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Address to the Nineteenth Symposium  
of  
The Defence Research Board, Ottawa  
on  
20 November, 1967

by

DR. O.M. SOLANDT

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## THE PLACE OF DEFENCE RESEARCH IN THE SCIENTIFIC COMMUNITY

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DR. O.M. SOLANDT

I was very pleased when Dr. Uffen invited me to speak to you today. Even the thought of the long line of distinguished speakers that I would be following did not spoil my initial pleasure. It was not until much later when I came to write my speech that I began to have misgivings. On thinking over what I might say, I realized more and more that I am becoming a "has been" in the defence field. My upbringing and education were about as far from defence as one could imagine. It was not until the outbreak of World War II in 1939 that I became concerned with defence. For the next 17 years, until I left the Defence Research Board in 1956, I lived continually with defence problems. For the ten years, from 1946 to 1956, I was intimately concerned with every aspect of Canadian defence, although, of course, my primary interest was DRB. From 1956 to the present, my contact with defence has been completely unofficial except for a position as a Trustee of the Mitre Corporation in Boston. I have been Chairman of the Science Council for barely 18 months but this has so far given me very little privileged insight into defence matters in Canada. Consequently, what I have to say today will be said as a reasonably well informed bystander watching with keen personal interest what has been happening in Canadian defence during the past 11 years. It is more than likely that I will not make sufficient allowance for all the important things that have happened during those 11 years and that my view of the future is too greatly influenced by the experience of the post-war years when I was deeply involved in Canadian defence problems. Having been warned, you can apply your own corrections. I must also assure you that the opinions that I will express are entirely personal and do not in any way represent the views of the Science Council nor have they been approved by Dr. Uffen, General Allard, Mr. Armstrong, or any Minister.

But first, I must express the regret that all of us feel for the sudden and unexpected passing of Hartley Zimmerman. He was Chairman of DRB for 11 years, through its most stable period. To oversimplify DRB's history, I was chairman during the period of formation and early growth, Hartley was chairman during the period of relative stability and Bob Uffen now takes over during the period of revolution. Dr. Zimmerman will be remembered for the quiet and effective way in which he presided over the affairs of the Board throughout this very successful period. It is particularly tragic that he should die just when he was getting set to enjoy many years of happy retirement. It is comforting to think that he did have a complete and delightful summer at his beloved Georgian Bay before his untimely death. I know that you would want me to publicly express our sympathy to Mrs. Zimmerman and to his son and daughter.

I am sure that you would not be greatly surprised if I devoted most of my speech to a eulogy of the success of the Defence Research Board over the past 20 years. I shall certainly not miss this opportunity to point with pride but will cut it short because the messages that I want to communicate have to do with the future.

DRB was founded to ensure that the Canadian services had available to them the very best in research and development whether done in Canada or available from our larger partners. It has always been said that the success of DRB should be judged primarily by the success of the Canadian services. If the Canadian services have kept well up with the leaders in the application of science to the solution of their military problems, then DRB has been a success. Judgement of the quality of the R&D done by scientists in DRB by their peers in the scientific community has been considered to be important but of secondary interest. When judged by both these criteria, you will agree that DRB has been successful. The Canadian services have had a first class reputation for scientific and technical competence in their particular fields. They have, with help from DRB, made some very significant independent advances. For example, navigation in the Air Force, variable depth sonar in the Navy, and gunnery in the Army. In addition, the partnership with DRB has given the Canadian Services entree to research and development in the US and UK that would have been much more difficult had we not been doing first class work in Canada. As would be expected when an applied research agency like DRB is successful in serving its customer, it is also highly esteemed in its own sphere. DRB has a first class reputation in the scientific community in Canada and internationally.

Looking back over these twenty years, it is particularly gratifying to see the great contribution that DRB has made to growth in the technical competence of Canadian industry. From the very beginning, DRB working with the services and DDP encouraged the transfer of evolving technology to industry at the earliest possible stage. The program of cooperation that was worked out for Velvet Glove formed the basis for many of the best technical teams in Canadian industry today. Datar, the Doppler Navigation System and the Alouette Satellites are other important examples of this cooperation with industry.

