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SIXTH ANNUAL BIRTHDAY ADDRESS

Downgraded to Unclassified/Unlimited

27 Apr 2007

T. Campbell DRDKIM 2

Dr. O.M. Solandt

Chairman of the Defence Research Board

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MAY, 1953



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SIXTH ANNIVERSARY ADDRESS

by

Dr. O.M. Solandt

Chairman of the Defence Research Board

I am happy to have once more this opportunity of speaking to you on the anniversary of the Defence Research Board. Once again, our anniversary is saddened by the death of a respected member of the Royal Family. I know that we all feel a deep personal sense of loss in the death of Queen Mary.

First, let me express a welcome to the friends of the Board who have joined us at our family party this morning. I would like to make it clear that this is a family party and that what I have to say will be addressed primarily toward our own staff, particularly those whose jobs do not ordinarily allow them to have a glimpse of our policy. In a team as large as the Defence Scientific Service we can only get effective team spirit if everyone knows what we are trying to do. The real purpose of these annual addresses is to give to the

whole of the staff a general review of where we are, of what we hope to do, and of how we are getting along. Those of you who are interested in a detailed review can read our progress reports. On such an occasion as this, it is not appropriate to go into detail on every program.

THE LARGER SCENE

To understand what the Defence Research Board is trying to do, we have to look at the larger setting in which we work: first at the state of the world, then the state of affairs in Canada and particularly in the Armed Services, and finally at our own activities to see how they fit into this larger picture.

In the past year, there has been an increasingly clear demarcation between Russia and its satellites and the free world. The

world is more and more being divided into two groups, those who believe in the freedom of the individual and those who do not. It is increasingly clear that what we are fighting is not Communism in the sense of a political philosophy, but rather Russian imperialism. The free world has, I think, come to the point of view that they do not mind much how the Russians live, provided the Russians do not attempt to force their way of life on others who do not want it. This is probably a clear-cut issue in which you can engage the loyalty of everyone.

I was particularly interested to find in India a feeling that there was too much talk in the western world about fighting communism. Quite a few Indians feel that communism is an attractive political philosophy, but they are willing to join with the western world in fighting Russian imperialism.

It seems to me that the probability of war has not changed much in the last year. The increasing strength of the free world has certainly made it less likely that the Russians would start a war. On the other hand, Stalin's death has made the internal conditions in Russia more uncertain,

and the pressures leading to war may have increased more rapidly than our strength. But as far as we can tell, this likelihood of war seems unchanged in the last year.

Canada's Part

What is the role of Canada in the world? It is becoming clear that Canada is emerging as the leading middle power of the world. Canada is the trusted friend of both the largest powers and the smallest countries. Our importance lies very much in this role of acting as a link and almost interpreter between the great and small nations. Canada has in the past few years begun to accept a full share of responsibility in all the world agencies that are working to preserve peace. We think particularly of the United Nations and the North Atlantic Treaty Organization, and sometimes tend to forget the Commonwealth, which is still one of the important world-wide organizations that uses all its strength in support of peace.

This influence of the Commonwealth was particularly brought home to me in India recently at a meeting of the Commonwealth Advisory Committee on Defence Science. The stability of India is one of the great factors in main-

taining peace in the Far East. India seemed to me, on a brief visit, to be surprisingly stable. This stability, I think, arises largely out of its membership in the Commonwealth and out of the support that it has had, particularly from the British.

It was really exciting to visit India and to feel the missionary zeal of its leaders in their efforts to better the lot of the people. There is no doubt that the group in control are devoted to the cause of improving the standard of living and the welfare of their people. Whether they will be able to achieve it is problematical, but in the meantime they are a real force for peace in the world and certainly deserve our support.

I was interested to find in India the greatest admiration for the British, and British residents told me that they felt happier and on better terms with the Indians than ever before. This included people who had lived there all their lives. I was quite overwhelmed with the admiration expressed for Canada. There is no doubt that the Indians envy us to some extent and with good reason, because from their point of view we seem to have most

of the things that they lack while we are spared many of their worst problems.

I also had an opportunity of seeing something of the organization of the free world in an exercise held at SHAPE Headquarters in Paris, which brought together top military and scientific leaders from all the countries in NATO. Probably the most important thing about it was that they gathered together in an informal and friendly atmosphere, spoke their minds freely about all sorts of military problems, and, in fact, behaved as if they were really members of the same team. It was amazing how even the difficulties of language were overcome. I think the most moving address, and the one that brought the most applause, was given in Turkish. Naturally, the Turkish general had a very good interpreter, but it shows that we are getting on in learning the techniques of working together throughout the world.

