The Defence Research Board of Canada, 1947 to 1977

by

Jonathan Turner

A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy
Institute for the History and Philosophy of Science and Technology
University of Toronto

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Abstract

The Defence Research Board of Canada existed from 1947 to 1977. It was created because of the successful contribution of scientific management and specific military technologies to victory in the Second World War, and it was dismantled during a period of review and renewal of the government’s science and defence policies. The demise of the Defence Research Board demonstrated the triumph of business and public administration models over scientific management in spite of the successful defence research program. Among the successful projects of the Defence Research Board were satellites, research rockets, hydrofoils, nylon pile clothing, the wind chill factor, the strategic distinction between first and second nuclear strikes, open heart surgery, and blast trials. The strengths of the Defence Research Board were the scientific management practices that united the four Chairmen (Omond Solandt, Hartley Zimmerman, Robert Uffen and Léon L’Heureux) and the bench scientists.

Over the course of its existence the Defence Research Board was shaped by six chains of events.

1. Solandt’s ability to recruit veterans from 1947 to 1953,

2. The election of John Diefenbaker and the ensuing conflict between Diefenbaker and civil servants, particularly over nuclear weapons, which led to the Royal Commission on
Government Organisation and a decade of review of national defence policy (including two White Papers, integration and unification, and the Management Review Group),

3. The science policy review that followed from C.D. Howe retiring from politics and the reports of the Royal Commission on Government Organization,

4. The Defence Research Board’s brushes with francophone nationalism and separatism,

5. The criticisms leveled against the Defence Research Board by the Voice of Women, and

6. The changing of Canadian demographics and values in general.

This thesis documents the story of the Defence Research Board against its international, national, scientific and historical contexts.
Acknowledgments

For their help and support during the process of researching and writing this dissertation I would like to thank the following people: Kate Turner, my family (the Turners and Oates), my extended family (the Pettifers and Heathcotes), Janis Langins, Chen-Pang Yeang, Robert Bothwell, Steven Penfold, Edward Jones-Imhotep, archivists and librarians, co-panelists and conference commentators, the Gerstein Gang, my history teachers and professors, and, of course, defence researchers past, present and future. Without all of you this dissertation would not have happened.
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## List of Abbreviations

**International or Multinational**

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AGARD</td>
<td>Advisory Group on Aeronautical Research and Development</td>
</tr>
<tr>
<td>ASDIC</td>
<td>Now known as sonar, but the original acronym is a mystery. It could stand for Active Sound Detection or it might have meant Allied Submarine Detection Investigation Committee.</td>
</tr>
<tr>
<td>ASW</td>
<td>Antisubmarine Warfare</td>
</tr>
<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>CUSSAT</td>
<td>Canada-United States Scientific Advisory Team</td>
</tr>
<tr>
<td>DDT</td>
<td>Dichlorodiphenyltrichloroethane</td>
</tr>
<tr>
<td>DEW</td>
<td>Distant Early Warning</td>
</tr>
<tr>
<td>GM</td>
<td>Guided Missile(s)</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product</td>
</tr>
<tr>
<td>HQ</td>
<td>Headquarters</td>
</tr>
<tr>
<td>ICBM</td>
<td>Intercontinental Ballistic Missile</td>
</tr>
<tr>
<td>IGY</td>
<td>International Geophysical Year</td>
</tr>
<tr>
<td>IPY</td>
<td>International Polar Year</td>
</tr>
<tr>
<td>Laser</td>
<td>Light Amplification by Stimulated Emission of Radiation</td>
</tr>
<tr>
<td>Maser</td>
<td>Microwave Amplification by Stimulated Emission of Radiation</td>
</tr>
<tr>
<td>MSG</td>
<td>Military Study Group</td>
</tr>
<tr>
<td>NATO</td>
<td>North Atlantic Treaty Organization</td>
</tr>
<tr>
<td>NORAD</td>
<td>North American Air / Aerospace Defence</td>
</tr>
<tr>
<td>OR</td>
<td>Operational Research (UK and Canada), Operations Research (US)</td>
</tr>
<tr>
<td>PERT</td>
<td>Program Evaluation and Review Technique</td>
</tr>
<tr>
<td>PJBD</td>
<td>Permanent Joint Board on Defence</td>
</tr>
<tr>
<td>Radar</td>
<td>Radio Direction and Ranging</td>
</tr>
<tr>
<td>RDF</td>
<td>Radio Direction Finding (radar)</td>
</tr>
<tr>
<td>RDX</td>
<td>Research Department Explosive</td>
</tr>
<tr>
<td>SACEUR</td>
<td>Supreme Allied Commander Europe</td>
</tr>
<tr>
<td>SHAPE</td>
<td>Supreme Headquarters Allied Powers Europe</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
</tr>
<tr>
<td>Sonar</td>
<td>Sound Navigation and Ranging</td>
</tr>
<tr>
<td>SW</td>
<td>Special Weapons (i.e. atomic, biological/bacteriological, chemical)</td>
</tr>
<tr>
<td>TTCP</td>
<td>Tripartite Technical Cooperation Program or The Technical Cooperation Program</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>Canada</td>
<td>Assistant Deputy Minister</td>
</tr>
<tr>
<td>ADM</td>
<td>Atomic Energy of Canada, Limited</td>
</tr>
<tr>
<td>AECL</td>
<td>A.V. Roe of Canada</td>
</tr>
<tr>
<td>Avro</td>
<td>Chief of the Air Staff</td>
</tr>
<tr>
<td>CBC</td>
<td>Canadian Broadcasting Corporation</td>
</tr>
<tr>
<td>CDRB</td>
<td>Chairman of the Defence Research Board</td>
</tr>
<tr>
<td>CDS</td>
<td>Chief of the Defence Staff</td>
</tr>
<tr>
<td>CF</td>
<td>Canadian Forces</td>
</tr>
<tr>
<td>CGS</td>
<td>Chief of the General Staff (Army)</td>
</tr>
<tr>
<td>CIHR</td>
<td>Canadian Institutes of Health Research</td>
</tr>
<tr>
<td>CNS</td>
<td>Chief of the Naval Staff</td>
</tr>
<tr>
<td>COMINCO</td>
<td>Consolidated Mining and Smelting Company</td>
</tr>
<tr>
<td>CRAD</td>
<td>Chief of Research and Development</td>
</tr>
<tr>
<td>CTS</td>
<td>Chief of Technical Services</td>
</tr>
<tr>
<td>DARPG</td>
<td>Development and Associated Research Policy Group</td>
</tr>
<tr>
<td>DDP</td>
<td>Department of Defence Production</td>
</tr>
<tr>
<td>DG</td>
<td>Director General</td>
</tr>
<tr>
<td>DIR</td>
<td>Defence Industrial Research</td>
</tr>
<tr>
<td>DM</td>
<td>Deputy Minister</td>
</tr>
<tr>
<td>DND</td>
<td>Department of National Defence</td>
</tr>
<tr>
<td>DRB</td>
<td>Defence Research Board</td>
</tr>
<tr>
<td>DRDB</td>
<td>Defence Research and Development Branch</td>
</tr>
<tr>
<td>DRDC</td>
<td>Defence Research and Development Canada</td>
</tr>
<tr>
<td>ISIS</td>
<td>International Satellites for Ionospheric Studies</td>
</tr>
<tr>
<td>MND</td>
<td>Minister of National Defence</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
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<td>--------------</td>
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</tr>
<tr>
<td>MOSST</td>
<td>Ministry of State for Science and Technology</td>
</tr>
<tr>
<td>MRC</td>
<td>Medical Research Council</td>
</tr>
<tr>
<td>NAE</td>
<td>National Aeronautical Establishment</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council</td>
</tr>
<tr>
<td>NSERC</td>
<td>Natural Sciences and Engineering Research Council</td>
</tr>
<tr>
<td>RCAF</td>
<td>Royal Canadian Air Force</td>
</tr>
<tr>
<td>RCN</td>
<td>Royal Canadian Navy</td>
</tr>
<tr>
<td>RIN</td>
<td>Rassemblement pour l'Indépendance National (National Independence Movement)</td>
</tr>
<tr>
<td>SSHRC</td>
<td>Social Sciences and Humanities Research Council</td>
</tr>
<tr>
<td>UofT</td>
<td>University of Toronto</td>
</tr>
<tr>
<td>UWO</td>
<td>University of Western Ontario</td>
</tr>
<tr>
<td>VCDS</td>
<td>Vice Chief of the Defence Staff</td>
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Canadian Defence Establishments (arranged geographically and chronologically)

