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**A BRIEF HISTORY OF THE DEVELOPMENT OF CANADIAN  
MILITARY OPERATIONAL RESEARCH**

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## A BRIEF HISTORY OF THE DEVELOPMENT OF CANADIAN MILITARY OPERATIONAL RESEARCH\*

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TO THE BEST of my knowledge, operational research, or operations research, was not a recognized term in Canada before World War II. Its origin lay, so far as Canadians were concerned, in the wartime work of British scientists who were, as you know, concerned with the effective use of radar in the air defense of Great Britain. If 1941 was the year of the first official institution in the U.K. of operational-research units conceived and named as such, the Canadian armed services were a year or more in arrears in setting up similar facilities. Historically the first was, I believe, the RCAF, which early in 1942 noted the work of the Air Ministry in this field, and by August of that year had arranged with the late Professor J. O. WILHELM to set up a small central office in Air Force Headquarters. The Royal Canadian Navy and the Canadian Army followed suit with the beginning of similar organizations—a Directorate of Operational Research in the RCN under Dr. J. H. L. JOHNSTONE in 1943, and a similar directorate in the Army together with a Canadian Army Operational Research Group under Dr. J. T. WILSON in 1944. As a matter of interest, two of the gentlemen whose names I have mentioned were university physicists, while the third was a professor of geophysics.

### SERVICE ORGANIZATIONS DURING THE WAR

A DESCRIPTIVE WORD about each of these service organizations in turn: In the RCAF, beyond the central office in Ottawa, units were established in Canada in the Eastern and Western Air Commands, overseas at RCAF Headquarters in London, and with the RCAF Bomber Group in the U.K. Moreover, in view of the extent to which RCAF personnel were integrated within the RAF, contributions of the scientific staff for operational research were made to D.D. Science in the Air Ministry, RAF Bomber Command, and RAF Coastal Command. Altogether about twenty scientists were employed. Those who were attached to the RAF shared generally in its program. This included work on such problems as the planning and assessment of such special bombing operations as those against the submarine pens and the V-1 sites, the analysis of anti-submarine depth charge attacks, and the use of blind bombing techniques. In Canada, one of the chief problems of study was the methods of search for missing aircraft.

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Various other questions—aircrew appraisal, bombing and navigation training assessment, and the operation of coastal radar—were also investigated in Canadian sections.

The Royal Canadian Navy had as its chief concern in wartime the safe passage of merchant vessels across the North Atlantic. This naturally led into considerations of anti-submarine and anti-mine warfare. The Directorate of Operational Research, which reported at Naval Headquarters to the Assistant Chief of Naval Staff who was primarily concerned with operations, dealt therefore very largely with the collection and analysis of data related to the effectiveness of anti-submarine weapons and equipment, the adequacy of plans or tactics of air and ship escort, the optimal routing of convoys, and the like. Some ten scientists, located either at Naval Headquarters, at the main Atlantic Canadian Naval Base at Halifax, or temporarily elsewhere, wrote a number of reports on such problems during the period July 1943 to August 1945.

The Canadian Army established in 1944 a Directorate of Operational Research in Army Headquarters. Its duty was in close association with the Scientific Adviser to the Chief of the General Staff to assist the Army with day-to-day problems of a scientific character, and to coordinate the activities of a field organization, set up at the same time, known as the Canadian Army Operational Research Group. The latter included units assigned to several of the major Army training areas in Canada, and to Pacific Command, and also individual scientists and officers who were attached for operational-research duty with British, Indian, and Australian units. A large part of the program of CAORG in Canada was centered on methods of training armored, signals, and artillery personnel. The use of radar also came in for considerable attention. Personnel attached to other Commonwealth units and formations participated in the programs of those forces. Altogether some 30 scientists and officers were employed. In 1945 provision was made for a Canadian Field Research Section to serve with the first Canadian Army in 21 Army Group in North West Europe, and subsequently with the proposed Canadian Division for employment in the Pacific. Cessation of hostilities first in Europe and subsequently in the East occurred too soon for this section to be effective, however. Nevertheless, in those latter days of the war and during the period of demobilization that succeeded them, CAORG did occupy itself to an appreciable extent in the conduct of field exercises in the Canadian North, of which perhaps the best known was Exercise Musk-Ox.

