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BY
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An Address to The Empire Club of Canada
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By
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I think that the Empire Club of Toronto must be an exceptionally intelligent and discriminating audience. I have been asked by many organizations to address them once, by a few twice, but the Empire Club of Toronto is the only one that has asked me to speak three times. I usually speak about the work of the Defence Research Board but since you have tolerantly listened to two addresses on that subject I felt that you deserved a change of diet on this occasion.

I have just returned from a brief trip to India and Pakistan where I attended a meeting of the Commonwealth Advisory Committee on Defence Science. This visit, and an earlier one to Australia, have naturally turned my thoughts to the research and especially defence research that is going on throughout the Commonwealth. It therefore occurred to me that you might be interested in a brief report on what I saw in India and of the impressions that I gained there concerning research activities in other parts of the Commonwealth. Thus I should like to tell you first about the work in India, then run quickly over the activities of the other members of the Commonwealth and finally, with the benefit of this perspective, re-survey our own effort here in Canada.

I am sure that if the average citizen were asked what he knew about scientific research and especially defence research in the Commonwealth he would be able to say a good deal about what had gone on in the United Kingdom, a little about work in Canada, and he would probably have heard about the guided missile range in Australia. He would deem it natural that the U.K. should play a leading role in the Commonwealth and indeed in the world in research, that Canada with her rapidly growing population and high level of industrialization should be the next important centre of research in the Commonwealth and that Australia should be a close third. However, I doubt if any Canadian would even think of India in connection with scientific research and yet India has a large and important research organization.

Ordinary scientific and industrial research in India is the responsibility of the Department of Scientific Research in the central government. The importance that is attached to scientific research is shown by the existence of an advisory committee for coordinating scientific work whose chairman is Mr. Nehru himself. Within the Department of Scientific Research is a Council for Scientific and Industrial Research which operates eleven major research laboratories. I was able to pay a brief visit to one of these, the National Physical Laboratory in Delhi, and to see another, the National Chemical Laboratory in Poona. Each of these laboratories is housed in a fine new building larger and more modern than any single laboratory building that we have in Canada. In addition to these main laboratories that deal primarily with basic research there are many smaller laboratories dealing with the problems of particular industries. There are also other important applied research laboratories such as the Agricultural Research Institute which do not come under the Council for Scientific and Industrial Research. Also under the Department of Scientific Research are the Atomic Energy Commission and the Indian scientific liaison office in the United Kingdom. The Atomic Energy Commission is concerned mainly with fundamental research work at the universities and in the Tata Institute of Fundamental Research in Bombay and with problems associated with the discovery of uranium and the processing of thorium from the huge monazite sand deposits of southern India.

In comparison with these substantial resources for civilian research the defence research organization in India is new and very modest. It consists primarily of a small laboratory which is at present housed in the National Physical Laboratory in Delhi. The laboratory is under the direction of Dr. D. S. Kothari, Scientific Adviser to the Minister of Defence, and deals with a considerable range of problems of immediate practical importance to the Indian services. It represents a small but well planned and competent start on a defence research organization. By working in close cooperation with technical schools in the armed services and with development agencies in ordnance factories it will be able to exert an influence out of all proportion to its size.

I was not in India long enough to form a reliable opinion of the quality of the work that is done in the research establishments but judging from the little I did see and from what I have heard before and since my visit it seems clear that the best scientific research that is done in India is as good as that done anywhere in the world. The average level of competence in these big labs may well be lower than in comparable labs in Canada, partly because the advanced education and post-graduate training required to make first-class research workers is not yet widely available in India and partly because the type of problem that has to be tackled in the applied research establishments of a relatively unindustrialized country do not demand the talents of the highest class of research worker. It has been said, and I think with some truth, that in the first enthusiastic days of the new Republic the Indians did over-expand their research facilities and probably spent more on research laboratories than canny Canadians would feel was necessary. However, in the modern world there is no doubt that a country is better off to have its scientific research facilities a little in advance of industrial and defence needs rather than lagging behind. The existence of these fine laboratories should attract more and better people into science and so increase the contribution that Indian scientists can make to the progressive development of their country.