<table>
<thead>
<tr>
<th>Location</th>
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<tbody>
<tr>
<td>Halifax</td>
<td>Naval Research Establishment</td>
</tr>
<tr>
<td></td>
<td>Defence Research Establishment Atlantic</td>
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<tr>
<td>Valcartier</td>
<td>Defence Research Establishment Valcartier</td>
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<tr>
<td>Valcartier</td>
<td>Canadian Armaments Research and Development Establishment</td>
</tr>
<tr>
<td>Grosse Île</td>
<td>Grosse Île Experimental Station</td>
</tr>
<tr>
<td>Ottawa</td>
<td>Chemical Warfare Laboratory or Laboratories</td>
</tr>
<tr>
<td>CWL</td>
<td>Defence Research Chemical Laboratories</td>
</tr>
<tr>
<td>DRCL</td>
<td>Defence Chemical, Biological, Radiation Laboratories</td>
</tr>
<tr>
<td>DCBRL</td>
<td>Defence Chemical, Biological, Radiation Establishment</td>
</tr>
<tr>
<td>RPL</td>
<td>Radio Propagation Laboratory / Radio Physics Laboratory</td>
</tr>
<tr>
<td>EL</td>
<td>Electronics Laboratory</td>
</tr>
<tr>
<td>DREL</td>
<td>Defence Research Electronics Laboratories</td>
</tr>
<tr>
<td>DRTE</td>
<td>Defence Research Telecommunications Establishment</td>
</tr>
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<td>Acronym</td>
<td>Description</td>
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<tr>
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<tr>
<td>DREO</td>
<td>Defence Research Establishment Ottawa</td>
</tr>
<tr>
<td>Kingston</td>
<td>Defence Research Kingston Laboratory</td>
</tr>
<tr>
<td>DRKL</td>
<td>Defence Research Kingston Laboratory</td>
</tr>
<tr>
<td>Toronto</td>
<td>Defence Research Establishment Toronto</td>
</tr>
<tr>
<td>IAM</td>
<td>Institute of Aviation Medicine</td>
</tr>
<tr>
<td>DRML</td>
<td>Defence Research Medical Laboratory</td>
</tr>
<tr>
<td>CFIEM</td>
<td>Canadian Forces Institute of Environmental Medicine</td>
</tr>
<tr>
<td>DRET</td>
<td>Defence Research Establishment Toronto</td>
</tr>
<tr>
<td>DCIEM</td>
<td>Defence and Civil Institute of Environmental Medicine</td>
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<tr>
<td>Churchill</td>
<td>Defence Research Northern Laboratory</td>
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<tr>
<td>DRNL</td>
<td>Defence Research Northern Laboratory</td>
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<tr>
<td>Prince Albert</td>
<td>Prince Albert Radar Laboratory</td>
</tr>
<tr>
<td>PARL</td>
<td>Prince Albert Radar Laboratory</td>
</tr>
<tr>
<td>Suffield</td>
<td>Defence Research Establishment Suffield</td>
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<td>Suffield Experimental Station</td>
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<td>DRES</td>
<td>Defence Research Establishment Suffield</td>
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<td>Esquimalt</td>
<td>Defence Research Establishment Pacific</td>
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<tr>
<td>PNL</td>
<td>Pacific Naval Laboratory</td>
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<tr>
<td>DREP</td>
<td>Defence Research Establishment Pacific</td>
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<tr>
<td>Other</td>
<td>Operational Research Group</td>
</tr>
<tr>
<td>ORG</td>
<td>Defence Research Analysis Establishment</td>
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<tr>
<td>DRAE</td>
<td>Defence Research Analysis Establishment</td>
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<tr>
<td>ORAE</td>
<td>Operational Research and Analysis Establishment</td>
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<tr>
<td>CORA</td>
<td>Centre for Operational Research and Analysis</td>
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<td>JIB</td>
<td>Joint Intelligence Bureau</td>
</tr>
<tr>
<td>DSIS</td>
<td>Defence Science Information Service</td>
</tr>
<tr>
<td>CSS</td>
<td>Centre for Security Science</td>
</tr>
<tr>
<td>PSTP</td>
<td>Public Security Technical Program</td>
</tr>
<tr>
<td>CBRNE CRTI</td>
<td>Chemical, Biological, Radiological-Nuclear, and Explosives Research and Technology Initiative</td>
</tr>
<tr>
<td>United Kingdom of Great Britain and Northern Ireland (United Kingdom or UK)</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
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</tr>
<tr>
<td>AMES</td>
<td>Air Ministry Experimental Station (Chain Home)</td>
</tr>
<tr>
<td>AWRE</td>
<td>Atomic Weapons Research Establishment</td>
</tr>
<tr>
<td>DRPC</td>
<td>Defence Research Policy Committee</td>
</tr>
<tr>
<td>DSIR</td>
<td>Department of Scientific and Industrial Research</td>
</tr>
<tr>
<td>NPL</td>
<td>National Physical Laboratory</td>
</tr>
<tr>
<td>RAE</td>
<td>Royal Aircraft Establishment</td>
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<tr>
<td>RAF</td>
<td>Royal Air Force</td>
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<td>RN</td>
<td>Royal Navy</td>
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<td>TRE</td>
<td>Telecommunications Research Establishment</td>
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<tr>
<td>United States of America (US or USA)</td>
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<td>ARPA or DARPA</td>
<td>(Defense) Advanced Research Projects Agency</td>
</tr>
<tr>
<td>BOMARC</td>
<td>Boeing Michigan Aeronautical Research Center</td>
</tr>
<tr>
<td>HUAC</td>
<td>House Un-American Activities Committee</td>
</tr>
<tr>
<td>MAD</td>
<td>Mutual Assured Destruction</td>
</tr>
<tr>
<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautical and Space Agency</td>
</tr>
<tr>
<td>NDRC</td>
<td>National Defense Research Committee</td>
</tr>
<tr>
<td>NSF</td>
<td>National Science Foundation</td>
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<tr>
<td>OSRD</td>
<td>Office of Scientific Research and Development</td>
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<tr>
<td>RadLab</td>
<td>Radiation Laboratory</td>
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<tr>
<td>RAND</td>
<td>Research and Development</td>
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<td>RDB</td>
<td>Research and Development Board</td>
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<tr>
<td>SAC</td>
<td>Strategic Air Command</td>
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<tr>
<td>SAGE</td>
<td>Semi-Automated Ground Environment</td>
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<tr>
<td>USAF</td>
<td>United States Air Force</td>
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<td>USN</td>
<td>United States Navy</td>
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</table>
Chapter 1
Introduction

