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EIGHTH ANNUAL BIRTHDAY  
ADDRESS

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Dr. O.M. Solandt

*Chairman of the Defence Research Board*

DR 93

AUGUST, 1955



*O.M. Solando.*

# EIGHTH ANNIVERSARY ADDRESS

by

**Dr. O.M. Solandt**

*Chairman of the Defence Research Board*

## EXPLANATORY NOTE

The eighth anniversary address was postponed twice. The first postponement was caused by the death of Dr. Donald Y. Solandt of Toronto, the Chairman's brother. Later, weather conditions delayed the Chairman's return from Washington for the second scheduled date. As a result, the Chairman finally spoke to a small audience of headquarters staff only.

The address is reproduced here. It is being distributed to those who were invited to the anniversary gathering, and to the staffs of the Board's establishments, as usual.

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The past year has been momentous, both in world affairs and in those of the Defence Research Board. I would like first to take note of some of the events in the affairs of the Defence Research Board that deserve mention.

## **TRIBUTES TO PROMINENT MEN**

First, I would like to express our grief at the passing of Dr. R.C. Wallace, the former Principal of Queen's University, who was, at the time of his death, a member of the Board. Dr. Wallace will always be remembered as one of the greatest principals in the history of Canadian universities. Because he was so well-known and much loved as a university principal, he was less well-known as a scientist. However, those of us who had the privilege of working with him realized that his knowledge of science was almost as wide as his understanding of human nature.

Shortly after Dr. Wallace died, the Board suffered another grievous loss in the death of Dr. Guilford B. Reed, Superintendent of our Kingston Laboratory and former Professor of Bacteriology at Queen's. Dr. Reed will long be remembered as one of the pioneers in the difficult field of bacteriological warfare, and for his diversified contribution to the scientific life of Canada as a distinguished university professor and research worker, as a member of many advisory committees

of the National Research Council, as Chairman of the Fisheries Research Board, as President of the Royal Society of Canada, and finally as Superintendent of our Kingston Laboratory.

I would like also to say a word about the passing of my brother, Dr. Donald Y. Solandt, because many of you knew him well and because he took a very active interest in defence matters. He served in the Navy during the war. He had been interested in flying and in the problems of the Air Force since his early days, when he flew a great deal in the North. His work as a physiologist was largely based on electronics, but his greatest interest in recent years was in the Arctic, and I think most of you came in contact with him because of that interest.

### *The Board's First Vice-Chairman*

Finally, I have to record the departure of another famous figure from DRB headquarters. Emlyn Llewelyn Davies came to Canada in 1940 from a small and primitive country in the mountains on the western edge of England. He immediately headed for the foothills of the Rockies, where he felt at home. He chose the site for the Suffield Experimental Station, pitched the first tents, did the first experiments, and established by decree the traditions of a first-class research organization, all within a few months.

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In 1947, we gave him a farewell party on the eve of his return to his mountain home. I well recall how he explained on that occasion, with some emotion, that we effete eastern Canadians could never properly appreciate the charm of the great open spaces of the West. He made it clear that he would have stayed out West permanently if it had been possible to grow decent leeks there.

A few days after that farewell party, we prevailed upon E.Ll. to stay in Canada. From that day till this, he has devoted his great energy, vast experience, and incomparable knowledge of human nature, Welsh and otherwise, to the welfare of the Defence Research Board. He has for a long time, in common with most of the headquarters staff, cherished an ambition to be the Board's liaison officer in London. At last, this year, it seemed possible for him to achieve this ambition. He has, therefore, officially resigned as Vice-Chairman of the Board and will leave during the summer to take over from Brigadier Morrison in London.

There is no need for me to emphasize to you the tremendous contribution that E.Ll. Davies has made to the success of DRB. However, I would like to take advantage of this opportunity to say publicly how much I personally owe to E.Ll. He has been a most devoted and loyal friend to me. He has, on many occasions, done things of which he did not approve, merely because he knew I

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wanted them done. You all know E.Ll. too well for me to get away with the platitude that he did these things without protest, but he did them cheerfully after a protest.