Before leaving India I cannot resist commenting upon the infectious enthusiasm with which the government officials we encountered were tackling the difficult problems that beset them. India is a country in which famine is always just around the corner and the average standard of living is very low. The government has embarked upon a five-year plan to increase the agricultural output, improve the standard of life in the villages and increase the industrialization of the country. The officials that I met were devoting themselves to the achievement of these objectives with a missionary enthusiasm that was most exciting and stimulating. I had an opportunity of discussing the programmes with several experts and there seems to be a general feeling that they will in the main achieve their objectives. I came away from India with the firm feeling that at least the top administrators that I met were a most devoted group who were trying hard to solve extremely difficult problems and that they deserved all the support and assistance that we could give them. It is quite likely that they will be successful in solving the problems of the next few years. However, I do not see how it will ever be possible to achieve even guaranteed protection against famine unless some form of population control can be discovered and applied.

Pakistan has made a much less ambitious start on scientific research. Unfortunately a large proportion of the teachers of science in the universities of Pakistan were Hindus and went to India when partition occurred. Consequently the first task that Pakistan has undertaken in building up a research organization is to restore the foundation of scientific teaching in its universities. However, in spite of these difficulties a Council for Scientific and Industrial Research has been formed and a small laboratory is already doing important industrial research in Karachi. A Scientific Adviser to the Minister of Defence was appointed some years ago but he has as yet no research laboratories or staff.

I fear that in my enthusiasm to discuss the problems of India and Pakistan I have wandered far from defence science. I have also demonstrated the typical reactions of the tourist. Having been in India only two weeks, my impressions regarding the country and its problems are clear-cut and the solutions to the problems seem obvious though not necessarily always attainable. I am sure that after two years in India the blacks and whites of my opinions would be much less vivid.

I also had the good fortune to visit Australia last September and October in connection with the British atomic bomb trials. I flew from England in an RAF plane with Sir William Penney. We entered Australia at Darwin in the Northern Territories and flew directly to Woomera to inspect the guided missile range before going on to the site of the atomic bomb trial at the Monte Bello islands. The guided missile range is a remarkable achievement and one of which Australians can well be proud. I feel sure that in the future it will become one of the main centres of guided missile development in the world. It is located in central Australia. The firing point is about 300 miles north and a little west of Adelaide. Near the firing point is the town of Woomera. This town has been built from the ground up since the war. In addition excellent test facilities, including two airfields and extensive instrumentation have

been installed. I was greatly impressed not only with the competence of the organization and construction but with the enthusiasm and high morale of the people who worked on the project. The guided missile range is a joint British-Australian project but almost the entire cost has been borne by Australia.

However, the guided missile project is not the whole of Australia's effort in defence science. The Research and Development Branch of the Department of Supply which controls the Long-Range Weapons Establishment also operates six other laboratories concerned with defence science. These include the Aeronautical Research Laboratories, the Defence Standards Laboratories, and the Chemical and Physical Research Laboratories in Melbourne and the High-Speed Aerodynamics Propulsion and Electronics Laboratory at Salisbury, near Adelaide. The total scientific staff of this organization is about equal to the scientific staff of the Defence Research Board or the National Research Council in Canada. Australia also has a very strong Commonwealth Scientific and Industrial Research Organization consisting of fifteen divisions, each with a major research establishment and many smaller sections.

I have never had an opportunity to visit New Zealand but have long been aware of the competent research that is carried out under their Department of Scientific and Industrial Research. This Department was established as far back as 1926 and has gradually built up a series of applied research laboratories which not only do applied research for industry but also supply scientific services to other government departments. During the war this organization did excellent defence research and since the war a small nucleus of workers in several of the laboratories have continued to help the armed services with their problems.