1.1 Defence Research in Canada

1.1.1 Peaceful Attitudes

Canada is a peaceful country. More properly, history and geography have provided Canadians with the rare opportunity to embrace a minimalist attitude towards defence. In the first half of the twentieth century, through the two world wars, Canada shifted from the British sphere of influence to American protection. As a consequence, Canadians were roused to war only when it seemed apparent that a conflict threatened Canada's allies the United Kingdom of Great Britain and Northern Ireland or the United States of America.

The heart of the informed debate in Canada when it comes to defence is about the appropriate ongoing contribution for Canadians to make to the alliance(s) as part of an overall ambition of stabilizing international balances and attaining peace. In addition to men and materiel, Canadians have contributed to the scientific and technical knowledge required to conduct and win wars. The first call to organize Canadian scientists and engineers for defence research came in the First World War, and it was issued by the British government. The Canadian government responded, but by then the war had ended and the organization, the National Research Council, focused on civilian research initiatives instead. As the Second World War became imminent, the National Research Council returned to its defence research roots. Following the victories in Europe and Japan a new organization was created to continue the research required for war, the Defence Research Board, and the National Research Council returned to more peaceful scientific and technical research.

Since the Second World War, Canada's minimalist contribution to global peace has always included defence research. Canadian defence research has avoided much of the popular scrutiny to which Canada's military has been subjected, and Canadian defence research has not seen a comparable level of public concern as British and American military research. This is not to suggest that Canadians are more tolerant of defence research than the Americans or British; it is an indication that Canadians are less aware that the country has a defence research apparatus, because of its relative size. Moreover, Canadian military research agencies, from the Defence
Research Board through to the current Defence Research and Development Canada have never tried to be covert. Over the entire course of its existence from 1947 to 1977 the Defence Research Board publicized its existence as often as possible as a means of recruitment and political survival.

The Defence Research Board attained a small measure of national recognition in the 1960s when Canada was the third country to have a satellite in orbit. National pride was attached to the Alouette I and II research satellites that were designed and built by members of the Defence Research Telecommunications Establishment in Ottawa and launched in 1962 and 1965. In Canada’s centennial year, 1967, the Defence Research Board’s media relations officer responded to hundreds of letters from elementary school students from all across Canada who had been assigned a research report on the Alouette satellites. Many of those students wrote letters to the Prime Minister, the Minister of National Defence, the Chairman of the Defence Research Board, and various other officials in the Department of National Defence requesting information about, and pictures of, the Alouette satellites. These letters all found their way to the desks of the media relations officer of the Defence Research Board.

The information provided to those students might have helped them to understand the basics of how and when the satellites were launched, but it certainly would not have clarified who was responsible for the research leading up to the launch or who was processing the information being transmitted back to earth from the satellites. The media releases did nothing to clarify how satellite communications were a significant step in the solution to the problem caused by the ionosphere for long-range communication near the North Pole; nor could anyone have foreseen the precise details of how drastically this would change global communications over the next five decades. Furthermore, these students would not have come away with any detailed understanding of what the Defence Research Board was, nor what functions it served.

This is the history of this under-studied and under-appreciated organization.