When Mr. Davies joined the Board's staff in 1947, we had no one else with anything like his breadth of experience in defence science and in scientific administration. He has done a great deal to mould the form and spirit of this organization.

## APPOINTMENTS

### *New Vice-Chairman*

Many of you have already met Mr. A. Hartley Zimmerman, who has been appointed Vice-Chairman of the Board to succeed Mr. Davies. Mr. Zimmerman has exceptional qualifications for this post. He is a graduate of the Royal Military College in Kingston, an experienced mining engineer, and for many years was engaged in research in industry. During the Second World War he was for four years Director of Electronic Production in the Department of Munitions and Supply. He returned briefly to a similar post in the Department of Defence Production during 1952, and when he was appointed Vice-Chairman he was representing the Department of Defence Production as a member of the Board.

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Mr. Zimmerman already has many friends in the Defence Scientific Service and in other departments in Ottawa. He is at present engaged in getting to know the Board's staff, and probably will not take over executive command as Vice-Chairman until June or July.

Many other important changes in personnel have occurred during the past year, and still others are impending. I cannot do more than mention a few, and I hope that any who are left out will not feel slighted.

### *Chief Scientist - a New Position*

In the reorganization of headquarters, Dr. George S. Field has been appointed Chief Scientist. In this position, he is next in seniority to the Vice-Chairman and has charge of the headquarters scientific staff.

### *Changes in Senior Staff*

Dr. F.H. Sanders has been appointed Scientific Adviser to the Chief of Naval Staff; Dr. N.W. Morton, Scientific Adviser to the Chief of the General Staff; Dr. J.W. Abrams, Scientific Adviser to the Chief of Air Staff.

Earlier in the year, Dr. D.B.W. Robinson finished his tour of duty as Superintendent of



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DRNL and came to Ottawa as head of the Canadian Army Operational Research Establishment. Mr. A.M. Pennie, who had been Secretary of the Board, became Superintendent of DRNL, while Dr. R. Martineau came from Armament Section to be Secretary of the Board.

When Dr. Abrams went as Scientific Adviser to the Chief of Air Staff, Dr. W. Petrie was appointed Superintendent of the Operational Research Group. Early this year, Dr. J.C. Arnell was appointed Director of Scientific Intelligence. Mr. G.D. Watson, who had been Project Officer in charge of the Velvet Glove project at CARDE, came to headquarters as head of Armament Section.

In addition to these changes, which have already taken place, you are probably aware that Dr. J.J. Green, who has been Chief of Division (B), will be going to Washington to relieve Brigadier Taber during this summer as Defence Research Member of the Canadian Joint Staff in Washington.

### *Professional Staff*

With reference to professional personnel, the recruiting situation improved in 1954. Our net increase in scientific staff last year was 63, as compared with 38 in the previous year.

Dr. Jamieson and his staff probably would not claim full credit for this improvement, but they certainly deserve a substantial share of it. The improvement in recruiting was partly due to a decline in wastage, which dropped from 12 per cent in 1953 to 9 per cent in 1954. The Selection Committee is firmly convinced that we have been able to achieve this improvement in our rate of recruiting without lowering our standards. Of the 115 staff taken on strength during 1954, 50 hold the Doctor's degree, 40 the Master's degree, and 25 the Bachelor's degree.

### ***Supply of Professional Personnel***

In spite of our good experience in 1954, I am not happy about the future of scientific and technical education in Canada. It is clear that the free world will not remain free unless we can keep ahead of the Russians in the application of science to war. The Russians are giving high priority to the education of scientists and engineers, because they recognize that their military strength rests ultimately on this foundation.

On the other hand, we in Canada are seriously neglecting our universities. They have just been able to keep pace with their responsibilities during the past few years, because they are now educating the children born in the thirties when the birth rate was low. Within the next few years our universities will be swamped with first-class

potential students. Unless the universities are given substantial financial aid to expand their facilities and increase their staffs, they will be unable to meet this demand. If we are to survive as a nation, we cannot afford to allow potential scientists of the future to go uneducated. Something must be done about this problem, and quickly.