In South Africa the arrangements for defence research are somewhat similar. The Council for Scientific and Industrial Research which was established just after World War II operates a series of research laboratories. The South African Army has as an element of it the South African Corps of Scientists. This consists of a small number of younger scientists with commissions in the Army who work on scientific problems for the services. Most of their actual work is done in the laboratories of the Council for Scientific and Industrial Research.

It is obviously not possible in such a brief talk to give more than passing mention to the vast scope of research and development for the armed services in the United Kingdom. Britain devotes a higher percentage of its defence budget to research and development than does any other country in the world. This large-scale expenditure is sometimes criticized as being extravagant. However, from my own personal observations of military research and development in the United Kingdom I would say that it is more effectively organized and more efficiently run than any other research effort of comparable size in the world. It was, in fact, reasonably well argued that Britain's expenditure on defence research prior to World War II led to the development of radar, the jet engine, the Spitfire fighter, and in fact the whole air defence system that won the Battle of Britain and prevented the loss of the war.

The outstanding achievements of the British research and development organization since the war are probably the development of an atomic bomb and the maintenance of their lead in jet engines. British scientists and engineers certainly deserve the highest praise for the accomplishment of designing, building and testing an atomic weapon in the short space of five years. It is fortunate that Canadian research at Chalk River was able to give the British substantial support in their efforts but nonetheless the principal credit should go to the British scientists. At the end of the war Britain had a substantial lead over the United States in the development of jet engines. Since then the two countries have engaged in a friendly and cooperative but nonetheless competitive race in this field. British scientists and engineers are happy to feel that they are holding their own in this race. It should be a source of satisfaction to us in Canada and to others in the free world that this competition does exist because it is through this sort of friendly rivalry that the most rapid progress is achieved.

After surveying progress in defence science in other parts of the Commonwealth it is natural that we should look critically at our achievements in Canada. I feel that we can on the whole be very well satisfied with the general growth of science in Canada. We have in the Canadian universities a splendid

foundation for the whole scientific community. The universities not only train scientists and engineers who will apply their knowledge to the practical problems of the nation but they also conduct first-class fundamental research. This in turn attracts new generations of scientists into research and gives them the basic training in the methods of science which will later enable them to continue the advance of knowledge on many fronts.

Government research in Canada is remarkably strong. It is led by the National Research Council with its main laboratories in Ottawa and branch laboratories in Saskatoon and Halifax and by two lusty offspring, Atomic Energy of Canada Limited, which operates the atomic energy project at Chalk River, and the National Aeronautical Establishment. But although the National Research Council is often thought of as the civil scientific side of the federal government, it represents only a small part of the total research expenditure of the government. Other important elements in the government's programme include research in the Experimental Farms and Science Service divisions of the Department of Agriculture, in many branches of the Departments of Mines and Technical Surveys and Resources and Development, including such important laboratories as the Mines Branch, the Forest Products Laboratory, and many others. In fact nearly every branch of government now includes some element of scientific research. Many of these, such as the Fisheries Research Board and the several laboratories of the Department of National Health and Welfare, play a dominant part in the affairs of the departments that they serve.

In addition to the federal government effort in research many of the provinces have provincial research organizations. In most cases these organizations operate an information service and do applied research. They attempt to help local industries to solve their own peculiar problems and in doing so call upon the knowledge and resources of all the other research elements in the country. And finally, on the civil side, there is research in industry. In the past Canada naturally imported in the form of finished products or blueprints a large proportion of the research results required to support her industries. However, since World War II there has been a rapid increase in the amount of research, development and design done in Canadian industry. A few of the larger industries now have quite important research laboratories. Many industries have competent development teams that make an essential contribution to their industries by designing and developing new products. In a good many cases even the Canadian subsidiaries of large American corporations are setting up independent research laboratories in Canada. The most tangible evidence of this growing emphasis on design and development in Canadian industry is the insatiable demand for engineers and even scientists in industry. The huge engineering classes of the post-war years have already been completely absorbed without saturating the demand.