1.1.2 The Board and the DRB

The Defence Research Board was created in 1947 as a direct response to the urgency of the Second World War and the foresight of Canada’s wartime political, scientific and military managers, C.D. Howe, C.J. Mackenzie and General Charles Foulkes. The Defence Research
Board was reorganized in 1974 as part of the general trends of transitioning the public service to the latest business and public administration models as well as the relative reduction of defence spending in Canada.

The Defence Research Board that was created in 1947 had two components. The first component was the collection of defence research establishments spaced out across the country. In 1947 there were five establishments across four provinces. In the early 1960s the Defence Research Board reached its peak in number of establishments at eleven, which were spread across seven provinces. The establishments were all administered by the Chairman from the headquarters in Ottawa. He had responsibility for hiring and promotion, as well as the direction of the overall research program. To aid him in the daily management of the establishments there was an administrative staff and a small group of senior scientists working as non-researching managers.

The Chairman was assisted in determining the overall direction of the research program, including which candidates to hire, by a Board, which was the second component of the Defence Research Board. In 1947 the Board of twelve voting members and a secretary was what was called the “Defence Research Board,” but over time the entire apparatus including the Board, headquarters and the establishments became known as the “Defence Research Board.” A few attempts were made between 1947 and 1977 to rename either the Board or the entire apparatus; “Defence Research Council” was the most commonly suggested option. Despite (or because of) the similarity to the name “National Research Council,” “Defence Research Council” never stuck.

Because it is proper to refer to both the Board and the entire apparatus as the “Defence Research Board” I have chosen the following distinction to avoid confusion. I will refer to the small council that advised the Chairman as the “Board,” and I will use “Defence Research Board” or “DRB” to refer to the broader case of the combination of the Board, headquarters and the establishments. In most cases that follow it will be quite obvious when the discussion is limited to the Board rather than the entire Defence Research Board.
1.2  Pieces of the Puzzle

1.2.1  Internal Histories

The obvious starting point for any research regarding the history of the Defence Research Board is Donald Goodspeed’s 1958 book *A History of the Defence Research Board of Canada*. Goodspeed’s account of the first decade of the DRB is excellent, and provides all the details one would hope for when trying to understand the history of the DRB. Goodspeed covers both the people and the projects that defined the creation and first decade of the DRB. The book is organized into chapters that cover the events leading up to the creation of the DRB, followed by chapters on each of the major research areas in which the DRB was active. These chapters focus on the managers and projects of the various establishments and groups.¹

One drawback of Goodspeed’s account is his perspective. Goodspeed, who was a Captain in the Army’s Historical Section, wrote the book in 1956 and 1957, but the Defence Research Board existed for another 20 years after this. The DRB changed in those final 20 years, and a large part of the changes within the DRB were a direct result of the transformation of Canada, and Canada’s role in the world. These changes in the DRB need to be documented. Furthermore, the first decade of the DRB can be reappraised as part of an historical analysis of the entire history of the DRB.

There have been several informal internal histories about the Defence Research Board. In every case (save one) they were authored or co-authored by retired or semi-retired researchers who had an interest in recording the history of the establishment at which they had spent all or part of their careers. These books are excellent sources of the history of the establishments as seen from the perspective of the defence researcher. Coincidentally, many of these internal histories were published during the defence research review that resulted in the creation of Defence Research and Development Canada in 2000.

Maritime research is documented in three different collections. John Longard published *Knots, Volts and Decibels: An informal History of the Naval Research Establishment, 1940-1967* in 1993. Not to be outdone, the Pacific coast researchers wrote their informal history in 1998;


The Valcartier establishment produced two histories in 1995 and 1996. The first was an informal history written by Henri Tardif, *Recollections of CARDE/DREV, 1945-1995*. The second was a more formal history written by historian Alain Gelly and Tardif, *Defence Research Establishment Valcartier: 1945-1995, 50 Years of History and Scientific Progress*.³

The Ottawa establishments produced both a fiftieth and a sixtieth anniversary history. Jim Norman and Rita Crow edited a collection, *A History of the Defence Research Establishment Ottawa, 1941-1991*. Ten years later an historian of science, Suzanne Board, was hired by the Ottawa establishment to update Norman’s and Crow’s work with *A Brief History of the Defence Research Establishment Ottawa, 1941-2001*.⁴

The two oldest internal histories of establishments are the collections assembled by Archie Pennie. He compiled anecdotes regarding the Suffield Experimental Station in 1961, and a year after its closing he assembled the *Defence Research Northern Laboratory, 1947-1965*.⁵

John Mayne wrote a report that documented the history of operational research in Canada in 1980. At the same time, Mayne’s former colleague, John Abrams, was attempting to write a more formal history, which he never finished.⁶

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In the same vein as these internally produced informal histories there is a collection of papers on the life of Omond Solandt. *Perspectives in Science and Technology: The Legacy of Omond Solandt* is the proceedings of a 1994 symposium organized by Cecil Law, George Lindsey and David Grenville. It brought together former colleagues of Solandt from his numerous posts, including his eleven years in Canadian defence research. The chapters devoted to Solandt’s time at the Defence Research Board are written by defence research colleagues, but with more hindsight than many of the other internal histories.⁷

### 1.2.2 Secondary Sources

There are seven recent historians who have discussed the Defence Research Board, at least indirectly. Edward Jones-Imhotep has written articles and his thesis about the electronics research in Ottawa. Andrew Godefroy’s theses and much of his post-doctoral writing cover rocketry in Canada. Stephen Bocking writes about the DRB’s contribution to the development of aerial geography. John Vardalas looks at developments in computing across Canada, while Scott Campbell’s dissertation is about the Computation Centre at the University of Toronto; the Computation Centre was funded and used, in part, by the DRB. Vera Pavri-Garcia writes about the conversion of communications research from the control of the DRB to the Department of Communications in the second half of the 1960s in her dissertation. Jason Ridler’s recent thesis is a biography of Omond Solandt limited to Solandt’s participation in defence research during the Second World War and with the DRB. All of these secondary sources are narrowly focused on aspects or individuals of the DRB.⁸

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Because of the scarcity of sources that deal directly with the Defence Research Board, and because of the desirability of situating the history of the DRB within Canadian, international, military, scientific and technical history, it is necessary to expand the scope of research to provide a broader background. The literature relevant to review for the history of the DRB can be limited to the relatively narrow fields of Canadian government science and technology (National Research Council, Atomic Energy of Canada Limited, etc.), twentieth-century Canadian politics, military, foreign relations, economics and society (with a particular focus on the Cold War), and the parallel developments of military and government research facilities in the United States and the United Kingdom (Advanced Research Projects Agency, Department of Scientific and Industrial Research, the Military-Industrial-Academic complex, etc.).

