1952

CANADA DEFENCE RESEARCH

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5 Anniversary

COPY NO. 1

DEFENCE RESEARCH BOARD
OTTAWA

FIFTH ANNUAL BIRTHDAY ADDRESS

Dr. O.M Solandt

Chairman of the Defence Research Board

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APRIL, 1952.

O. M. Solandt.

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by

Dr. O. M. Solandt
Chairman of the Defence Research Board

I am delighted to have this opportunity of speaking to you on the fifth anniversary of the formation of the Defence Research Board. Owing to the death of King George VI we are unable this year to have the festivities usually associated with an anniversary, but we can all nonetheless take real satisfaction from contemplating a year of solid achievement. In spite of minor setbacks and difficulties, we have on the whole achieved the goals that we set ourselves last year. Our efforts have also been successful in a larger sense because the deterrent forces of the free world, of which the Defence Research Board is a very small part, have been sufficient to prevent the outbreak of a third world war. On the whole, the international situation looks a little better than it did a year ago.

It is most gratifying to see the way many parts of the Board are now beginning to reach maturity. Even our newest establishments are achieving the high standard of competence and productivity attained by the older establishments. The staff as a whole seems to feel the confidence of a good team in which each member feels that he can depend on his team-mates. This increasing confidence and competence are showing not only in the increased productivity of our laboratories but in the way in which the Armed Forces are placing greater reliance on us for advice and assistance.

In past years I have attempted to review the highlights of the progress of the whole organization. The organization is now getting so large that it is not possible to do this in a limited time, and in any

case a detailed catalogue of progress can be rather dull. Those of you who are interested in detail can read my report to the Board written last September.

SOME INDICES OF PROGRESS

Instead of a detailed catalogue of events I plan to deal briefly with some of the obvious numerical indices of progress, then to discuss a few selected items of the program in considerable detail, next to consider some general changes in the character and direction of the Board's work that have already begun, then to offer some words of warning concerning certain aspects of our work, and finally to take a brief look at the future.

New Staff

First, on general indices of progress, our recruiting has gone surprisingly well. In the ten months ending January 31st our staff increased by 120 professional and technical officers, 79 technicians, and 210 others. In spite of this rapid increase I feel that we have been able to maintain or even improve the quality of our staff. The most gratifying aspect of this recruiting is that it has taken place during a period of exceptionally full employment. While the Directorate of Research Personnel deserves credit for doing a splendid job, I think that every member of the Board's staff should share in the credit for our success in recruiting, because there is no doubt that the main attraction that the Board now has to offer is its steadily growing reputation as a first-class research organization.

You may recall that in the early days of the Board it was agreed that we would have to pay slightly higher salaries to scientists than did other government departments, because of the security restrictions which limit the publication of scientific papers. In a recent discussion on this subject, several members of the Selection Committee suggested that the reputation of the Defence Research Board was now more than sufficient to offset the disadvantages of secrecy, and that we

could compete on equal terms with any research organization in the government. If this is true, then every one of you deserves a share in the credit for this accomplishment, and also a share in the warning not to be complacent about it. This has been an exceptionally busy year for DRP, as they have had to deal with more than 4,000 applications for employment and with the complex task of a complete salary revision.

Senior Appointments

There have been few changes in senior staff during the year. Colonel G.M. Carrie returned from London to Headquarters to become Chief of Division C and Scientific Adviser to the Chief of the General Staff. His place in London was taken by Brigadier Morrison, following his retirement from the Army. In May, 1951, Dr. J.A. Pearce joined our staff as Director of Personnel. He was formerly on the Chalk River staff of N.R.C. Mr. Carleton Craig, who has for three years been Chief Superintendent of the Canadian Armament Research and Development Establishment, is returning to McGill University in September. He was originally borrowed for a period of two years, but this was extended to three. It is with regret that we see him returning to McGill. His place will be taken by Dr. H.M. Barrett from Suffield, who in turn will be replaced by Dr. G.O. Langstroth, Head of the Physics and Meteorology Division at Suffield. Before making the latter two appointments we looked carefully throughout Canada, the United States, and the United Kingdom for suitably qualified people to fill them. It is most gratifying to assure you that we found no one to equal these two members of our own staff.