### *Careers within the Board*

At the moment, I feel that we have a first-class staff. If you look over the organization as a whole in relation to other scientific organizations, we have done remarkably well in our recruiting at all levels. The morale of the team is high. But we have now reached the end of our period of rapid expansion. We have to shake down and prepare for a long pull, and this involves some new problems and particularly new personnel problems.

Mr. Zimmerman comes to us from industry with a special knowledge and special interest in the problems of career planning. One of his first jobs is to work out more detailed plans for careers for all of you, at all levels in the Board. We hope that in the next year you will get a clearer picture of what the future holds for you individually.

Finally, I would like to mention the general scientific competence of the Defence Scientific

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Service. While I am a biased witness, I do have an opportunity of seeing scientists at work in many other organizations. You have only to look at the three people that the Defence Scientific Service was able to supply as Scientific Advisers to the Services to see the quality of people that we have available. I am firmly convinced that neither in the United States nor in Britain would it be possible to find a more competent, better trained, or more experienced triumvirate than Drs. Sanders, Morton, and Abrams, and there are more where they came from that are just as good. We are just beginning to see the benefits of the continued operation of a Defence Scientific Service, in which individual scientists can grow and mature, and gain a breadth of experience unobtainable in any other kind of organization.

## **ADMINISTRATION**

### ***Finance***

There is not much to be said about finance this year. The research budget has remained fixed, as in previous years, at \$22,900,000. We have continued to operate within this fixed budget by cutting down on construction costs as operating costs have risen. The development budget for the year 1954-55 was about \$27,000,000. For 1955-56, it is \$29,700,000. This increase is

almost entirely due to the increase in the Air Force development program.

### **Construction**

The original construction program has proceeded as planned, and is virtually complete. A fine new building for the Pacific Naval Laboratory was opened last October. The Central Stores and Services Building at Shirley Bay was completed and occupied last year. The new central laboratory at Suffield will be completed within a few weeks, at an estimated cost of one and one-half million dollars. This is the last of the major laboratories included in the original plan. It is hoped to have a formal opening of this building at the time of the Tripartite Conference on Toxicological Warfare in September of this year.

We are already expanding laboratories where changes in emphasis require it. A major extension to the Naval Research Establishment at Halifax is the first item on this expansion program, and is now nearing completion. Our original building program tailored each laboratory to the size of the staff then authorized for that particular field of work. We recognized that as the emphasis of the program changed we would have to add to the laboratories, but we felt it was a wiser way of using the money available to us than building a few laboratories bigger than were needed.

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During the past year a major item, not originally foreseen, has been added to the construction program. This is the supersonic wind tunnel to be erected at Uplands Airport. Design of this tunnel is well under way, and its construction will probably begin this year.

### ***Stores Accounting Important***

Before leaving this discussion of the problems of personnel, finance, and building, I would like to say a word of praise for the Chief of Administration and his entire staff, and particularly for the Director of General Services and his staff, whose efforts so often go unnoticed. They have continued to do a splendid job, and I hope that the scientists particularly will do everything they can to help them in their work. During the past year or two, we have been particularly plagued with difficulties over stores accounting. Stores accounting in a scientific organization is admittedly difficult, and unfortunately often does not seem important to the scientists. However, serious trouble over stores accounting could be as disastrous to our general effort as poor scientific research. It is, therefore, essential that all the scientists support the administrative staff in their efforts to do effective stores accounting.

### **REORGANIZING OUR HEADQUARTERS**

Regarding the reorganization of head-

quarters, I would say that DRB presents one of the most difficult organizational problems one could possibly imagine. We are trying to cover a wide field of activity; we are dealing with three customers, each of whom regards his interests as of primary importance. We have to face the fact that our organizational problems can never be ideally solved. But they can be kept under control, if we modify our organization from time to time as the demands change.

The reorganization that is just being completed is a natural stage in our evolution. We have foreseen the need for three or four years, if not longer. It represents a further stage in the specialization of function within the organization.

### ***Separating the Functions***

The history of the growth of DRB, or of any other organization, shows that it started with a single man who did all the functions. Then as the staff builds up, each person takes on a narrower range of function and devotes more attention to that function.