The starting point for the history of Canadian government science is the most recent work on the topic: Donald Avery’s *The Science of War: Canadian Scientists and Allied Military Technology during the Second World War* published in 1998. The next most recent is George Lindsey’s edited collection from 1997: *No Day Long Enough: Canadian Science in World War II*. Lindsey’s collection is written by him and several others who participated in wartime research and many of whom continued with the Defence Research Board.  

Because of their impeccable quality, several older sources are still quite useful when doing work on institutional science and technology in Canada. Robert Bothwell’s *Nucleus* and *Eldorado* are essential sources on the history of atomic energy in Canada, including the central figures of Howe and Mackenzie. Wilfrid Eggleston’s *National Research in Canada* and Mel Thistle’s *The Inner Ring* are the most thorough sources covering the early history of the Defence Research Board’s sibling agency. Eggleston’s *Scientists at War* is often a more useful source

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than the more recent works on wartime science because of its focus on the facts and details, like people and dates, rather than sweeping themes and broad concepts or personal accounts.  

*Scientia Canadensis* produced a useful collection of essays on the National Research Council in 1991 edited by Richard Jarrell and Yves Gingras, and Philip Enros and James Hull are in the midst of creating a special issue on the topic of science in the Canadian government (to which I have contributed an article about the Defence Research Board).

The classics of Canadian military history are Charles Stacey’s *Arms, Men and Governments: The War Policies of Canada, 1939-1945* and Jon McLin’s *Canada’s Changing Defense Policy, 1957-1963: The Problems of a Middle Power in Alliance*. The latter is far more readable than the former. Of the subset of histories of Canada’s involvement in North American Aerospace Defence (NORAD), the starting point is Joseph Jockel’s *Canada in NORAD, 1957-2007*, which is his second history of NORAD (the earlier is just as good).

For Canadian politics, economics and society one could start with Robert Bothwell’s *The Penguin History of Canada* and then consult his earlier co-authored (with Ian Drummond and John English) histories of the twentieth century: *Canada: 1900-1945* and *Canada Since 1945*. For a more detailed look at the Cold War and Canadian foreign relations the most recent and thorough study is Bothwell’s *Alliance and Illusion*, but there are excellent older works by Denis Smith (*Diplomacy of Fear*) and Denis Stairs (*The Diplomacy of Constraint*), among others, that cover particular aspects such as the early Cold War and the Korean War in greater detail.

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Of Canada’s two Cold War allies there is an overabundance of sources on American defence research. There was no direct parallel to the Defence Research Board in the United States. Research was undertaken within each service and by contractors. Starting in 1958 some research was sponsored by the Advanced Research Projects Agency (ARPA or DARPA – Defense ARPA). The closest thing to a history of the Department of Defense’s Advanced Research Projects Agency is Janet Abbate’s *Inventing the Internet*, but this is only a history of the evolution of the ARPAnet to the internet, which leaves much of the bureaucratic details of ARPA unexplored. Most of the projects and history of ARPA are still classified. The rest of the secondary sources on American military research are specialized to a single project. Representative examples include Donald MacKenzie’s *Inventing Accuracy*, Stuart Leslie’s *The Cold War and American Science*, Paul Edwards’ *The Closed World* and *Military Enterprise and Technological Change* a collection edited and compiled by Merritt Roe Smith. There is no history of the fractured organization of research for defence in the United States.\(^{14}\)

The most recent source on British military research is David Edgerton’s *Warfare State*. However, Edgerton’s work is not particularly useful as a straightforward chronology of the important people and events in the history of the Department of Scientific and Industrial Research or the National Physical Laboratories. Edgerton’s interest lies more in trends and themes; he is reinterpreting three veins of historiography in light of his factual research. Edgerton sheds new light on Charles Snow’s *Two Cultures*; he reinterprets the growth in the twentieth century of a British Welfare State (highlighting the previously unnoticed importance of the military-industrial-academic complex), and he applies a similar approach to Michael Sherry’s

excellent description of twentieth century American society and politics, *In the Shadow of War*. Edgerton never explicitly acknowledges the ground-breaking work and methodology of Sherry.\(^\text{15}\)

There are no comparable studies of the militarization of Canadian society in the twentieth century, because Canadians resisted militarization (choosing to rely on our Allies for most of our defence needs). Therefore, this survey of the Defence Research Board must be informed by all of the fields of research mentioned (Canadian government science, Canadian politics, society, economics, foreign relations and military, and defence research in allied nations), but it must also break new ground.

### 1.2.3 Primary Sources

The obvious sources to which an historian could turn are archives, both the ones that previous historians and journalists have reviewed and materials that no one else has studied. Unfortunately there are significant gaps in the archival records due to the different managerial styles of the four Chairmen of the Defence Research Board and more importantly the surprising and hasty reorganization of defence research in Canada in 1974. The files that were kept, which does not appear to be all of them, often have the appearance that they were angrily or indifferently stuffed into boxes and shipped off to storage with little concern for accurate labeling. Storage constraints have led to recent culling efforts by Library and Archives Canada.

It has been possible to supplement the archival record with oral history. There have been many willing participants in this effort unfortunately time is never on an historian's side when he or she is trying to fill gaps through interviews. Memories of events from 35 or more years in the past are not always clear or reliable, and have often been reevaluated in light of more recent events. Deaths are even more difficult to overcome. All the former Chairmen of the Board died before this history was completed, and only two of them left their personal papers at university archives.

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1.3 Interpretative Narration

The net result of the available sources has led to many important and interesting questions that seem to have no answers. There is an abundant reservoir of materials (on particular projects of the DRB) that either could not be incorporated in this bureaucratically-focused history, or have not been consulted. Happily, there remain important research questions for historians of the Defence Research Board to answer, and new information that could result in reinterpretations of this first complete history of the DRB.