Our Defence Forces

Next, let us look at the progress of the Canadian Armed Forces, which we in the Defence Research Board serve. During

the past year all three of the Services have grown amazingly in stature, and in maturity and general feeling of competence. The Navy has been doing splendid work in the Korean area. The Army has been fighting in Korea and has put a brigade into Europe. The Air Force is building up in Europe a group that forms an important part of the NATO Air Force. It becomes increasingly clear that the RCAF unit will be one of the dominant elements in the defence of Europe.

We in the Defence Scientific Service can well share in the pride of achievement of the Services during the past year. We noted with regret the retirement of Air Marshal Curtis, who, as Chief of Air Staff, has been one of our great friends and supporters. I know that we will have equally active support from his successor, Air Marshal Slemon. General Foulkes is now the only remaining member of the group of Chiefs of Staff who helped in the foundation of the Defence Research Board, and we are happy that he remains with defence work as Chairman of the Chiefs of Staff Committee.

THE MEASURE OF SUCCESS

In reviewing the progress of the Defence Scientific Service itself, I think we can justly say that during the past year our main aims have been achieved. The first aim of the Defence Scientific Service, like that of the Armed Forces and of the people of Canada, is to avert war. While war is still going on in Korea, the situation has not, on the whole, got any worse during the year. Canada has done her full share in this activity of preventing war, and the Canadian Services have shown steady growth and improvement in techniques and equipment. We may say that our long-term objectives have been successfully achieved during the past year. Let us now look in a little more detail at how we made our contribution to this general success and how we can improve our contribution in the future.

Change in Emphasis

In the past, in speaking to you on such occasions, I have tended to emphasize the material indices of progress, the number of staff, the amount of money that we have spent, the number of buildings built, and so on.

Such indices of progress are appropriate to a growing organization, when expansion is the primary objective. In a more mature scientific organization, the emphasis must be almost entirely on achievements, actual finished research and development jobs. At the present stage in DRB's history we must continue to use both kinds of indices; but we should realize that more and more our measure of success will be scientific achievement, rather than material accomplishment in the sense of recruiting, finance, and buildings.

Material Evidences

Consider first the material factors in our progress. On personnel we have had a rather poor year. The net increase of scientific staff has been only thirty-three. This was due partly to late approval of our establishment increase last spring, partly to an increasing loss rate, partly to competition with industry. It was influenced to a considerable extent by too limited a selection of candidates by the establishments. We hope to do much better this year and have taken steps to correct all these defects.

During the formative years of the Board, our rate of staff turnover was amazingly low. It was much lower than any other organization in the government, or than comparable organizations in other countries. This was understandable during the phase of expansion. Now our rate of loss of staff is rising. It is still considerably below average where I hope it will remain, but we should not worry about it rising. It is, in fact, a healthy sign that an organization has a fair turnover of staff. Quite apart from the fact that we will occasionally hire the wrong person and have to get rid of him, we do not have careers to offer to everybody. When a person gets to the end of his particular limb in the organization, he should leave if he can get a better job elsewhere. It will make it easier for us to recruit good people, particularly in the narrower specialities, if it is known that people who have worked with us are in line for good positions in other places.

On the general problem of recruiting, it is clear that we shall have a difficult time for the next two years at least, because the graduating classes in the universities, particularly

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in engineering, are exceptionally small this year and next. After that they will start to rise again and, unless there is an unexpected demand for engineering staff, recruiting should become a little easier. As a result, we shall probably not achieve our goal of a scientific staff of about 600 for two years, and possibly three. This means that to meet the demands of the Services during these busy years ahead everyone will have to work a little harder.

Senior Appointments

I might mention some of the senior appointments made during the year, although you probably know of them. At Headquarters the main change was a reorganization to form a new division, Division (D), under Dr. N.W. Morton. When Dr. Morton became head of Division (D), Dr. J.W. Abrams was made Superintendent of the Operational Research Group, which was split off as an independent establishment.

Dr. H.M. Barrett went from Suffield to CARDE in place of Mr. Carleton Craig, who returned to McGill after three years

on loan from the University. Dr. G.O. Langstroth of the Physics Division at Suffield took Dr. Barrett's place as Chief Superintendent.