By 1954, we had reached the degree of specialization, below the level of the Vice-Chairman, of chiefs of division, each responsible for a considerable area of the Board's interest. But

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the functions of these chiefs included at least three distinct and separable jobs. The first job was that three of the four chiefs of division were also scientific advisers to the chiefs of staff. The second was that each chief was responsible for the direction of a portion of the headquarters scientific staff; and finally, each chief was responsible for general policy and guidance of some of our research establishments.

The purpose of the reorganization was primarily to separate these three functions and assign them to different people. The need for separating the functions of scientific advice to the Services from the others is obvious. It is essential that the Scientific Advisers to the Services develop a real loyalty to their Service, and that they should even develop the prejudices of the Service or at least understand them. They must look at the Defence Research Board from the point of view of their particular Service. It is difficult for a person who is attempting to run a substantial part of DRB to achieve this objectivity at the same time, and the advantages of separating the task of Scientific Adviser from the other jobs are clear.

The need to split the headquarters staff function from that of guiding the establishments is possibly not so obvious. It goes back to an understanding of the relation of DRB to the



Services. The Board's job is to see that the Canadian Services have available the best scientific knowledge and information in the free world, and to see that the Services make use of this scientific knowledge.

### *Specialization Our Policy*

If we are to get scientific knowledge from every part of the free world, and particularly from Britain and the United States, we will have to contribute to this body of scientific knowledge. Hence, we have evolved our policy of specialization. The Defence Research Board is trying to do a relatively small amount of first-class scientific research to contribute to the common pool of knowledge. It is also trying to ensure that the Canadian Services get the results not only of our own program, but also of the much larger British and American research programs.

This fundamental policy seems to be working well. We have, compared to our larger partners, a tiny organization and minute expenditure, but this small organization is producing big dividends. Our productivity per man is higher than that of any of the bigger organizations. The United States and the United Kingdom clearly recognize the quality of our work and feel that we are doing

a satisfactory quantity, because they are most co-operative in giving us the results of their work.

### *Services Our Primary Interest*

All the good work that we do and our good liaison with the U.S.A. and the U.K. is effective only if we have good relations with the Services, and are able to get them to integrate in their programs the knowledge that we can supply to them. If we are to maintain closely integrated and co-operative relations with the Services, we must convince them that we have no axe to grind, that we are primarily concerned only with helping them.

This is not an easy task. We are faced with two major difficulties in carrying it out. The first is that we have three Services to convince individually of our primary interest in their welfare and in their problems. One of the big contributions we can make toward that end is to show them we are not trying to build an empire for our own sake — that the Defence Research Board itself has no separate reason for existence, but exists only to help them. This then narrows the problem to convincing each of the three Services that we are giving them a fair share of our effort.

Our second and more difficult barrier to close co-operation with the Services is the Board's responsibility to the Minister of National Defence on any scientific or technical matter on which he seeks advice. We must give the Minister the most objective opinion that we can. In carrying out this responsibility, it is sometimes necessary to give advice that is contrary to the views of the Services. We must demonstrate to them that in doing this we are honest and objective, and that we are not being difficult. The Services are coming to understand our position. They feel that we are concerned with their welfare, that when we give advice contrary to theirs it is sincerely meant, and that it is probably worth their while to re-examine their problems and discuss them with us.

Reviewing the Board's development, we saw a danger that in building up our own establishments, their needs rather than those of the armed forces would increasingly bias our advice. It is primarily because of this danger that we have attempted to split the headquarters scientific staff from the management of the establishments. This should not only give the establishments more independence and autonomy, but it should enable the headquarters scientific staff to have a much closer understanding of Service problems and to develop to some extent the biases of the Services.

*Reorganization Raises New Problems*

In making this change in organization, we have exchanged one problem for another, because we will in future be faced with the problem of keeping our establishments in close touch with Service problems. If they are not directly responsible to the Services for advice, they may drift off to work that is of scientific importance but not closely related to Service needs. This is probably a much easier problem to solve than the one we are avoiding. Knowing it exists, we can control it by encouraging our establishments to have the closest possible contact with the Services.