It is the Board's firm policy to promote its own staff wherever possible, but on the other hand we will never hesitate to bring in a newcomer, even at top level, if he is demonstrably better than anyone we have available for the position. I know that all of you would support this policy, as it is the only way of maintaining the leadership that results in high morale and effective performance.

Board Membership

You will all have read of Dr. C.J. Mackenzie's resignation as President of the National Research Council and his appointment as President of Atomic Energy of Canada, Ltd. I would like, on behalf of the Board and personally, to express our regret at his departure from the Board and to thank him for all the help and support that he has given us. Few of you realize how much the Board owes to the support and guidance of Dr. Mackenzie. I hope that he shares our pride and satisfaction in the enterprise that he has helped to build up, and would like to wish him every success in his new job.

It is a pleasure to welcome his successor, Dr. E.W.R. Steacie, as a member of the Board. He is already well known to many of the staff. He has in the past worked so closely and effectively with us that I cannot really feel that he is a newcomer to our councils. He has been, and I am sure will continue to be, an effective member of the team.

Expenditures

The amount of money spent by an organization is another useful index of progress. We must, however, be cautious in using it too freely as expenditure is not an end in itself. We can only feel satisfied with our expenditure when we know that it represents the successful accomplishment of a part of an essential program. Our expenditure in this year can almost all be put in this category, though I know that we can improve the efficiency of our operations as the years go on. The expenditure on research has risen from four million dollars in the fiscal year 1947-48, the first year of the Board's operations, to twelve million dollars in 1950-51, and seventeen million dollars in 1951-52. The estimates for 1952-53, which are at present before Parliament, include twenty-three million dollars for defence research.

The biggest change in our financial arrangements made during the past year was the transfer of responsibility for expenditure on development from the Deputy Minister to the Defence Research Board.

Since the Board's foundation it has had a vague general responsibility for the coordination of Service development programs. Until recently we did not feel that we had adequate headquarters staff to accept responsibility for taking a more effective part in development. However, this past year it was felt that the time had come when we could make an effective contribution to the development program by assuming the Deputy Minister's responsibility for authorizing expenditure. The plan has worked well this year and will be even more effective in the future.

The great advantage of the plan is that in most cases the Services have already discussed a development project with our staff before expenditure is contemplated. This means that when approval for spending money is required there is no delay in explaining the reasons for the proposal to the Deputy Minister's staff. Our staff are already familiar with the proposal and are prepared to recommend appropriate expenditure without further delay.

Building Program

One of the most tangible evidences of progress during 1951-52 has been the substantial accomplishment in building permanent laboratories. During the course of this summer the Naval Research Establishment, the Defence Research Electronics Laboratory, the Radio Physics Laboratory, and the Ballistics Wing at CARDE, will move into splendid new laboratory buildings. In addition, the Community Centre at Ralston will be officially opened. The occupation of these new buildings represents the completion of a major part of our building program. Everyone who has helped with the program deserves congratulations for carrying it through so effectively under difficult circumstances. Mr. A.E. Cooney deserves special mention, as the main weight of the task has fallen on him.

PROJECTS OF SPECIAL INTEREST

I have chosen three items of special interest to discuss in detail: Guided Missiles, Early Warning, and Operational Research. In

each case I propose to discuss the organizational and policy problems rather than the scientific or technical. As you will see, I have chosen these subjects not because they are the most important with which the Board has dealt in the past year, but because they illustrate how certain kinds of problem have been tackled. The discourse on Guided Missiles will show how we have attempted to solve the problems encountered upon entering for the first time a new and complex field of research and development. The one on Early Warning will show how we have attempted to encourage and exploit a new approach to an old problem; and the one on Operational Research will show how this relatively new branch is beginning to pervade the whole organization.

GUIDED MISSILES

Naturally, when the Defence Research Board was first established it considered the problems of guided missiles in relation to the needs of the Canadian Forces. It was immediately apparent that the problem was not whether Canada would get into the guided missile field, but when and how. It was obvious even then that the Canadian Services could not maintain leadership unless they kept pace with development in guided missiles and were prepared to fight both with and against these weapons. However, as research and development in guided missiles is expensive and requires relatively large resources, we could not consider embarking in the field in 1947.