Even a brief survey of this whole structure for non-military research in Canada suggests that on the whole its growth has been remarkably rapid and well coordinated. If it retains a proper balance during the expected expansion of the next decade there will be a spectacular increase in the scope of industrial research and a much more modest but greatly needed increase in the basic support for research in the universities.

Prior to World War II Canada had no organized research for defence. However, with the rapid industrialization of Canada and the growing importance of science in war it was recognized that Canada must follow the pattern of other industrial nations and establish an applied research organization dealing particularly with the problems of the armed forces. This was done by the formation of the Defence Research Board. When we see the healthy state of the rest of the scientific community in Canada and of the Canadian armed forces it is small wonder that a defence research organization should have prospered in Canada. The Board, which was formed only in 1947, now has under it a defence scientific service comparable in size to the staff of the National Research Council. It operates twelve laboratories scattered across Canada from Halifax to Esquimalt and from Toronto to Churchill. It has the most friendly relations with all the other elements of the scientific community in Canada and regularly enlists their support in defence work. It also has cordial relationships with all the defence science organizations in the Commonwealth and throughout the rest of the free world. I am obviously not the best person to give you an objective view of its accomplishments. However, I am confident that, by rigidly following a policy of specialization

in problems of particular importance to Canada, it has established a reputation for doing first-class work. I will not bore you with a detailed survey of its organization and achievements. It is sufficient merely to note how the post-war evolution of the defence research organization has completed the structure of the scientific community in Canada and helped to keep the Canadian services and Canadian industry abreast of progress in other comparable countries throughout the world.

I have said a good deal about defence science in the Commonwealth and mentioned the Commonwealth Advisory Committee on Defence Science. I do not wish to leave with you the impression that there is any closely knit organization of defence science within the Commonwealth or that the Commonwealth attempts to speak with one voice in this field. The real situation is quite the contrary. At a Commonwealth Conference on Defence Science each nation speaks as an independent and sovereign state. Each one reserves the right to make its own decisions on policy and to make its own arrangements for the exchange of information with other nations whether within or outside the Commonwealth. It is for instance clearly recognized that we in Canada have a very special position in relationship to the United States. We have the common problem of defending North America and the great advantage of being close and friendly neighbours. Other members of the Commonwealth sometimes envy us our enduring association with the United States but they do not feel that this is in any way bound up with our Commonwealth associations.

In conclusion I would like to say a brief word about the impression of Canada's position in the world today that I have gained as the result of my trips to Australia and India. As a Canadian I find myself both pleased and embarrassed by the sincere attitude of friendship and admiration with which Canadians are greeted in every country that I have visited. This general attitude makes travel a real pleasure for a Canadian. The embarrassment arises when one starts to wonder whether we in Canada have really done enough to deserve this special attention. I asked several of my friends in other countries this question and they have all said that they did feel that Canada and Canadians deserved the admiration and friendship of the rest of the world. They see as we do that we have been remarkably favoured by Providence in having abundant natural resources, in having inherited and developed a remarkably satisfactory system of government, and in having only one neighbour and that one large, powerful and consistently friendly. However, having admitted these natural advantages they contend that Canadians have done a remarkably good job of exploiting these advantages and while doing it have not lost sight of their responsibilities to the community of nations whether in the United Nations, the North Atlantic Treaty Organization, or the Commonwealth. There is also a feeling that if the people of Canada cannot effectively solve their problems then there is little hope for our civilization. They look at Canada and see our free, happy, prosperous and energetic citizens and feel that there is hope for the world and at least some possibility of solving their own much more difficult problems. Our friends throughout the world envy us our motor cars and our television sets, but they do not like and admire us because of our high standard of living but because the Canadians that they have met have been pleasant, modest, honest and friendly. It would lead me too far from the field of defence science to discuss what led this nation to produce people who are regarded with affection throughout the world. I think religion, education, and home environment are the principal factors and we must look critically at modern tendencies in all of these fields to be sure that we are not losing the essential features that have made the nation great. Canadians must not fail to meet the responsibilities that have been thrust upon them by the inheritance of great national wealth, good neighbours and a favoured position in the Commonwealth.