I have said earlier that organizational problems, both internal and inter-Service, are insoluble and can only be kept under control. To use a medical analogy — the disease is like diabetes. It can be adequately treated and controlled, so that the patient is in good health though never cured. We shall have future organizational problems. I already see one on the horizon. With the resources available to DRB, we cannot meet all the needs of the Canadian Services. We will have to shelve many problems of lower priority that they consider important. Frequently, they can meet these lower priority needs by hiring civilians or diverting the efforts of uniformed staff to their solution. We may see within the Services the

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building of groups of scientific and technical people to carry out work of lower priority, which we have not been able to do. This is an inefficient way of tackling the problem, and one that we can discourage by meeting a higher proportion of Service needs.

### *Adaptability*

Summarizing the internal problems, we can say that we have an excellent organization. It is beginning to pay substantial dividends, it is evolving satisfactorily. It has shown no signs of ossification, it is still flexible, and capable of growth and change. In fact, two of our distinguished visitors in the past year, Sir Henry Tizard and Sir Owen Wansborough-Jones, commented particularly on this adaptability. They were both most complimentary of the way in which we had modified our program to meet the changing needs of the last five years. They felt we had been more successful in doing this than they had in Britain. This is no particular evidence that we are better than the British; it merely means that we have a younger and more adaptable organization, and we must try to keep it so in spirit.

### WORLD PERSPECTIVE

For the past and the present, we have reason

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for modest satisfaction. Let us look at the future. Although I shall not dwell on political or military aspects, a brief survey is needed because the whole future of the Defence Research Board depends on these factors.

### *Three Kinds of War*

The free world is locked in a struggle with Russian imperialism marching under the banner of Communism. This struggle may take one of many forms. There is first the ideological or cold war. It is going on now, and on the whole we are doing fairly well. We are more alert to the problem than we were in the past, and are learning how to fight the Communists in this field. Although we have no grounds for congratulation or satisfaction on our progress, it still is better than it was.

There is also the possibility of limited wars, with or without the use of tactical atomic weapons. Finally, there is the possibility of total war, against which we must always guard. For many years, the real problem faced by defence planners has been to balance effort between these three.

### *New Threat - New Emphasis*

The advent of thermonuclear weapons, which we learned about for the first time during 1954, and particularly the existence of huge weapons with their potential "fall-out" over a wide area, have changed the relative emphasis on the three possible kinds of war. This knowledge has put great emphasis on the need to avoid total war. Simple arithmetic shows that a fairly small number of large thermonuclear weapons is capable of wiping out a high proportion of the human race. In total war we now face a new kind of threat. Consequently, in planning DRB's program we must put more emphasis on preventing the possibility of a total war, and less on preparing to win limited wars.

The free world has attempted to meet this threat of war by adopting a policy of deterrent force. There is some tendency to feel that the deterrent force of the free world is made up only of Strategic Air Command. This belief is false, as the free world's strength comes from a careful balance of all the elements that offer resistance to aggression.

### *The Price of Freedom*

The deterrent force is made up partly of ideological factors. We must have a firm conviction

in the value of freedom, and try to spread this conviction to others. Deterrent force also requires the maintenance of high-class conventional forces ready to deal quickly with local wars. If Strategic Air Command is to be a real deterrent to war, we must maintain a strong position in western Europe. To discourage the Russians from any idea of winning local wars in western Europe, it must be clear that any effort to overrun even a part of it would lead to total war. In addition to maintaining a strong strategic striking force, we must make sure that the bases of that force are adequately defended, and this is a major role of Canadian air defence.

Finally, our deterrent force depends on the will to resist among the people. Many people in the free world rather glibly say that they are prepared to fight in defence of their freedom. Yet they have not rethought this problem, nor fully understood what fighting in defence of their freedom may mean in a world where H-bombs exist. If we really mean to fight in defence of freedom, we must be prepared to visualize the complete destruction of most of the cities in Canada, and of our homes and everything we have worked for.

Unless we face that fact, and feel that we would continue to fight under those circumstances, then the whole of our deterrent force breaks down. If the Russians know that in the final analysis we will give in, it does not matter how big is the club in our hand.



## CONTINENTAL DEFENCE

The advent of the hydrogen bomb has led everyone to rethink the problems of air defence, and the U.S.A. and Canada particularly to rethink the problems of continental defence.