Even though there were no immediate operational requirements forthcoming from the Services, the Board decided to send some young scientists for training in the United States on various aspects of guided missile research and development. One scientist was attached to the main USAF research and development base at Wright Field. Another was sent to the University of Michigan, and two were sent to Johns Hopkins University.

At the same time, assistance was obtained from the US forces in running a series of guided missile indoctrination courses for

the Services. Through our liaison offices and by means of frequent visits, an effort was made to increase the supply of information on American and British guided missile research and development programs, and to keep fully abreast of their progress. Because of the possibility that Canada might contribute to those programs by supplying a cold-weather test range, a survey of possible sites for this purpose was carried out.

The Need Stated

By 1949, RCAF plans for production of the CF-100 fighter were well-advanced and it had become clear that neither guns nor rockets would provide really satisfactory armament for it. Accordingly, in December 1949, the Air Force drew up a tentative operational requirement for an air-to-air guided missile, stating the proposed military characteristics and setting a target date for the delivery of a prototype.

The Chief of the Air Staff asked DRB to study this operational requirement, and to advise him as to the practicability and cost of meeting it, either by design and development of the components in Canada or by suitably modifying a missile under development in some other country. The CAS further indicated that if the development were practical on either basis he would request DRB to undertake the necessary research and development program.

Tripartite Agreement

Before the Board commenced the detailed study of this project it was considered important to profit as much as possible by the experience of others, and in particular the USA and the UK. For this reason the first step taken was to consult with the Guided Missile Committee of the United States Research and Development Board. It was agreed at this meeting, which was held in February 1950, that the best way to obtain the combined assistance of the US and the UK was to work through the Air Standardization Coordinating Committee, on which the RAF, USAF, and RCAF were all represented.

The guided missile working party of this committee at a special meeting in April 1950, drafted a unified and coordinated US-Canadian-British requirement for an air-to-air guided missile. The working party also recommended that, because the completion dates of British and US projects were still well in the future, Canada should undertake the development of an interim type of missile that would meet the agreed tripartite requirement, and which might be available to the RCAF before the others were ready. The missile was to be relatively simple in concept, employing existing techniques and knowledge, and incorporating already developed components wherever possible.

In June 1950, the RCAF formally requested DRB to undertake the development of a guided missile with the characteristics recommended by the working party as a minimum requirement. The Board accepted the commitment at its June meeting and the approval of the Cabinet Defence Committee was obtained shortly thereafter.

Planning the Work

The Canadian Armament Research and Development Establishment was then charged with the task of making a preliminary technical appreciation of this missile. The study was to be completed and ready for submission to the three Air Staffs within 45 days after the recommendations of the working party had been approved by them. Their approval was obtained on 9 October, 1950, and the study was completed on 23 November, 1950.

The CARDE staff were extremely busy with the 45-day study and with visits to American and British guided missile establishments. During the autumn of 1950, CARDE was also busy surveying potential sources of industrial assistance and in completing arrangements for assigning parts of the project to the National Aeronautical Establishment and the Defence Research Telecommunications Establishment. Negotiations to obtain the use of the Army's anti-aircraft firing range at Point Petre, near Picton, Ontario, were begun, and test equipment was ordered. In March 1951, a special ad hoc committee, on which the air

forces and guided missile development agencies of all three countries were represented, met at CARDE and gave unqualified approval to the CARDE technical proposal.

The Missile

The missile that CARDE was planning was relatively small – about 10 feet long and less than a foot in diameter. Although it was considered to be 'unsophisticated', a lot of complicated equipment would have to be crowded into it, and a number of difficult problems would have to be solved, including its aerodynamic design, the systems of guidance and control, and the type of warhead and fuze. In addition, an elaborate system of instrumentation would be required, first to test the various components of the missile, and finally the missile as an integrated unit in action.

By the summer of 1951 the design studies on all these problems, and particularly the aerodynamics, were far enough advanced to place a contract with Canadair Ltd., for the mechanical design and construction of missile air-frames for ground-launched tests. These were to be, in effect, full scale models of the missile, and were given the name of 'test vehicles'.

Both CARDE and Canadair worked so effectively on this phase of the problem that a number of 'test vehicles' were completed and three had been fired before the contract negotiations had been completed.