One of the major new scientific developments of World War II was Operational Research. After the War, DRB was able to recruit far more than a fair share of the leaders in this new field and built up powerful operational research staffs both within DRB and in the Canadian Services. The rapid diffusion of this new scientific discipline did much to ensure the intelligent use of science by the Canadian services. In addition, DRB has been the source of many of the best practitioners and teachers of operational research in industry and in the universities. A large part of the modern bodies of knowledge that are known as management science and industrial engineering has grown out of this wartime and post-war operational research. This therefore has represented another major contribution by DRB to the productivity of Canadian industry and to the strength of the Canadian economy.

Much is now said and written about the fall-out from US space programs. A good many keen students of the subject say that the most important fall-out has been a growing understanding of the techniques of systems engineering and of all the intricate processes and procedures that bridge the gap from the first conception of a complex system to its final functioning. The systems that are needed to land a space vehicle on the moon represent a tremendous increase in complexity compared with most of man's previous activities and also require functional reliability of a completely new standard. These new concepts of systems design, procurement, and management may well prove to be one of the most important new elements in the success of industries with high technical content. DRB has been a leader of Canadian efforts in the field. DRTE and CARDE between them are the repository of almost all the knowledge that Canada has accumulated in this field. This 'know-how' represents another of DRB's important contributions to the competence of Canadian industry and a very important resource for the future.

Looking back on my own 10 years with DRB, I realize that our most serious errors arose from a lack of confidence in Canada's ability as a nation to carry through major projects. With the perfect vision of hindsight, I have no doubt whatever that Canadian industry would be technically stronger and more competitive and the taxpayer at least no worse off and probably much better off had we had the resolve to carry projects such as Velvet Glove, Datar and the Arrow aircraft and the Iriquois engine through to completion. One can only hope that the spectacular success of EXPO as a Canadian accomplishment will give us the self-confidence required to complete difficult projects in the future. It is hard now to find the skeptics who loudly declared that EXPO could not be done in Canada. They are hard to find because they are all joining in the chorus of praise for the success of this tremendous venture.

That is all I want to say about the past. I merely want to leave with you the clear impression that during its first 20 years DRB has been a credit to Canada, that it has succeeded in its primary object of helping to ensure the scientific and technical competence of the Canadian services and in its secondary objectives of helping to improve the technical competence of Canadian industry and of building up a research and development team in Canada of which the rest of the scientific community would be proud.

But now is the time for a completely new assessment of DRB and its relation to the services and to the scientific and industrial community in Canada. The Army, the Navy and the Air Force have all disappeared. Canada has a single unified defence service. The role of this service in the defence of Canada and in peace keeping throughout the world has not yet been fully defined but it should emerge very soon. As an aside, I might express the hope that we never again develop a rigid and static outline of the role of the Canadian services. Those of you who are interested in history, will recall that during most of the years from the end of the War of 1812 until World War II, the planned role of the Canadian Services was defence against the United States. Fortunately, everyone now recognizes that the role of the Canadian Services has been and will continue to be constantly changing to adapt to a changing world environment. It is to be hoped that the Government can define this role with reasonable clarity from time to time but we would be better to be a little uncertain about the role at any given time rather than to be rigidly preparing for some role that had long since ceased to make sense.

In addition to the changes in the defence scene, there have been almost equally important changes in the national attitude to science. Political leaders and even the man in the street have come to see that science can make a major contribution toward the solution of our economic and social problems. Formation of the Science Council in 1966 was a tangible institutional recognition of this changing point of view. In the past there was a tendency in the Canadian scientific community to judge research, whether pure or applied, by rigidly objective standards of excellence. Nowadays, scientists, engineers, and even the public are beginning to demand that expenditures for applied research and development be judged first by standards of relevance with excellence as a secondary consideration. To put it bluntly, we now see that there is no point in doing the highest quality of applied research if the results, when available, are of no economic or social value. It is better to do something less exciting but more useful.

Having laid a reasonably firm foundation of verifiable facts as a launching pad, I am going to take off in the wild blue yonder and outline for you a possible vision of a Canadian defence policy for the future, naturally centered around DRB. I believe that what I have to say makes practical sense but I have not checked it with any of the authorities concerned nor can I pretend to be well informed about current developments in Canadian defence policy. It may be that many of the things that I envision are already in hand and that others are obviously impossible; however, I don't think so. I believe that with some minor changes the vision that I will outline is attainable.