### *Dual Aims*

The aims of continental defence are now two-fold. The first is to protect Strategic Air Command, the major striking force of the free world. The biggest element in its protection is adequate early warning. It is likely that before long the Strategic Air Command will be so organized and equipped that really adequate and effective early warning would give it a high degree of protection.

But the secondary, and possibly scarcely less important, role of air defence is to reduce the impact of an attack on our cities and industrial areas to a tolerable level. Air defence always has had this aim.

In the past this meant a comparatively small level of attrition, merely enough to discourage the enemy from continued attacks. In the future, with large thermonuclear bombs, we must aim at substantially higher rates of attrition if we are to have tolerable attacks. To quote a simple example,

many people are talking of a continental air defence weapons system that would shoot down as much as 95 per cent of any attacking force. It sounds like a wonderful defence, and would be difficult to achieve. But if you put it another way, this force is expected to reduce casualties in the United States to about seven and a half million dead!

### *Russian Technical Progress*

The most difficult problem in foreseeing air defence is to assess the threat and to keep our defences in step. We are convinced that the Russians have the H-bomb and that they will stock-pile them. We know they have what appears to be a modern, subsonic, long-range jet bomber, the Bison. We know it is within their ability to build a supersonic manned bomber. Anyone who can build a supersonic manned bomber can build a supersonic unmanned bomber or wing-guided missile. There is no reason for us to believe that the Russians are incapable of building ballistic missiles. They inherited, as we did, the German knowledge and experience that led to the V-2, and from their work in other fields it is reasonable to expect that they could make rapid and effective progress in this direction.

Looking to the future, then, we have to consider a continental air defence capable of acting against any of these weapons. Here we

see the greatest handicap under which we labour. The Russians have the scientific and technical as well as the military and political initiative. With their excellent security system, we learn what they are doing only at a comparatively advanced stage. Further, they need not go through all the stages outlined above. They could, for instance, choose to go directly from the subsonic manned bomber to the intercontinental ballistic missile. They may have so chosen several years ago. But we cannot be sure, and we are faced with the problem of building air defences by stages, always ready for any threat that the Russians might present. This means we have a bigger job to do than they have, and there is some danger that our resources are declining relative to theirs.

It would be well to remember that the Russian rate of technical progress is of primary importance to the whole of the free world, and especially to us as a scientific research organization.

During the past few years we have seen that in the development of the H-bomb, where our knowledge of Russian progress is comparatively limited, and in the development of jet engines, where we have fairly detailed knowledge, the Russians have been able to achieve a substantially greater rate of progress than the whole of the free world. This does not mean that they have greater scientific and technical resources. It merely means

that when they choose a fairly limited field in which to become pre-eminent or to make a substantial advance, they are able to achieve a higher rate of progress than the free world. In this lies our greatest danger, because if they choose the right fields in which to get ahead of us, they may some day hold sufficient scientific initiative to embark on World War III.

## **CANADIAN PROGRAM**

In the past, I have sometimes attempted to forecast how the programs of individual DRB establishments would be affected in the coming year. This time, I will merely suggest where we should do more because of the factors outlined. In listing these fields in which to do more, I do not suggest that we must cut out any other. I have omitted many fields of considerable priority, where we will continue to work; but with our limited resources, if we increase effort in one field we usually have to cut it down in some other. So cuts as well as increases will undoubtedly occur in our program.

### ***Scientific Intelligence***

We should, wherever possible, increase our effort in scientific intelligence. The job faced by the scientists of the free world is relatively

much larger than that faced by Russian scientists. The best way to narrow down our job would be by good scientific intelligence. If we knew which paths the Russians had chosen to pursue, we would more easily block them.

In addition, scientific intelligence may contribute to warning of any Russian intention to embark on a third world war, and this could be of inestimable value. I am not optimistic about our ability to penetrate the Iron Curtain, but we must not miss any opportunity.