At this point in the story we move from the past to the future. During 1952 we expect to launch about 20 'test vehicles' at Point Petre to test the aerodynamics and design of the airframe. In addition, NAE will complete a very thorough wind tunnel investigation of both the missile characteristics in supersonic flight and the effect of missiles stowed on CF-100 and F-86 aircraft. Flight trials of experimental guidance systems will be carried out at Quebec by a special flight of two B-25 aircraft, which the RCAF is assigning to CARDE. As soon as the results of these trials start to become available the electronics con-

tractor will begin the engineering of the final design of components.

In 1953, air launchings for aerodynamic information, and later to test the guidance system, will be carried out to supplement the ground-launching test program. By the end of 1953 the missile should be in an advanced state of design, and if all goes well it should be ready for service tests by the RCAF in 1954.

Costly Development

The cost of guided missile development is high. Our project is relatively speaking very small. And yet we have already spent nearly $2,000,000 and can look forward to investing in it an additional $1,500,000 per year for the next three years. To give you an idea of the way in which the money goes, a single analogue computer cost nearly $100,000; a small installation of 4 kinetheodolites for tracking the missile in flight cost $170,000; a radar and plotting table, also used for tracking and for range safety, came to $360,000; and at Canadair we are already spending at the rate of $1000 a day.

The cost is high not only in terms of dollars and cents, but also in terms of manpower; both in our own research establishments and in the associated agencies, a number of scientists, engineers, and technicians have been diverted from other jobs.

The magnitude of the guided missile project in relation to the total resources available for defence research and development in Canada emphasizes the importance of the practical application of Board policies in selecting the tasks to be undertaken in determining the scale of effort to be assigned to each, and in seeing that they are carried forward effectively by making the best use of all available facilities.

The Returns

While the guided missile project is in these early stages I would like to make clear its objectives. Let us assume for the moment that we are looking at the project merely as taxpayers. From the point of view of the taxpayer who has invested his money in the project, the

scheme will just break even if it produces a first-class team of guided missile experts in the development and construction of the main components that enter into guided missiles. This much would be well worth all the money invested in the program, because it would make it possible for Canada rapidly and effectively to take designs from other countries and manufacture and use them. It is the first essential step toward the introduction of guided missiles in our Services.

If, in addition to this, the program results in new components, new techniques, or new ideas that are adopted by the United States or the United Kingdom for incorporation in their missiles, then the project will have paid a small but nonetheless satisfactory dividend.

If, as we firmly hope, the project results in an effective operational missile, then we will figuratively have 'struck it rich' and and the return will be many times the money invested.

These possibilities require emphasis, because we are gambling for relatively big stakes in the guided missile game. Fortunately it is a very special kind of gambling, because at the worst we will get our money back, rather than losing our shirt as in the more conventional forms of gambling.

EARLY WARNING SYSTEMS

The next special item for discussion is Early Warning. This outline of an attack on the early warning problem is not intended as a record of accomplishment in research or development, but is intended to show how we in Canada can take advantage of our small and flexible organization in order to achieve speed and efficiency in the early stages of exploring a new approach to an old problem.

The Problem

All who are concerned with air defence have become increasingly alarmed at the growing size, cost, complexity, and inflexibility, of radar installations. All over the world groups have been formed to go back over our basic scientific knowledge to see if there is some

simpler approach to the problem.

In considering the air defence of Canada we have not only to consider this general need for simplification of warning systems, but also another outstanding and unique feature of the Canadian air defence situation – that we have in most directions several hundred miles of almost uninhabited territory between our major targets and our potential enemy. As no one else but the Russians have this condition, we do not know how any other nation has tackled the problem of using such an asset.

A Radar Fence

Many ideas for using this asset were discussed. One that kept recurring was the possibility of erecting some sort of a radar fence across our northern territory, which would serve to give a preliminary warning of the approach of enemy aircraft. If such a fence were reliable, we could obtain adequate protection with a much lower state of readiness in the main air defences and with consequent saving in manpower; we would gain many other advantages from the increased warning time, and might in fact be able to get a more effective warning system with fewer of the large and expensive stations.

Doppler Systems

Ideas of this kind had for some time been stirring in the minds of Professor Woonton and his staff at the Eaton Laboratory at McGill, Dr. McKinley and his staff at the Radio Division of the NRC, Mr. Scott and the staff of RPL, and Dr. Lewis at Chalk River. Early in 1951, these people met to discuss the possibilities of a variety of Doppler systems, which might meet the need for a radar fence.