At NRE we got a new permanent Superintendent. Most of you will recognize him as the same man who has been on loan from the Royal Naval Scientific Service for the last three years. This year, Dr. J.E. Keyston formally became a Canadian and severed his ties with the Royal Naval Scientific Service to throw in his lot with us in Canada.

Dr. G.B. Reed will, within a few weeks, be relinquishing some of his duties as Head of the Department of Bacteriology at Queen's University to become the fulltime Superintendent of our new laboratory at Kingston. Dr. J.C. Arnell, who was on leave to attend the National Defence College, returned during the year as Superintendent of DRCL.

New Buildings

One of the outstanding features of the last year has been the success of our construction program. I shall merely

CONFIDENTIAL

list for you the buildings that have been completed during the year. There is the new laboratory for NRE in Dartmouth, and the Electronics Laboratory east of Ottawa on the Montreal Road. At Shirley Bay just west of Ottawa, the Radio Physics Laboratory, the DRCL Pilot Plant, and the central services building, have been completed. The Chemical Laboratories are nearing completion and should be occupied this summer.

At Churchill, a major extension of the laboratory was completed and opened early this year. The Kingston laboratory has just been completed and is in the process of being occupied. A new Ballistics Laboratory was completed at CARDE and has been occupied. At Suffield the shopping and recreation centre was completed, as were a group of houses, a new school, and a new motor transport garage.

In addition, we are well along with construction of the Defence Research Medical Laboratories in Toronto and of an Aero-Medical Wing on it to house a section of the RCAF Institute of Aviation Medicine. This building should be completed during

the year. One of our largest construction jobs has been the new hangar and workshops and associated buildings for the Flight Research Section of the National Aeronautical Establishment at Uplands, near Ottawa. It also should be finished this summer.

Work has started on the Pacific Naval Laboratory's new building at Esquimalt, on a central stores and administration building at Shirley Bay, and on an extension to the workshop at CARDE. We hope in the next few months to start new permanent laboratories at Suffield. This means that within a few months we will have underway almost all of our permanent construction program.

Finances

As many of you know, we have a fixed financial ceiling for the operations of the Defence Research Board for the next few years. It is fixed at 22.9 million dollars, which is the amount that we had last year. It may seem at first sight unreasonable for the Government to have asked us to work on a fixed budget. In fact, it was in

line with our own plans, because our capital expenditure program is fitted in with the rising operating costs as we recruit new staff. As these costs rise, construction costs should fall.

Construction has lagged a little, so we must fit in a little more construction and operating expense next year than we had budgeted for, and this means that we all must exercise the utmost economy.

ACTIVITY HIGHLIGHTS

I would like now to review what seemed to be outstanding characteristics of the activities of the Board during the year. The first I have already mentioned, the construction of permanent laboratories. Completion of so many laboratories during the last year puts in tangible form the facts that the Board is a permanent part of Canada's defence organization and that as long as we have need for Armed Services we will need a defence research organization. I feel that this will have a substantial effect on the morale of the whole organization by giving the feeling of permanence to it.

Effective Teams

Another thing that has struck me in going around our laboratories is the growing maturity of our research teams. One of the outstanding facts about applied research is that a good team of people working together can do jobs that no one of them individually is capable of doing. It is often possible to weld together a team of real brilliance in applied research out of people who individually are merely competent scientists or engineers.

It takes time to weld these teams together, and somehow they function effectively only against a background of permanence and a feeling of competence in their particular subject. I have become more and more convinced that no matter how good the people you get together, they do not form the most effective team until they have worked together for some time.

I was particularly struck with this difference in visiting the two parts of our Telecommunications Establishment. I think there is nothing to choose between the competence of the individuals in these two labora-

tories; there are first-class people in both. At the Radio Physics Laboratory many of the people have been together for three, four, and five years, while at least a few have been together for seven or eight years. When you visit RPL you have a strong feeling of group competence, a feeling that somebody in the team knows the answer to almost any problem in their field. At DREL, which is much less mature, you somehow do not have that feeling, although you know that the individuals are equally competent and with a little more experience in working together will form really brilliant teams. I hope that those in DREL will not feel that I am picking on them in this illustration of my point, because I could say the same thing about many of our establishments.

One of the reassuring things about an organization such as ours is the realization that we have not begun to reach our full level of competence, that even if we were not to recruit any more staff we could in a few years tremendously increase our productivity and our value to the Services.