### *Systems Analysis*

We must give increasing priority to systems analysis. This is a rapidly growing problem. During the past year we have been asked by the Air Force and the Navy, and to a less extent by the Army, to advise them on what they should do regarding purchase of equipment to fit into a system, and how the system should be planned and organized. We must gather a staff of competent scientists who are thoroughly familiar with the techniques of systems analysis, as well as with the problems peculiar to Canadian weapons systems.

We have already gone a long way toward that end in the Operational Research Group; but the problem is spreading so that we are drawing in

other people, to integrate our scientific and technical knowledge with the skill of the operational research worker. We are exploring the possibility of joint DRB-Service teams to deal with this problem, and it undoubtedly will loom large in the coming year.

### **Electronics**

*Early Warning:* We face a growing number of problems in the field of electronics. We must install effective, cheap, and reliable early warning as quickly as possible. DRB has made a substantial contribution in this field, but the problems are by no means solved. As part of the early warning problem, we need cheap, reliable communications, and new developments are promising.

*Data Handling:* One of our acute problems at the moment is to solve the problem of improved electronic data handling systems. Much experimental laboratory work has been done, and we must soon build operational systems. It will not be easy to choose the best system, and we must be prepared to help the Services. Data handling systems that are designed and installed now for control of manned interceptors should, if possible, be capable of evolving into missile control systems, suitable for control of the ground-to-air guided missiles that undoubtedly will be used in our air defence weapons system within a very few years.

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*ECM:* We have tended, with the rest of the free world, to ignore the problem of electronic countermeasures. As we develop air defence systems that depend more and more on good communications and rapid data handling, the systems become increasingly vulnerable to electronic countermeasures. Consequently, we must start an active program to deal with this weakness.

*ICBM:* We must start now to find the basis for a defence against the intercontinental ballistic missile. Design of intercontinental ballistic missiles is beyond the capacity of Canada. We may not be able to handle even the problem of designing a missile to attack such missiles. But we have a splendid background in radar, and we are hopeful that we can make a contribution toward detection of intercontinental ballistic missiles.

### **Atomic Weapons**

In the field of atomic weapons, we must accelerate our programs. On the passive side, both the Armed Forces and Civil Defence need our help to work out techniques and equipment for dealing with the new problems of fall-out. This is particularly important in civil defence. Public interest in fall-out is high, and the time is ripe for more effective public participation in civil defence. The advent of the huge bombs, with the

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fall-out problem, makes civil defence a more attractive job than it was before, in a way, because many positive and effective measures can be taken to minimize the results of attack. Civil defence is one of the essential elements in our defence — it should not be regarded as a mere frill.

In active air defence, the Canadian forces will probably be using atomic warheads within a few years, on both air-to-air and surface-to-air guided missiles. We must learn about these things as soon as possible, so that we can help the Services to use them.

### ***Guided Missiles***

Our emphasis on guided missiles must continue. We are at present engaged in discussions with the Services, to work out the next stage in the Canadian guided missile program. An important recent development was the announcement that when the supersonic wind tunnel at Uplands is completed, the wind tunnel and the flight research establishment will be separated from the National Aeronautical Establishment, to be taken over by DRB as the nucleus of an organization to deal with all the problems of supersonic aerodynamics. This will greatly strengthen our guided missile program.



## IN SUMMARY

To summarize, we have a good team, we are working well together, working well with the Services, and with our allies. We are just beginning to reap the benefits of team work and experience. We will get even greater benefit from these in the future. It is essential that we maintain the flexibility of organization and of program that has so far distinguished the Defence Research Board.

We must be sure that we give the Services the best possible prediction of the future and the best possible help in meeting it. We must never shrink from the unpleasant task of admitting that we were wrong if we think we were, because we are all going to make mistakes in predicting the future and in guiding programs from the basis of those predictions.

It is certain that in the coming years we shall have to change the direction of our programs many times to meet the changing Russian threat. We must not make these changes in a hurry. We must not be continually chopping and changing so that we do not get anything done. They must be done deliberately and after careful consideration, but we must never reject the possibility of change just because we are committed to a course of action.

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Above all, we must maintain our faith in our cause. Existence of the H-bomb demands that we reassess our attitude to war. We must be quite sure, each one of us, that we are prepared to face the horrors of a hydrogen-bomb war rather than sacrifice our freedom.