I will begin with an outline of the place of defence research in a national science policy. It seems to me that in a nation like Canada, defence research contributes to the nation in three different ways. First, it makes a direct contribution toward the strength and competence of the Canadian Defence Force by ensuring the early and intelligent application of science to the solution of its problems. Second, in helping the Defence Force in the design, development and later production of new weapons, it makes a major contribution toward the growth of technical competence and productivity in industry. Third, it forms an important element in the scientific community, adding to the available store of science and technology and providing challenging jobs for innovative scientists and engineers. In times when the threat of major war is high, absolute priority must be given to the first of these. In times such as the present when the world is far from peaceful but when a major conflict is not immediately imminent, I believe that the balance should shift in favour of the second.

In planning expenditures for defence research, development and procurement, a conscious effort must be made to achieve the best balance of high quality, low cost, and large contribution to improving the technical competence of Canadian industry. Naturally more weight will be given to improvements in

competence that are likely to result in export sales either of military equipment or of products for the civilian market to which newly acquired technology can easily be transferred. The pursuit of such a policy will obviously not result in the Canadian Defence Force being entirely armed with 'Made in Canada' weapons. However, it does mean that the Services must be prepared to accept minor sacrifices in quality and increases in cost where the resulting benefits to the national economy are sufficiently large. The trade-offs must in each case be carefully examined and fully evaluated. This must be done from the point of view of the total national interest rather than from the narrower viewpoint of the Canadian Defence Forces.

If by following these policies DRB continues to succeed in its efforts to help the Canadian Defence Force and Canadian industry, it will always be able to attract good scientists and engineers and thus make an effective contribution in the third area as a part of the broad Community of Science.

The first step in implementing such a policy is to keep the requirements for the support of industry in mind in choosing roles for the Canadian Services. Of the many possible roles in which the Canadian Services could be cast, it would be best to choose one that requires relatively simple and unsophisticated equipment. I don't mean that we should go back to bows and arrows but that we should avoid intercontinental ballistic missiles and sophisticated nuclear weapons and even the most advanced and expensive kinds of fighter aircraft. I believe that the Canadian Defence Forces can find a satisfying and important military role by building up Mobile Command until the Canadian Defence Force become the world's leading specialist in the application of modern science to the problems of triphibious warfare with conventional weapons. One has only to look at the experience of the Korean War and the war in Vietnam to see how this important field of applying science to the apparently simple problems of ground-air warfare has been neglected. It was at least 18 months after the outbreak of war in Korea before the control of close air support was as good as it had been in northwest Europe. I suspect that the situation in Vietnam has not been greatly different. The Canadian Defence Force, aided by the Defence Research Board, could become world leaders in this important field. Success depends on many difficult and interesting applications of science. However, fortunately these are on a scale that is well within the capabilities of Canadian science and industry.

Such a program would not only directly improve the competitive competence of Canadian industry in world markets, but would also provide weapons for which there might well be a substantial market in other countries.

In discussing possible roles for the Canadian Defence Force, I cannot resist returning for a brief ride on one of my favorite hobby horses; I still think that, though the possibility of conflict in the Arctic is remote, the Canadian Defence Force should retain and continually improve its ability to live and fight in the Arctic. Preparation of this role should be supported by the development of new equipment and new techniques for life in the North that will be helpful in the economic development of the area. No other equally important industrial country other than Russia has a greater need to develop techniques for living, moving and if necessary fighting in the Arctic than does Canada. And yet in recent years, our Forces have been spending less and less time in the North. I am even so old fashioned a reactionary that I would advocate that the Armed Forces take on some of the difficult and demanding civilian tasks that need to be done in the Arctic. I was very sad to see the Navy give up HMCS Labrador, the Army withdraw from Churchill, and the Air Force from Resolute. I am quite familiar with the many powerful arguments against this point-of-view, but I still think that on balance, the Canadian Defence Force should continue to take an active interest in Arctic operations. When there is no enemy at hand to challenge the courage, stamina and ingenuity of the individual, conflict with the elements can supply at least a partial substitute.

If jobs such as those that I have briefly sketched are to be done efficiently, we must make better use of the scientific and engineering talents that are available. At present, there are three partially overlapping technical staffs working on the problems of defence weapons and equipment, one in the Canadian Armed Forces, one in DRB, and one in DDP. Why not consider the possibility of creating a new

organizational structure that would include a single technical and logistic agency that did research, development, design and procurement of weapons for the Defence Force. This new element would be built out of DRB, DDP and many of the technical staff of the Defence Forces. Thus, instead of three relatively weak technical staffs, who have, of necessity, to devote a great deal of their time to the coordination of their efforts, there would be a single staff working toward a single objective.