They soon decided that the scientific information available on Doppler systems was not sufficient to allow them even to discuss the design of a system. Each of the groups had its own ideas concerning the best way of getting further information and of evolving a workable system. As all of their proposals seemed to have merit, it was decided

that the three groups should pursue three separate but related lines of investigation – one at the Eaton Electronics Laboratory at McGill, one at the Radio Division of the National Research Council, and the third at the Radio Physics Laboratory.

In the course of these investigations important new information concerning Doppler systems was discovered, several promising avenues for further research were opened up, some of the original schemes were abandoned, and some new and promising schemes were discovered.

Test Trials

Toward the end of 1951 a further meeting was held to discuss progress. It was decided that the exploratory phase of the investigation had made it possible to select two basic techniques for further trial. It was agreed that the NRC would proceed to build equipment to test one scheme, which embodied the basic ideas of the Radio Physics Laboratory as well as elements of their own original scheme. A contract was awarded to industry to construct trials equipment of another type, which had grown out of the Eaton Laboratory work and Dr. Lewis's original suggestion. In addition, Professor Woonton had become so interested in some of the research aspects of the problem that he proposed to continue basic research in this field. It is hoped that the two systems that have been chosen for test will be ready for detailed technical trials, and possibly simple operational trials, during the coming summer.

The trials already done in the course of the early research have given us sufficient indication of the characteristics and limitations of the system to consider how such a system would fit into Canadian air defence. It is too early to say whether an operational system will be evolved, but it is already quite clear that the technical possibilities of the idea are substantial and that it merits the effort that has gone into it.

Our Own Capabilities

I quote this as a good example of the sort of thing that we

should do in Canada. I am certain that we have been able to carry the exploration of these ideas to their present stage in a fraction of the time and for a fraction of the cost that could have been achieved in larger countries. It is one way in which we can take advantage of the smallness and flexibility of our organization. To do this involves having faith in the brilliance and ingenuity of our own scientists.

There is always a tendency in a country such as Canada to consider that the scientists of other countries are much better than our own. When we view the subject dispassionately we find that there is nothing whatever to support this view. There is no need for us to wait and follow the leads given by scientists in other countries. If we choose wisely we can depend very largely upon the initiative of our own scientists.

GROWTH OF OPERATIONAL RESEARCH

When the Defence Research Board was first formed the need for operational research was certainly not overlooked. It was given a low priority because the Services were so preoccupied with the problems of post-war reorganization that they had no time to think of operations, or even of advanced training, and because it was felt that the Board's first task was to build up an effective research team before attempting to give direct assistance to the Services.

However, during the past two or three years operational research has gradually grown, and during the year just ended has finally become one of the major and effective parts of the Board's organization. This has been partly due to the growth of our own staff, partly due to the fact that the Services have actually been engaged in operations in Korea and have been actively preparing for the possibility of operations in Canada and Europe.

As you know, the original plan was to have an operational research group in DRB headquarters, with operational research sections in each of the three Services. These sections were to be staffed both with serving officers and with scientists seconded from the Defence

Research Board. While this pattern has been adhered to, the original concept has been extended by the development of operational research in many other places.

A small operational research group has been working with the Twenty-Fifth Brigade in Korea; others may join the Twenty-Seventh Brigade and RCAF Air Division in Europe; a small but growing operational research section has been established at Air Defence Command; another is being set up at Western Command in Edmonton; a considerable part of the program at the Defence Research Northern Laboratory is operational research; and the techniques of operational research, or the actual staff of the Operational Research Group, have also infiltrated most of our establishments.

New Section at ADC

The status of the operational research section at Air Defence Command probably deserves further description, because, if it proves successful, the pattern may well be followed elsewhere. Air Defence Command is really a huge weapons system now under construction. The main elements of it are a radar system, communications, and fighter aircraft with their armament. Each of these elements of the system is in itself a major subject for scientific and operational research, but the most difficult and challenging research problem is the system as a whole.

