the whole technical range from pure science to consulting and testing services. The problems range all the way from pure chemistry and physics to testing lubricating oils, and from calibrating surveying tapes to getting the William Carson into Port-aux-Basques harbour. In view of the complexity of these operations it is desirable to ask how the functions of a government laboratory dovetail into those of a university and an industrial laboratory. It

can be convincingly argued that the larger, and in many ways more expensive laboratories which carry on long-term applied research which has applications to industry as a whole should be sponsored by government or public bodies, and in many countries this has happened. Also, if all private industries could afford to operate research laboratories, they would naturally take care of their own immediate *ad hoc* problems, since such activities show an immediate profit. All very large industries and many moderate-sized industries should and usually do operate such laboratories, but in Canada and most other countries over 95 per cent of all industries are so small that it is entirely impracticable for them to operate their own research laboratories. This problem can only be solved by some form of public support.

"Over the years in Canada a network of Research Councils has been built up, starting with the National Research Council in 1916 (with laboratories of its own in 1932), and now extending to more than half the provinces. All these have followed the tradition of having much more freedom of action than does a normal government department, and they have constituted a considerable Canadian achievement.

"Based on the experience of the National Research Council, there are a wide variety of types of work which such organizations are called upon to do. As far as the National Research Council is concerned the list includes fundamental work, long-term applied work with no specific objective, work on specific industrial problems, short-term industrial problems (i.e., *ad hoc* investigations), investigations for the Services, consulting, testing, specifications, and miscellaneous enquiries. All of these are important but it is essential if the organization is to develop any reputation or scientific self-respect that the *ad hoc* and routine-enquiry type of problem shall not be allowed to force real research out of the door. It is very easy for this to happen and in many laboratories of similar type in other countries it has happened. As far as the National Research Council is concerned, long-term investigations, fundamental or applied, must constitute the major effort of the laboratories if they are to keep the scientific reputation they have earned.

"A most vital feature of the Research Council has been its dual function. By being responsible both for university support and the operation of laboratories it has been able to avoid two pitfalls. In the first place as an operating laboratory it can retain first-rate scientists, and avoid a narrow bureaucratic outlook in dealing with the university programme. Secondly, by maintaining the interest and active participation of university people, it can maintain the scientific standards of its laboratories.