My approach to writing this history has been to place an emphasis on the chronology of events and people rather than my interpretations. Primarily this is because I prefer reading narrative histories, especially for my first exposure to a topic. I have also been reminded countless times while writing this dissertation that reliable resources containing the important historical details with subtle and minimalist interpretations are invaluable and are the histories that I return to repeatedly. Where these reliable summaries do not exist the alternative is wading into the sea of primary sources to master a topic, even when one's interest is only tangential, which results in a broader scope of study than originally intended.

Where my interpretation becomes most evident is what I have chosen to include and exclude from this history of the Defence Research Board.

The least subtle of the interpretations of the history of the Defence Research Board embraced in this dissertation is represented in the organization of the chapters. The thesis is bookended by a short overview of government and military science in Canada, namely the creation and evolution of the National Research Council, which follows this introduction, and an epilogue covering defence research in Canada since 1977. The bulk of the thesis is split into three chapters covering the four Chairmen: Omond Solandt, A. Hartley Zimmerman, Robert Uffen and Léon L’Heureux (the latter two are grouped together). This top-down approach allows for easy comparison of the men who ran the Defence Research Board, and the different challenges they faced internationally, nationally and internally. However, this focus on personalities pushes the science and technology to the background in favour of the management, politics and international relations. Further work, in addition to the work already being done by other historians like Godefroy and Jones-Imhotep, can fill the gap in the knowledge regarding the projects undertaken by the DRB.
Chapter 2
Canadian Defence Research before the DRB


2.1 Introduction

The Defence Research Board was created in 1947 as a direct response to the success of scientific and technical research in the Second World War. It would be tempting to believe, in light of the emphasis on nuclear weapons over the second half of the Twentieth Century, that the application of science and technology to war was born in the Manhattan Project, or at the very least took on a new and drastically different direction. Moreover, other large projects from the Second World War like radar, jet propulsion and rocketry actually began in government, military, university and industry laboratories before 1939, but those projects received a new emphasis and priority during the war.

Astrophysicist, operational researcher, scientific adviser, and historian of science John Abrams was always quick to remind students and colleagues that the application of innovations in science and technology to war was as old as war itself. However, the military research seen during and after the Second World War, characterized by government laboratories working in large teams on complicated and classified projects in conjunction with industries and universities, is a much more recent phenomenon than Abrams argues, but older than popular opinion.16

There is a clear and direct progression from the Department of Scientific and Industrial Research (DSIR) in the United Kingdom, to the National Research Council (NRC) in Canada and finally to the Defence Research Board. The DSIR arose as a direct response to the needs of the First World War. The three institutions are unique from any previous government or military laboratories in number of employees, budget, relationships with industries and universities, and application of science and technology to war. In the cases of the DSIR and NRC, after the First

16 LAC, MG 31 J 16 Vol 24 File “John W Abrams ‘Historical Background of Operational Research’ Combined Manuscript and Annotated Typescript pp 17, nd.”
World War ended, both institutions shifted to more peaceful research projects from their previous directives of meeting the defence research needs of their nations.

The history of defence research in Canada prior to the creation of the Defence Research Board in 1947 brings several important trends and themes to the fore.

1. Government-driven defence research arose in the First World War;

2. After a decade and a half of peaceful research, the National Research Council returned to its defence research roots in the lead-up to the Second World War thanks to the leadership of Andrew McNaughton;

3. Liaison with the British and Americans was one of the prominent activities of the National Research Council during and immediately before the Second World War, which the Defence Research Board continued after 1947;

4. The Canadian defence research contribution to the war effort qualitatively matched Canada’s contribution to the war effort, but a few Canadians, notably C.J. Mackenzie and Omond Solandt, earned distinguished international reputations based on their contributions;

5. The success of atomic weapons, radar, rockets, jet propulsion and other innovations in science and technology during the war and the Depression cemented the case that defence research should continue in the postwar;

6. And the ongoing tension between the Atlantic Triangle allies and the Russians heightened fears that the postwar peace would not last.

2.2 Organizing Government Science

2.2.1 Department of Scientific and Industrial Research

The Defence Research Board’s origins can be traced to the creation of government research laboratories during the First World War. Canada, the United States and the United Kingdom all created agencies devoted to research in 1915 and 1916. All three countries were driven by the need for their governments to have control over their nations’ scientific and
engineering effort that was devoted to creating new weapons and new defences to be applied in the Great War.

The British created their Department of Scientific and Industrial Research in 1915, the Americans started a National Research Council in 1916 in anticipation of their entry into the First World War and the Canadians created an Honorary Research Council in 1916, which was renamed the National Research Council in 1925. The Canadian Honorary Research Council was a direct response to the requirements of the British (Imperial) government that had created the Department of Scientific and Industrial Research and recommended that all Colonial governments do likewise.17

The British Department of Scientific and Industrial Research was essentially a collection of research facilities, but the upper levels of its administration served both advisory and policy-writing functions. Some of the laboratories existed before the creation of the DSIR (for instance, the Services’ facilities); the DSIR served an organizing and managing function. The main motivation for this sort of centralization was to avoid duplication of effort; a theme we will see repeated after the Second World War. The British military services retained their own research facilities, but these were coordinated with the DSIR through committees.

2.2.2 National Research Council

The situation in Canada was quite different. The Honorary Research Council was thrust into a vacuum. While some government departments like Agriculture, Mines and Fisheries employed scientists, there were no major government laboratories. The military relied on the

British for equipment, and therefore had no research facilities of their own. The Research Council was purely an advisory body.\textsuperscript{18}

The Honorary Research Council started with modest budgets and made one of its first tasks the recommendation that a Central Bureau of Standards be established in Ottawa. It took until 1924 for the government to agree that they needed a scientific and industrial research laboratory. A year later the Honorary Research Council became the National Research Council. It took a further five years for the laboratories (often called ‘the Temple of Science’) on Sussex Street in Ottawa to be built and staffed.