During the period 1942 to 1945 the Canadian services employed altogether some sixty civilian scientists and engineers who had entered the services for regular duty, but who were transferred to operational research when its requirements for staff had to be met. The civilians were for the

most part made available through the National Research Council, which among other things in wartime acted as a clearing house and sponsor for university scientists whose services were needed on a civilian basis in the armed forces.

#### OPERATIONAL-RESEARCH ORGANIZATION SINCE THE WAR

IT COULD, I believe, be fairly concluded that by the end of the war operational research had been reasonably well established and accepted in all three armed forces. However, at the close of hostilities the tremendous requirement for academic scientists to return to universities to help cope with the flood of post-war students resulted in the rapid melting away of operational-research staffs, so that by a year afterwards almost no one was left. Thus, when the services began to evolve their post-war permanent organization, the operational-research units that had been laboriously developed were missing. This was a pity, and it is of interest to note that it will have taken ten years since that time to rebuild the operational-research staff in the Department of National Defence to the approximate size that it had attained in wartime. It was a pity particularly because as many wartime scientists pointed out, the successful making of an operational-research worker depended among other things on learning how to live and work with the armed services, and on his personal acceptability, as well as on his developed skill in helping to define and solve military problems.

However, by 1947 provision was made in the Canadian Department of National Defence for a unified research element known as the Defence Research Board, intended to serve all three armed services. The organization set up under this Board later came to be referred to as the Defence Scientific Service. Although in its planning early provision was made for the inclusion of operational research—no surprising fact, in view of the consideration that OMOND SOLANDT, the head of the new Canadian defence research organization, had been Superintendent of the British Army Operational Research Group in wartime—no concrete steps could be taken to bring together a nucleus of an operational-research staff until early in 1949. This was then accomplished by selecting a few new graduates for training, luring back into the fold three or four of the younger scientists and military officers who had gained experience in operational research in wartime, and obtaining part-time assistance from several of the more senior university scientists such as ABRAMS, BARNES, FISHER, STANLEY—to mention only a few—who had spent several of the war years at this work.

An agreement was reached among the Board and the three armed services that an operational-research team would be set up in each service and in the Board, and that these would be staffed largely by DRB scientists, with provision for assignment of qualified service officers at the discretion

of each service. DRB, through an establishment specially set up for the purpose, known as the Operational Research Group, was to give general technical supervision and support to their work and plan individual postings and careers of the civilian scientists. While the program of each of the four units was to be a responsibility of the RCN, Army, RCAF, and DRB respectively, a joint committee would review programs periodically with a view to balance of effort, avoidance of duplication, and a reasonable apportionment of resources relative to need.

This scheme has been successfully applied, and has been somewhat extended by the addition of certain joint-service field teams to undertake work on problems of a local character that typically involve inter-service cooperative operations. Examples of these are to be found in the fields of air defense and maritime warfare. Such teams report to a local commander or commanders, and derive their program from this local setting, although there is a good deal of communication and give-and-take in work between them and the more centrally located operational-research staffs. General technical support and supervision of the local teams are again the responsibility of the Defence Research Board, however, being provided by the Superintendent of the DRB Operational Research Group, which also acts as the holding organization for all civilian scientists engaged in operational research anywhere in the Department of National Defence.

To summarize what has happened: Through the middle and later war years the individual services built up with the aid of the National Research Council operational-research organizations that failed as such to survive the transition from war to peace. By the joint effort of the post-war services and the newly created Defence Research Board, a fresh start has since been made, however, which has brought the operational-research staff almost to its wartime strength again. This new organization involves a mainly civilian scientific staff, divided among RCN, Army, RCAF, and DRB headquarters units plus certain joint field teams, with local determination of program subject to over-all review of program by a departmental committee and to central scientific supervision and personnel administration by the DRB Operational Research Group.

