

Council were named and charged with wide responsibilities. Why did this happen in 1916? There were two reasons. First, the allies had become painfully aware that the Germans were far ahead of them in organizing and adopting the application of science for practical purposes in war and peace.

The Government of Great Britain set up an organization for scientific and industrial research and suggested that the Canadian Government do likewise, which was done.

Secondly, the war had seriously reduced the sales of many industries in Canada and their representatives also pressed for government assistance in making available to them the advantage of organized programs of industrial research.

In 1919 the Chairman of the National Research Council, Dr. A. B. Macallum, made many speeches across the country. He was a good scientist and fine crusader as well. He made four points that I am going to quote to give you some idea of how small our scientific effort was then. "In 1919 there were 37 industrial research laboratories in the Dominion of Canada that had one scientist" and "only seven firms that had laboratories with four or more scientists". So probably the total number of scientists employed in industrial research laboratories in 1919 was not more than 50 or 60; whereas today there are over 6,000 people employed in industrial research establishments in Canada.

Macallum stated that in the whole country there were only 50 qualified research people. Today we have what?—Eight to ten thousand. From 1896 when the first Ph.D. course was instituted in Toronto to 1919 there were only 11 Ph.D. degrees granted in the entire Dominion of Canada.

Now, how could there be much research when there were so few people qualified to do it? I suppose there was not a professor in Canada at that time who had a Ph.D. degree from a Canadian university. The National Research Council was instructed "to co-ordinate and promote science and industrial research in Canada." The Council members soon realized that there was nothing to co-ordinate.

How did the National Research Council start to promote scientific research? They did it by recognizing that the immediate task was to build up scientific research and teaching facilities in Canadian universities to supply the necessary scientists. They started off by

granting scholarships, but they did not just stop at that. They also made research grants to Canadian universities, but they did something else which, to me, seems of basic importance. They said, "Unless we make these scholarships tenable only in Canadian universities for the present, our students will go abroad; there will be little development in university research facilities here, and Canada will still be more or less a colony as far as science is concerned." For nearly 50 years the National Research Council has continued to support, by increasing sums, our universities; and it is certain that if this had not been done the scientific and research competence at our Canadian universities would not have attained the high level found today.

In 1939 the total expenditure by the federal Government for research and development was about \$5 million. Eighty per cent of that was for research in natural resources and only 20 per cent went for what we would now call industrial research. I think the expenditures in natural resources paid magnificent dividends, but the support for secondary industry was limited in money and effect. The war changed all that.

In 1935 the N.R.C. had a total staff of 300 and a budget of about \$1 million. By the end of the war a direct and indirect staff of about 2,000 was directing research expenditure of over \$10 million. As N.R.C. was responsible for government support of scientific and industrial research, these statistics illustrate how the war accelerated Canada's participation in this area.

In 1963 I was asked to make a report to the Government on the organization of science. I will sketch briefly the picture as I saw it in 1963, before the scientific secretariat and scientific council were set up. In 1963 private industry was much more research-oriented than in 1939 and was spending \$155 million in industrial research. There were many efficient research laboratories, small and large, and about 700 companies with well-defined research programs. While the research and development programs of Canadian industry are less extensive than is desirable, the recent progress is impressive. The Dominion Bureau of Statistics reports show that from 1961 to 1965 the total number of people engaged in research and development has increased from about 4,800 to 6,400, and the qualified research personnel have increased from 1,000 to 1,500, of which 800 have doctorate degrees.