It is the job of the Air Officer Commanding, Air Defence Command, to assemble all this equipment, together with thousands of men who have each been trained in a particular element of the task, and to weld the whole into an effective weapons system capable of detecting and shooting down enemy bombers should they attack Canada. This is a formidable task that will fully extend the capabilities of the RCAF, even with the very best scientific assistance. The Board has set out to give this assistance to the very limit of its capabilities.

In doing this we are fortunate in the personalities involved. First of all, Air Vice Marshal James, the Air Officer Commanding, Air

Defence Command, is himself thoroughly familiar with the scientific and technical aspects of his job, and fully aware of the importance of getting all the help he can.

Secondly, we are fortunate in getting Mr. Larnder, a Canadian who has had extensive experience in operational research with the RAF, to take charge of the section. At Air Defence Command Mr. Larnder has a dual role, and it is hard to say which part of his role comes first or is more important. He is not only the head of the operational research section, which seeks to apply the techniques of operational research to the solution of the problems of Air Defence Command, but he is also Scientific Adviser to the AOC. In this latter capacity he is authorized to make available to the AOC all the resources of the Defence Research Board and, through the Board, help that is available from all the scientific community in Canada and in other friendly countries. In a sense Mr. Larnder and his group at Air Defence Command are a microcosm of the Defence Research Board, just as the Command is itself a microcosm of the RCAF.

I am confident that this experiment will work, and that it will prove a most effective way both of bringing scientific knowledge to bear on the problems of the Air Force and of obtaining real, authentic, and up-to-date facts concerning problems of the Air Force for the guidance of the planners.

FUNCTIONS OF DRB

This brief outline of the development of operational research serves as a suitable introduction to my next topic. When the Defence Research Board was first established it was visualized that its staff would have two functions. One was to act as the scientific and technical advisers to the Services, in order to make available to them all the scientific knowledge of Canada and the rest of the free world. The other was to conduct a limited program of research and development on purely military problems of special importance to the Canadian Services.

It is not possible to say which of these functions is the more important, as they cannot be separated. The function of giving scientific advice cannot be effectively performed without doing research. A scientific advisory organization with no research laboratories of its own would be merely a post office. It would have no opinions of its own and would be unable to interpret information received from other countries in terms of Canadian needs.

Change in Emphasis

In the early days of the Board, the Services were fully occupied with the problems of post-war reorganization and so had little need for scientific advice. The Board therefore concentrated initially on building up its own research and development organization. During the past two years the whole emphasis has changed. The services are actively rearming and are thoroughly immersed in operational problems in Korea, in Europe, and in Canada. As a result of this change of emphasis on the part of the Services, the Defence Research Board's work has undergone a similar change.

The most important outward signs of this change are the increased activity of the Operational Research Group, the reorganization and strengthening of the Scientific Information Service, and the increase in size and activity of the headquarters staff. A less obvious but equally important part of the change is seen in the increasing number of scientists, in our own establishments and in other agencies working on defence research, who devote the whole or a part of their time to giving direct assistance to the Services, either as project officers on development programs, or as scientific or technical advisers on some equipment or operational problem. This increased emphasis on our scientific advisory function will continue as the strength and activity of the Armed Forces continue to increase.

Unique Advisory Function

It is important to realize that this function of the Defence

Research Board is one that has no exact parallel in the United States or the United Kingdom. In both those countries, their defence research organization is conducting a relatively complete program covering almost all the needs of the Armed Services. The Armed Services therefore get scientific advice and assistance as a by-product of the work of each research team.

With our limited research program in Canada we cannot hope to cover every part of every field. While doing research on a few limited projects in a field we must attempt to keep abreast of the progress in the whole of that field, and ensure that the Canadian Services have available to them the best scientific knowledge from the other countries.

The problem of maintaining a proper balance between these two kinds of activities is almost insoluble. We are now in a phase of increasing the scientific advisory function at the expense of laboratory research, but it is important to avoid going too far; if we do seriously curtail our research program, the scientific advisory function itself will ultimately suffer.

Defence Science Service

This increased emphasis on the scientific advisory function has also resulted in a change in terminology that I am sure you will all welcome. Ever since the organization was formed, we have suffered from the lack of a precise way of distinguishing between the Defence Research Board itself and the staff that works for the Board to carry out its policies. As the staff of the Board have a position in our defence organization rather like that of a junior Service, it seemed appropriate to use the term 'Service' to describe the staff. At first we thought of calling ourselves the Defence Research Service, but on more careful contemplation this did not seem to describe adequately the functions that I have outlined. So we propose in the future to refer to the Board's staff as the Defence Scientific Service.