Relations with the Services

Another outstanding aspect of the past year is the way in which our relations with the Services have improved. It seems to me that the biggest change is the great improvement in contact with the Services at the working levels, and particularly with the laboratories. You may not all realize that in the early days of the Board the senior members of the staff, and particularly myself, spent a good deal of time peddling our wares to the Chiefs of Staff and other senior officers in the Services. The interesting thing is that in the last year we have seen the change to a situation where we no longer have to peddle our wares. Rather, we are beginning to have to fend off customers. This is highly desirable, because it means we have to discuss with the Services which things are most important to them, in order to concentrate our effort on the things that matter most to their immediate plans.

This change in relations with the Services is leading to another important change, and that is a clarification of the Defence Research Board's role in the department. As many of

CONFIDENTIAL

you know, ever since the Board was formed there has been a mild argument over our relation to development. At one time the Services were quite opposed to DRB participation in development, but now they are more and more asking us to help.

I think the reason is that both we and they have come to see clearly the important factors in this relation. The critical factor is that the Services must maintain the initiative. It must be up to them to decide which things they want developed. It then becomes our job to help develop the things that they want. This does not mean that we will not try to sell them ideas that have evolved in our own research programs or things that we see evolving in the research programs in other countries. We must do this as our duty. But we should never proceed with a particular development unless we can convince one of the Canadian Services that they have an important requirement for this bit of equipment, and also that its development will not interfere with standardization.

If we stick to this view, past difficulties in discussing

development with the Services will disappear, and DRB's role in helping the Services with development will become even more important in the future than it has been in the past.

Co-operation with Other Interests

In reviewing the last year it is also worth mentioning that our relations with the rest of the Canadian scientific community, in other government departments, in the universities, and in industry, have continued to be excellent. I am still not entirely happy about our contacts with industrial research, but they have broadened substantially during the past year. We are beginning to understand the problems better and to make more effective use of the industrial research capacity available in Canada.

In the international field our good relations have continued and even improved. We have been host to and have attended many tripartite conferences, and find our relations with Britain and the United States still on an excellent basis. We have also taken a fairly active part in some Commonwealth matters and a

very tentative part in some NATO problems. It is likely that in the next year or two as NATO develops we may become more involved in research and development problems in relation to NATO, but for the moment that is quite a minor part of our work.

THE ESTABLISHMENTS

It might be interesting now to list a series of the accomplishments of our different laboratories, to give you an idea of the kind of thing that is being achieved. I would again warn you that in such a list there is always too much emphasis on hardware. It is easy to describe a bit of hardware and often very difficult to describe a new idea, yet the idea may be much more important as a product of one of our laboratories than the hardware. Those of you who have been exposed frequently to these catalogues realize that I nearly always describe our organization starting in Halifax. This time I shall try my hand from west to east, so shall start the list in Esquimalt.

Pacific Naval Laboratory

The Pacific Naval Laboratory during the past year has completed the development of its optical analogue tank. This is a simple and ingenious device for plotting visually the path of sound rays in the ocean. It promises to have considerable value in training, and possibly in operations. Development of an anti-submarine depth corrector to facilitate the correction of depth readings on asdic is almost completed. This again is a thing of considerable training value, but particularly important in operations.

PNL have also embarked on a whole new field of fundamental research that may be very important to anti-submarine warfare. This is the study of the microstructure of isothermal water. In the past, PNL have felt that they had the most beautifully uniform water conditions on the west coast. Looking more critically, they now find that if water temperatures, salinities, and other factors are studied on a small scale, what was apparently isothermal water really is turbulent and can produce substantial effects on sound transmitted through it.

Suffield Experimental Station

Coming eastward to Suffield, the biggest contribution during the past year was development of the wind shed, which is really a new laboratory tool of gigantic size designed to facilitate field trials of both biological and chemical agents. It has shown great promise. Use of this new tool will tremendously speed up the conduct of trials with biological and chemical agents, and, in fact, promises to be a very real improvement in the field.

SES have started some experiments on the defensive aspects of atomic warfare, particularly the problems of decontamination after an atomic explosion, and with the help of Chalk River have done some important experiments in this field. During the year we helped the British Ministry of Supply in the conduct of some large explosions designed to test means of protecting magazines. One of these explosions was large enough to rate an 'atomic' headline in the newspapers. It was, of course, quite unjustified; but it is nice to know that we at least make enough noise to attract attention occasionally!