Under this new organization, the procurement side of this new body would work in the closest possible cooperation with the Department of Industry to ensure that defence expenditure for research, development, design and fabrication that were made in industry were planned in order to maximize their contribution toward the technical competence of Canadian industry. Such a policy would require the making of many careful choices. However, this is one of the facts of life that we must face in Canada; we cannot do everything well – we must rather try to do a few things relatively well so that our work in these fields can be sold abroad even in the toughest competitive world markets. In collaboration with the Department of Industry, this new staff would decide what things would be carried right through from research to production in Canada, what things would be manufactured in Canada under license and what things would be purchased abroad. These are not problems new to Canada. We have tackled these problems with varying success in the past. What we must do now is to reorganize in order to solve them with greater success in the future.

This is a good place to insert a thumbnail sketch of some of the main ideas that must guide us in the selection of projects for completion in Canada. First, we should try to meet unique Canadian needs, particularly those that arise out of Canada's sparse population, difficult climate, or lack of fully developed facilities such as roads and airfields. Experience has shown that equipment developed to meet these Canadian needs often finds acceptance in other parts of the world where similar though not identical conditions are encountered. Second, we must always avoid head on competition with the US. If the exploitation of a new idea or the production of a new bit of equipment is of vital importance to the US Armed Forces or to the US economy, then the resources needed to find a satisfactory and effective solution will be forthcoming. Canada would be wise to adopt the US solution when it appears and devote her own effort along other lines. Third, we must be more venturesome and aggressive in exploiting important new ideas that originate in Canada. New ideas are sometimes just as important to success in industry as the classical inputs to the economy; unfortunately they are usually much more portable so that if we do not develop them rapidly they will be taken elsewhere for exploitation.

One of the major difficulties that faces Canada in trying to develop a world competitive secondary industry is the tremendous influence of foreign-owned branch plants in Canada. This problem is often even more acute in development and production for defence use. However, both in defence and in ordinary civilian production it must be squarely faced. The choice of individual companies for defence orders should not necessarily be based on whether they are owned in Canada or abroad but rather on their technical competence, their willingness to devote their best talents to defence work, and especially on their willingness to exploit the results of defence research in the development of new consumer products and their willingness to attempt to sell these products in world markets. These are tough tests and would undoubtedly eliminate many foreign owned subsidiaries but they would also if realistically applied eliminate many Canadian owned companies.

An intelligent program of defence development and production clearly necessitates the selection of individual companies as chosen instruments at least in some important fields. The success or failure of the whole scheme will depend on the wisdom with which the choices are made. The easy alternative of avoiding a decision by doing work in Government laboratories that should be done in industry must be firmly rejected. Here again it is important to point out that this is not a new problem. These choices are being made every day now but they tend to be made from the view of maximizing the benefit to the Defence Forces rather than to the nation as a whole. The most suitable equipment is often available from abroad at a lower price. A true assessment of the national interest would frequently suggest that a slightly less suitable equipment should be designed and built in Canada at a slightly higher cost. We must learn to make these judgements from the point of view of the benefit of the nation rather than from the narrower viewpoint of the interests of the Defence Force.

You may well disagree strongly and possibly with good reason with my suggested roles for the Canadian Armed Forces. You may be equally unhappy with my suggestions for reorganizing the R and D and procurement functions. This will not make me very unhappy because these ideas have been advanced to provoke argument in the hope that active discussion will lead to the right solution. I will be very unhappy if I have not convinced you of the necessity for continuing to have, as an integral part of our defence program, a strong, vigorous program of research and development, design and production for defence uses that has the dual aim of meeting the needs of the service with high quality, low cost equipment and at the same time making the greatest possible contribution to strengthening the technical competence of Canadian world markets. A defence R and D program conceived on this basis will be seen to be sensible and desirable not only to all the interested Government departments and to the scientific community but also to the ordinary taxpayer who foots the bill. It provides a way in which we can spend at least part of our defence dollar in order to get both guns and butter for little more than the price of either one alone.