Critical Appraisal Needed

Now for a few words of warning. The first is to reiterate the need for a highly selective program. As each research project grows it develops branches, often with buds on them that look almost as promising as the main stem. However, if we are to get a few first class flowers from our research bush we must rigorously prune off all but a few of the best buds. This simile is a useful one because it indicates the continual growth of a research program. You cannot prune it once and expect it to stay pruned. You must keep pruning it at frequent intervals; and in the pruning it is essential to look not only at the new buds, but also at the main bud that you previously chose for flowering, because at any pruning it may prove wise to prune off the main bud and leave one of the new ones to develop instead.

The need for pruning of the program has now become more urgent than ever before. Many of our establishments and headquarters functions have almost reached the maximum staff that we can envisage for them. Other parts of the organization will continue to expand, but even there the limit of expansion is already in sight. This means, in the future, that new projects can be taken on only by eliminating old ones, and more time can be given to the scientific advisory function only by cutting off some of the research work.

There is a tendency for some of you to reject entirely the idea of stopping any research project. A good research worker can always see some further extension of his work, and so he carries on long after the original promise of his idea has either been realized or failed to materialize. When new projects are suggested, such a person at once asks for additional staff. The fact that additional staff will not be forthcoming in the future should by no means be regarded as an unmitigated disaster. The impossibility of expanding your staff to meet new commitments will force you to cut off your most unproductive projects. If this is done wisely it will inevitably raise the average level of productivity of the whole staff, with a consequent increase in morale and

in the feeling of satisfaction that you get from your work.

Regulations and Initiative

The second word of warning that I would like to give is about laws, rules, regulations, and red tape. During the last year I have occasionally heard of people in the Defence Scientific Service who have done things that were obviously silly, and who have justified their action by saying that that is what the rules required. Every one of you, regardless of your status in the organization, should realize that rules, regulations, and even laws, are made by fallible human beings just like yourselves. They are just someone's attempt at writing down a sensible guide for behaviour under particular circumstances. Circumstances can change. The people who make rules and regulations can fail to foresee every situation. They can even make mistakes about situations that they have foreseen.

If any one of you is ever forced by rules, regulations or even laws, to do anything that seems to you to be unfair, stupid or unwise, then you should complain to the person next above you and keep on complaining until the rule is changed or the reasons for it are satisfactorily explained to you. I am quite sure that most of the difficulties and frustrations encountered in government service arise from a failure to take this action. People far too often suffer under rules and regulations that they know to be wrong merely because they lack the missionary enthusiasm to have them changed.

We in Canada are exceedingly fortunate in having an admirable system of government, which on the whole is staffed with sensible people. This means that it is relatively easy to have rules and regulations and even laws changed if you can show that they can be improved. We should all take full advantage of this fact. Let no one complain about the stupidity or complexity of the rules and regulations that govern his job until he has had a good try at changing them.

In giving this warning I do not suggest that we in the Defence Research Board are particularly bad in this respect. I think in fact that

we are still better than average because we are a relatively new organization. I give the warning because I am sure that the time to fight the stultifying effect of a rigid system of rules and regulations is while we are young and active, and before we have become frustrated and disillusioned and willing to put up with difficulties rather than try to overcome them.

The Year Ahead

Now, a word about the future. The outlook for the Board's sixth year seems bright. We have an effective and well staffed organization; in every establishment we now have a nucleus of competent scientists and engineers who are rapidly building up a background of knowledge and experience that is the Board's principal stock in trade. Our relations with the Services, with the rest of the Scientific community in Canada, and with our colleagues in other countries, are excellent. We are, in fact, in a splendid position to go on improving the effectiveness of the service that we render to our customers, the Armed Forces.

During 1952 we should give first priority to helping the Services with the immediate problems of training and equipping for the operational roles that have been assigned to them under NATO. This will mean some diversion of effort from our long-term research objectives, but this must be accepted if we are to make our greatest contribution to the concept of a deterrent force in being, which will prevent war and make possible the attainment of more lasting peace.

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