Suffield has also collaborated with the Department of Agriculture in an attack on the spruce bud-worm in the Kenora district. This is a good example of the application of knowledge obtained for defence purposes to purely peaceful purposes. All the information that we had available on aerial spraying was used in planning these trials. In return, of course, we got a good deal of information about the penetration of spray into forests.

Defence Research Northern Laboratory

The Defence Research Northern Laboratory at Churchill has been gradually switching its interests away from the purely human or physiological problems, to problems of operational research and human engineering. It has already done quite important work in helping the Services on studies of land navigation, and of operational loads, in the Arctic. In addition, it is becoming more and more the scientific advisor to the Services locally in Churchill. We hope gradually to build up in the Northern Laboratory not only a library of

knowledge, but a group of competent scientists who will serve as a reservoir of knowledge available on the spot to all the Services.

I might digress here for a moment to one of the changes during the year that I probably should have mentioned. We are giving more effort in several places, particularly in the two naval laboratories and at Churchill, to helping the Services solve their immediate technical problems. This may be a bit off our original concept of the role of the Defence Research Board, but it represents a service to the Armed Forces that we can provide easily while it would be difficult for them to provide it themselves. It is not too hard for us to keep good scientists and engineers in our establishments who can be available as consultants to the Services, whereas it would be very difficult for them to keep people of corresponding competence available as consultants, say in one of the dockyards. Consequently, we are more and more diverting a percentage of the effort of several of our laboratories to this sort of immediate consultation.

Defence Research Medical Laboratories

Continuing eastward, at Toronto we have the Defence Research Medical Laboratories. Their most important work in the past year has probably been in the field of human engineering. DRML have done some important work on the efficiency of radar operators, on layout in naval communications centres, on carbon monoxide poisoning in Centurion tanks, on noise in aircraft, and some very interesting studies on the effect of parka hoods on perception both auditory and visual.

DRML have continued their investigation of motion sickness, and have perfected a machine that they claim produces severe motion sickness in at least 95% of subjects in less than five minutes. They tell me the machine is not popular!

The Food Section has been doing excellent though sometimes unspectacular work with the Services, and in particular have helped the Air Force to improve their survival pack.

**Defence Research
Kingston Laboratory**

At Kingston our small laboratory, which was located in Queen's University, has just moved into a new building at Barriefield alongside the Army camp. This laboratory is concerned with the defensive aspects of bacteriological warfare. Its projects are important but rather detailed technical projects, which I shall not attempt to describe.

**Canadian Armament Research
and Development Establishment**

Let us skip past Ottawa for the present and go on to CARDE. CARDE is by far our biggest establishment. It has been increased particularly to take on the guided missile job for the Air Force. During the year CARDE opened two important new facilities. One is the aeroballistics range at CARDE itself, a huge enclosed range where projectiles or models of larger projectiles can be fired and all their characteristics measured. It is proving to be a most useful scientific tool. We have also developed during the year a small guided missile

range at Point Petre, on Lake Ontario. Already, sixteen test vehicles of different kinds for the guided missile program have been fired there. The main project at CARDE now is the air-to-air guided missile for the Air Force. This is going ahead very well. It is beginning to appear in hardware, and the testing of the various elements of the system is well in hand, both at the range and on aircraft operated by the Air Force at Ancienne Lorette.

Excellent work has been done on improvement of various kinds of sabot ammunition. One of the most spectacular and interesting developments has been the application of the sabot technique to study of aerodynamics of the guided missile. It is now possible as a routine to build a model of a thing like the guided missile and to fire it from a smooth bore gun at high supersonic velocities, and so get aerodynamic data on it in a short time. For certain kinds of aerodynamic information this technique is much simpler and more rapid than any known wind tunnel.

The Heller, an infantry anti-tank weapon, has passed out of the research and develop-

ment stage into pilot manufacture. It seems to be fulfilling its early promise of being the most accurate weapon of its type. It is apparently a very successful weapon. In addition to the success achieved in designing the weapon, we have obtained valuable experience in learning how to facilitate the transition from research and development to production and use.

Looking at Canadian history, you will realize that there have been surprisingly few military items developed and subsequently manufactured in Canada. As a result, no one has much experience of taking a developed item into production in Canadian industry. This is particularly difficult with armament, because we have no experienced armament industry in Canada. CARDE therefore had not only to design the weapon, but had to try to design manufacturing methods as well. On the whole we have been successful, not only in our cooperation with industry, but especially in the cooperation with the Army. This transition from the laboratory to the factory involves not only the manufacturer, but a transfer of control to the Services.