Despite its origins as a response to the needs created by the First World War, the National Research Council devoted itself to national projects with civilian applications in the early part of the Depression. Some projects could or would be applied to military needs, but the emphasis had shifted (as early as 1917) to improving Canada’s sorry lot in university and industrial research on the whole rather than the specific military needs that drove the British government’s recommendation.

The Honorary Research Council surveyed the state of Canada’s scientific and industrial research in 1917. Only the University of Toronto and McGill University were engaged in extensive scientific research, and those two universities combined had only produced eleven doctoral degrees in science since 1894. The majority of Canada’s professors of science and engineering had been educated in the United States and/or the United Kingdom, and their focus was on teaching undergraduates rather than basic research and the education of graduate students.\textsuperscript{19}

In its very first budget the Honorary Research Council allocated $10,000 for scholarships and fellowships, but because the war had diverted both talented students and their potential supervisors, the Research Council was not able to spend its entire allocation. When the war ended in 1918, matters improved slowly. By 1926, the National Research Council “had awarded 344 scholarships and Fellowships to 199 students. Sixteen departments of science at twelve


\textsuperscript{19} Eggleston, \textit{National Research in Canada}, 8.
Canadian universities had been involved.” Only 155 of those 199 students completed their graduate training, and 123 of those successful post-graduates were active researchers.

The funding of external research increased until 1931. $237,000 was allocated for funding of research (including studentships and fellowships), out of the total budget of $323,000 for the NRC in 1928–29. Two years later the amount allocated to extramural research had not changed significantly but its share of the pot had shrunk because of the commencement of work at the National Research Council laboratories in Ottawa; external research received $240,000 ($60,000 for students) from the total budget of $550,000. Of the $310,000 for internal research $185,000 was dedicated to salaries alone.

The number of applicants for extramural funding increased throughout the 1920s and 1930s, but the available resources dwindled in the Depression that had gripped Canada since October 1929. Applications increased in the Depression as more students attempted to stay in school in practical studies like engineering and science. This kept them out of the harsh job market for a longer period of time, and put them into relatively safe job markets when they finally graduated. The March 1933 budget for extramural funding was $16,600, compared to the $60,000 that had been allocated in 1928. The number of applicants had reached 138, but only 28 were given bursaries, studentships or fellowships ranging from $500 to $700.

The Depression also caused turmoil for the internal program of the National Research Council. The NRC accommodated its budget cuts largely by reducing its funding to students. The diminished budget also meant that the NRC had no hopes of expanding its own laboratories, or even running those laboratories satisfactorily in each successive year. The cost of operating a laboratory increased each year as the various commodities on which it relied (primarily labour) incrementally increased. A fixed or decreasing budget meant that savings had to be realized through scaled back operations or staff-cuts.

In 1935 the direction of the National Research Council shifted. Henry Tory, a career academic and administrator, who had been President of the NRC since 1923, was replaced by

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20 Eggleston, National Research in Canada, 24.
21 Eggleston, National Research in Canada, 24.
22 Eggleston, National Research in Canada, 66.
23 Eggleston, National Research in Canada, 78.
Major-General Andrew McNaughton. In addition to his storied military career, McNaughton along with Colonel W.A. Steel obtained a patent in 1926 for a Cathode Ray Direction Finder (a forerunner of radar), which he sold to the Canadian government for $1. McNaughton remained the President of the National Research Council until 1944, although from 1939 to 1944 he was the Commander of First Canadian Corps and then the First Canadian Army with the rank of Lieutenant-General and C.J. Mackenzie was the acting President of the NRC.24

The 1935 shuffle in the Presidency of the National Research Council was the result of two factors. First, Henry Tory was 72. Second, the patronage whims of Prime Minister R.B. Bennett had shifted. Bennett, in turn, lost the 1935 election to William Lyon Mackenzie King. McNaughton had taken the job based on promises from Bennett for more funding to the National Research Council, especially for research on Cathode Ray Direction Finders and other fields with military interest. The Liberals rescinded these budgetary commitments and the NRC was forced to scrounge together any applied research on top of the existing basic research. McNaughton was interested in applied science projects that could be used by the military in an impending war, but his scientific training meant that he did not overlook the need for continued basic research.25

2.2.3 Anticipating the War

It was fortuitous that McNaughton’s military and scientific mind was brought into the NRC in 1935. The prospects of a new global conflagration increased that year. Germany was actively remilitarizing in violation of the Treaty of Versailles. Both Italy and Japan were involved in invasions and occupations in defiance of the League of Nations.

A few fields and projects were explored by researchers in the NRC from 1935 to 1939 that proved to have important applications in the Second World War, and were continued by the Defence Research Board and/or the National Research Council after the war. One project that

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arose during McNaughton’s tenure was the collaboration between Lloyd Pidgeon, a chemist with the NRC, and Consolidated Mining and Smelting Company (COMINCO) in British Columbia. In 1937 Pidgeon improved Consolidated Mining’s process for the production of metallic magnesium. Magnesium is used directly in the production of goods and munitions. In its oxide form (magnesia) it is valued as a refractory for the iron and steel industry in crucibles and to form molds.26

In addition to Pidgeon’s work, the National Research Council was convinced by McNaughton to undertake research in radar, aviation medicine, artillery, aircraft and gas masks. The rudimentary preparations and work done before the war were mobilized thoroughly in 1939 and 1940 as part of the conversion of the National Research Council and Canadian universities from peacetime research to applicable war research.

Along with the internal changes in the National Research Council starting in 1935, there were also changes in Canada’s national defence policies. A year after the 1935 election, King convened the first meeting of a Cabinet Defence Committee to address the escalating international tensions. Despite this foresight, King allowed only modest increases in Canada’s national defence budget.