#### CURRENT DEVELOPMENTS IN OPERATIONAL RESEARCH

APART FROM ORGANIZATION, other changes have taken place. I will name those that I think are most notable.

First, it was characteristic of the wartime units that because scientific effort generally at that time had to be composed rapidly from the elements available to grapple with the issues of the moment, and because many of these questions were new and the work of a pioneering character, programs included problems of a type that have subsequently been referred to spe-

cialized agencies to deal with. For example, in the Canadian area this is true of a good deal of the work in radio propagation and on personnel selection, training, and human engineering.

Second, a transfer of emphasis has taken place from assessment of specific operational equipment and activities to the evaluation of over-all operational systems and strategies. Thus instead of being concerned only with, say, the effectiveness of use of a new-type of bomb sight, we are now involved perhaps in the general evaluation of a projected air-defense system including radars, interceptor forces, data handling devices, etc. This shift is not by any means total, of course, and has in any event been forced upon us by the obvious fact that while we are not actively at war we yet must devise plans for national defense that will give the most value for the dollar. And there is no doubt that it represents a distinct advance in the development of operational research as a useful branch of military science. It might be added that such operational-systems evaluations are being undertaken here by relatively small groups of mostly permanently employed persons—typically four to eight in number, and usually including both service officers and civilian scientists—rather than by very large or by specially invited groups.

Third, and perhaps rather obviously, we are now very much concerned with the future, and sometimes the comparatively remote future, rather than with the present alone. This results principally from our concern with the introduction of important new weapons and equipment, and the impact of these on existing weapons systems, which may result in essentially new systems being necessary. Since some choice of future courses of action is likely to be open, we are concerned with the evaluation of these optional courses. Frequently there is an accompanying problem of compatibility of major features of systems that we may see as succeeding one another, arising from the considerable capital investment that each may in turn involve. Such preoccupation with the future leads to the interesting possibility that, aside from consideration of the use of new types of weapons under actual development, operational research may influence the conception of weapons as yet unborn.

Fourth, the past few years have been characterized by an increased interest in gaming techniques and machine computation to deal with increasingly novel and complex battle situations. To a great extent this has followed from the concern with ever-extending defense systems, but also I think because the rapid development of new types of weapons untried in battle has forced upon us use of abstract means to represent complex situations of which we lack actual experience.

I might have added to these developments a fifth, except that I think it merely refers to the current effect of ten or fifteen years mutual experi-

ence of armed services and operational-research staffs. This is the degree to which the latter have in Canada now been accepted as a part of the military organization privy to that organization's problems, worries, hopes, and plans. While imperfections in communication, and in appreciation of a practical military problem or the value of a scientifically arrived at conclusion will continue to occur, I for one am frequently impressed by the degree of mutual insight, and of acceptance of operational scientists by the service planners and decision-makers, which has in fact been attained.

A word might be said also on the possibility that military operational-research programs in Canada will be paralleled by a comparable development in the civilian field. I think it is true that the latter development is yet only in its early stages. It is represented at this meeting, however, by the presence of a number of Canadian industrial contributors, and will surely grow. As it does, those who are concerned with operational research in defense will look forward to useful associations with colleagues in the civilian field.

Canadian ingratitude would be great indeed if I were not to close my remarks by taking the opportunity to record appreciation of the extent to which military operational research in Canada has been assisted by British and United States colleagues. This assistance has involved training of Canadian staff, loans and exchange of scientists, provision of information, and cooperation in joint programs. Without it any Canadian progress would have been enormously lessened. Recompense for this timely help will, we trust, be made in the degree to which a strong Canadian military operational-research program aids in the promotion of an efficient Canadian contribution to the defense of the free world.

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