Once the weapon reaches a stage of manufacture it becomes the responsibility of the Service and DDP.

The pack howitzer is another design project that is drawing to a close at CARDE. This was started at the end of the war on request of the UK. It was taken on as an educational project but may now pay dividends, because we find that India is interested in an improved pack howitzer. They feel that such a weapon is important to their armed forces, and Canada and the United Kingdom have recently agreed to give to India the pilot model and complete drawings. We will certainly give them also every assistance in getting it into production, should they decide to produce it in India.

One relatively small but interesting job done at CARDE last year is worth mentioning, because it shows the importance of the group competence that I mentioned. Early last year the Army decided to produce a compromise small arms round, one that would have the seven millimeter calibre advocated by the British, but made with components and manufacturing tech-

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niques used in the United States. It was important that this be done quickly to be of any value. CARDE was asked in April, 1952 if they could undertake this job. The first round was fired in July, and an order for 50,000 rounds was completed in December, 1952. This demonstrates the advantages of a background of knowledge in an organization like CARDE, because even five years earlier it would have been impossible to undertake such a thing in this time.

As an index of the increased activity of CARDE, I might mention that during 1952 they fired over 20,000 rounds of ammunition in both proof and experimental firings, compared with only 1,600 rounds in 1948.

Naval Research Establishment

Continuing eastward to Halifax, the Naval Research Establishment have been occupied in moving into their new building, but in spite of that have continued to do excellent work. Their principal project is the development of a towed asdic equipment to meet peculiar Canadian requirements. Not

only have they worked on the development of this equipment, but have continued studies of the related oceanographic problems. They have in addition done some very interesting work on hydrofoil craft. Those of you who have been to Halifax have probably seen the craft disporting itself in the harbour or in Bedford Basin. It looks like a promising high-speed craft.

You may recall that NRE has for some years been working on the cathodic protection of vessels from corrosion. More than three-quarters of all vessels of the RCN are now protected cathodically, and this protection is producing a substantial annual saving for the Navy. NRE has also been doing some important work on sea-water batteries.

I mentioned briefly the work on direct help to the Navy. In Halifax there is a complete Dockyard Laboratory, separate from NRE which is across at Dartmouth. This laboratory alone has answered more than 900 inquiries during the past year compared with only 300 the year before, which gives an indication of the importance of this service to the Navy.

**Defence Research
Chemical Laboratories**

Now to come back to Ottawa. DRCL, the oldest of our establishments in the Ottawa area, has continued its work on chemical problems for the Services. It has been working particularly on flame thrower fuels, and on studies of new compounds as possible toxic agents. It has been doing excellent development work on respirators, particularly an Arctic respirator.

During the past year it has taken on a new field of activity in a study of low temperature batteries. This is of primary importance to the Canadian services, and so far no one has found a satisfactory solution.

DRCL has also done important work in studies of atmospheric pollution. This again is an example of the application of defence knowledge to practical civilian problems. Dr. Katz, who has been working on such problems from the military point of view for many years, has also become an expert on problems of atmospheric pollution. He is helping the International Joint Commission in some of their work.

**Defence Research
Telecommunications
Establishment**

In the Telecommunications Establishment, DREL is working on a fuze for the guided missile being developed at CARDE. It is specializing in problems of transistor manufacture and circuitry, and has nearly completed some important work on frequency stabilization. DREL is beginning what may become one of its major projects, helping the RCAF in the development of improved navigational systems.

At the Radio Physics Laboratory, they have devoted in the past year a good part of their effort to the development of a cheap and a simple early warning system. The results of their work and of work at McGill show great promise and may well be widely applied. They have continued their basic study of the ionosphere and are this year beginning to issue their own frequency prediction charts for the Arctic. In the past, the world-wide frequency prediction charts issued in Washington have not adequately covered the Arctic. The Radio Physics Laboratory has devised a new technique for portraying the

information required. It is hoped that these frequency predictions will be of great value not only to the Services, but also to all the civilian agencies that have to communicate in the Arctic.

RPL has been doing interesting work on both low frequency and very high frequency communication in the auroral zone. Their work on low frequency is particularly interesting, because they have started to re-examine a field of radio communication that has been neglected for many years. As so often happens, there are dividends to be picked up for comparatively little work. This can be done by applying techniques devised in other fields during the last twenty or thirty years, during which low frequency communication has tended to be in the background. Their work in this field may easily prove to be of importance.

Operational Research Group

Among the establishments in the Ottawa district is included the Operational Research Group. Their job is different from that of our other establishments. Probably even more than in

other establishments they must try to keep abreast of thinking in both the United States and the United Kingdom, and they have devoted a lot of effort to that task in the past year.

ORG have in general directed their effort into three principal fields. One is the problem of air defence. Here, the Operational Research Group in Ottawa has concentrated on problems of air defence five to ten years hence, and particularly on problems that will be associated with the introduction of guided missiles into our air defence system. The more immediate, operational, research problems of air defence are done at St. Hubert by the section that is with Air Defence Command there, and also by the section in Air Force Headquarters. The second top priority item is anti-submarine warfare. We have been working closely with the Navy in studying both equipment and techniques of future anti-submarine warfare. Finally, ORG cooperates with the Northern Laboratory in operational research on northern military problems.

I should emphasize that in all of these fields there is no intention that the operational

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research worker should solve the military problems and give the military man the final answer. The job of the operational research worker is to give to the military planner fairly clear-cut quantitative information on the probable effectiveness of different elements in the weapons systems, or of the system itself. I am particularly happy that this relation is becoming well understood in the Canadian Services, and that the officers who must make decisions are going directly to the operational research people to get the information they want in the form that they need it. An operational research group tends to be judged by the quality of its reports. In fact, it should be judged by the quality of the plans made by those it advises. One could imagine a successful operational research group that never put out any reports, but merely passed information to the planners. More and more, we are doing that.

Headquarters

I need only mention briefly the work at Headquarters, because most of you know what it is doing. As I could not possibly cover the good work being done

by everybody in a short speech, I will not attempt to go into detail. Please do not feel, if I have not mentioned your work, that it is not appreciated.

DSIS has had a particularly active and successful year. They have had 15,000 new accessions to the library during the year, and are now getting fairly good centralized control of our accessions, particularly of classified documents. This, as you know, is a very important problem, because one of the duties of the Defence Research Board is to make available to the Canadian Services the results of work done in Britain and the United States. DSIS is the key agency for this basic work.

DSI has also had a most successful year, and is increasingly exerting its influence through collaboration with the Services and the Joint Intelligence Staff, rather than directly through the Board.

I shall not say anything individually about the scientific staff sections at Headquarters. I have a list of their accomplishments, and it is really overwhelming. It would take half an hour just to read the headings!

CONFIDENTIAL

The important thing is that the concept of the scientific staff seems to be working better and better. As the members gain in experience and particularly in team spirit they work together more effectively, and are also working more effectively with the Services. I am happy to find that usually there is now no need for top level action to get cooperation on problems with the Services, because the Scientific Staff Officers know their opposite numbers well enough for consultation to take place directly on a staff level.

At times I get so optimistic about the work of the scientific staff that I feel we might start eliminating a few committees, and that might be set down as one of the objectives for next year.

We are all very happy that Mr. Dunn, Chief of Administration, has recovered from his illness and is back on the job. Both DGS and DRP have done a splendid job during the past year. I mentioned our difficulties in recruiting, but the blame should not be placed on DRP. Most of the difficulties have been well beyond their control,

and they have done their best to overcome these difficulties.

A FORWARD VIEW

Now let us look to the future and the things that we have to be careful about. It seems to me that the last year has been successful and that we can continue along the same lines in the coming year. As always, our major problem will be that of pruning our program. The program is growing so successfully that it is developing branches and buds in every direction, and we will have to nip some off if we are to get good flowers. This is a painful process but has to be repeated annually, so that it is not peculiar to this year.

Loyalties

One thing we as a group should recognize is that the organization is getting so big that we tend a little more to develop loyalties within the main group. I felt that in the formative years of the Defence Scientific Service we had exceptionally high morale and had a team spirit as a whole. The entire group felt an interest in

what everyone else was doing. While I hope we can retain this broad loyalty, we must try to foster increasing individuality in the establishments, and loyalty not only in establishment groups but even in smaller teams. On the whole, this change is taking place naturally and spontaneously in most establishments. It is much more difficult in Headquarters. In spite of its size, Headquarters must always operate more or less as a team. Although little groups of people have special jobs, their jobs are related to those of half a dozen other little groups in the Headquarters, which tends organizationally to be a mosaic rather than a tree. This makes the problem of group loyalty a little more difficult. We must give considerable attention to it in the future, particularly in Headquarters.

Maximum Returns

I have already mentioned that we have accepted a fixed level of expenditure for the next few years. We are building up toward our full complement of staff. Our construction program has already passed its peak and after next year will drop quite

sharply. We must now try to increase the productivity of the whole organization, not only the productivity per man or woman but the productivity per dollar. There is still a good deal of room for improvement in this line. During the formative phases of the organization we have not looked quite as critically as we now should at expenditures for things like equipment, transportation, and sub-staff. In the future we must look closely at all these items. When we spend money on any of the supporting structure of research we are taking money away from research. We must realize that good research can be hampered by too much equipment, too many facilities, or especially by too many junior and inexperienced staff. Everyone, at every level in the organization, should look critically at any additional expenditure not directly related to a research program.

The Question of Regulations

Last year I spoke about the problems of red-tape. What I said was apparently enjoyed by most and misinterpreted by some, and I would like to repeat the warning.

One of the top jobs that we have in the Defence Research Board, in common with all other parts of the government, is to prove to ourselves and to the world that a democratic government organization can work efficiently, smoothly, and effectively; that it can be just as competent and efficient and effective at its job as private enterprise. The only way to show this is for every individual in the organization to feel that he or she personally has a stake in proving this. The stupidities and difficulties that arise in a big organization do not always, in fact probably do not often, arise only at the higher levels. They arise throughout the organization, at every sort of level. Consequently, no individual can sit back and say, 'Well, this organization doesn't work very well, but it's no fault of mine. I've got nothing to do with it.' Everybody has a chance to improve the effectiveness of the organization.

What I attempted to say about red-tape and rules last year, and what I shall say again, is that if you are forced by rules and regulations to do something that seems to you to be silly, do not carry it out without com-

plaining. I emphasize that I am not suggesting you merely break the rules. That is not satisfactory. It often leads to great complication, even if it does not lead to disciplinary action. What I do suggest is that you point out to the person next above you that this rule does not fit the case you are dealing with, and that it should be changed.

The Rules are Not Rigid

One of the features of our whole organization of government in Canada, and in the Defence Research Board, is that the rules can be changed. None of them were made by infallible people; none of them, apart from the laws of nature, have been made by any authority higher than the Government. We have excellent access to the Government, and even if it is necessary to have an Act of Parliament changed we can usually get it done. Certainly we can change our own rules if they are proven to be bad. So let no one act stupidly because the rules are bad, without complaining about them.

This same remark applies to instructions from the superior. Sometimes I have been asked

for an opinion about a subject, which I have given. Months later I find that something has been done which seems to be rather stupid. On inquiry I am told, 'Well, this is what you said should have been done'; to which my reply is, 'I didn't know about this particular problem when I made that remark. What I said applied to something quite different.' If instructions from a superior officer do not jibe with commonsense in dealing later with another problem, do not hesitate to go back and ask for new instructions. Nothing is more embarrassing to a senior officer than to find that his instructions have been carried out to the extent of producing complete nonsense.

If everyone in the organization will feel that he has this personal responsibility, we shall be able to retain our present remarkable freedom from the inertia of a large government organization. I have previously said that we have this freedom, not because of our inherent ability, but because we are new. We must strive to take full advantage of that fact, and continue to have the freshness and enthusiasm of a youthful organization just as long as we can.

Our Responsibility

We begin the seventh year of the official existence of the Board in excellent shape. We have a first-class staff who are pulling together as an effective team. We have good buildings and equipment. We have excellent friends who are kind and helpful to us, and we are members of a proud and successful team in the Canadian Armed Services. But after visiting many parts of the world in the past year, I feel that I should end with a note of warning to us in Canada.

When you go to countries like England, France, India, Pakistan, Australia, countries throughout the world, you find that they are looking with the utmost admiration and friendship toward Canada. In every country you find a friendly admiration and remarkably little sign of jealousy, even in countries who suffer severely from lack of the natural resources that we have in such abundance. The alarming thing about their attitude is that they all look to Canada as the model of a democratic country. They feel that if we cannot succeed — not just adequately, but brilliantly — then there is no

hope for a democratic way of life in other countries.

This puts a heavy responsibility on us. I would ordinarily be hesitant to suggest, for instance, that the Defence Research Board ought to be the best defence research organization in the world. I would ordinarily say that we would be quite happy if it turned out to be

a good one rather than the best. But when one sees the way in which Canada is viewed throughout the world, and the way in which people throughout the world are looking to us as a model of what can be achieved by a democratic system, then I feel that nothing less than perfection is acceptable to us and to our friends.