Canada had always been a country with a small military budget, and the Great Depression caused even further cuts. Spending dropped from $23,732,000 in 1930-31 to $14,145,000 in 1932-33. Despite the modernizing and mechanizing efforts of McNaughton before he was moved to the National Research Council, this was only enough for some out of date equipment, less than 3800 soldiers and 524 horses. The proposed budget for 1937-38 was announced by Minister of National Defence Ian Mackenzie to be $36,000,000, and possibly could have been more without resistance from King.27

The United Kingdom was more prepared than Canada for a war in 1935. As an island nation, the British were uniquely vulnerable, but also afforded natural defences by the sea and air gap that separated them from Europe. Because of this vulnerability and opportunity, the

27 Eggleston, National Research in Canada, 100; Bothwell, Drummond and English, Canada, 1900-1945, 296.
Department of Scientific and Industrial Research’s National Physical Laboratory worked with
electromagnetic propagation to locate and track airplanes (and surface ships). Although he was
not the only man working on the project, the bulk of the credit for the development of an
application of Radio Direction Finding (RDF) to defence is given to Robert Watson-Watt.28

The man responsible for bringing Radio Direction Finding (more commonly known as
radar) to the Air Ministry, and consequently to the British military and government, was Henry
Tizard. Tizard made a name for himself as a researcher for the Royal Flying Corps (later the
Royal Air Force) in the First World War, following the war as Permanent Undersecretary of the
Department of Scientific and Industrial Research, and then as an administrator and educator at
Imperial College, London. In 1935 Tizard won a committee battle with Winston Churchill’s
personal scientific adviser, Frederick Lindemann. According to Charles Snow in the readable
Science and Government both Tizard and Lindemann supported scientifically unproved
defensive gimmicks, but Tizard backed RDF which had the support of the respected scientific
community. Lindemann was disconnected from the scientific community and supported his own
ideas like parachuted mines.29

When Churchill came to power in the United Kingdom after the resignation of Neville
Chamberlain on 10 May 1940 Lindemann was installed as the main scientific adviser and Tizard,
who was the scientific adviser to the Air Ministry, was forced out. Tizard was banished on a
liaison mission to Canada and the United States, which unexpectedly resulted in increased
collaboration between the UK and its Atlantic Allies. When he returned from the United States
Tizard worked as a freelance consultant for the Ministry of Aircraft Production and on the Air
Council of the Royal Air Force. Lindemann became a member of Cabinet known as Lord
Cherwell, the only member of Cabinet with scientific training.

28 Robert Alexander Watson-Watt, Three Steps to Victory; a Personal Account by Radar’s Greatest Pioneer
2.3 The Second World War

2.3.1 Mobilizing Science and Technology: The Fall of France

The Second World War started on 1 September 1939, but there was a relative calm until 10 May 1940 when France was invaded. It took until the fall of France in June 1940, when the United Kingdom and its colonies stood alone against the Germans and Japanese, for the full mobilization of Canadian science. The National Resources Mobilization Act of June 1940 brought all scientific research under the direction of the National Research Council, which was responsible for organizing research on problems with military applications.

Even though it was not at war, the United States began mobilizing its scientific resources in anticipation of war in June 1940 as well. This foresight by President Franklin Roosevelt was largely the result of persuading from Vannevar Bush and their overlapping networks of friends and colleagues. Bush, with the help of James Conant, led the National Defense Research Committee (NDRC) that was created by Roosevelt as a result of Bush’s lobbying.  

Bush’s and Conant’s first task was discovering the scope and breadth of scientists, engineers and laboratories that existed in universities across the United States. A year later in June 1941, Bush was given more power to act as the head of the Office of Scientific Research and Development (OSRD) and Conant took over the NDRC. Before the United States entered the war Bush and Conant set out to combine the efforts of university researchers with existing defence contractors like Bell Laboratories, Sperry Gyroscope, General Electric and Du Pont.

2.3.2 Wartime Projects: Radar

One example of collaboration between university and industry researchers was in radar. Sperry and Bell were working with the United States Army and Navy on specific contracts for radar sets for ships and anti-aircraft artillery, and Radiation Laboratory (RadLab) was established at Massachusetts Institute of Technology (MIT) in October and November 1940 to accelerate the

research and development effort. A total of $1.5 billion was spent on the project by 1945, and it employed as many as one in five of the professional physicists in the United States. It was the largest defence research facility in the United States, Canada and the United Kingdom. Among those employed was McGill’s nuclear physics expert, John Foster, Sr.\textsuperscript{32}

RadLab was also a node in the British-American (-Canadian) collaboration of defence research efforts. In the United Kingdom the laboratory primarily responsible for work on radar (or RDF) was the Telecommunications Research Establishment (TRE). TRE was created in May 1940 and it was put to the Americans as an ideal model to emulate in the creation of RadLab in October 1940. TRE was an enlarged continuation of the Air Ministry’s Bawdsey Research Station, which was created in 1936 for full scale testing of Chain Home (the line of coastal stations in Great Britain, officially known as Air Ministry Experimental Station – AMES – Type 1). Bawdsey Research Station originally employed a handful of men, by 1939 there were about 200 working at Bawdsey and a year later when TRE was created there were over 2000; by war’s end there were over 3500 working for the Telecommunications Research Establishment.\textsuperscript{33}

Robert Watson-Watt, the man who gives himself the lion’s share of the credit for inventing radar, was in charge of the Bawdsey Research Station until 1938 when he left to become the Director of Communications for the Royal Aircraft Establishment (RAE), Farnborough. Prior to running the Bawdsey Research Station, Watson-Watt was the Superintendent of the Radio Department of the National Physical Laboratory (NPL).\textsuperscript{34}


The single biggest contribution to radar during the war was the development of the cavity magnetron at the University of Birmingham. Two physicists, John Randall and Harry Boot, designed a more powerful and efficient source for microwaves in February 1940. The increased power and efficiency, as well as the decreased size of the cavity magnetron, meant that radar sets could be installed and used in every imaginable military operation.

Tizard made his second notable contribution to the development of radar from August to October 1940. He arrived by plane in Montréal on 15 August 1940 and was greeted by Otto Maass (both men had spent time studying chemistry with Walther Nernst at the University of Berlin prior to the First World War, but not at the same time). The two men then travelled by train to Ottawa where Tizard met with William Lyon Mackenzie King, C.J. Mackenzie, C.D. Howe and James Ralston who was serving his second tour of duty as the Minister of National Defence. Tizard and the British scientific liaison attaché stationed in Ottawa, Ralph Fowler, surveyed the current Canadian efforts and made recommendations on what Canada could do scientifically towards the war effort. They recommended the continuation and expansion of the British Commonwealth Air Training Plan, as well as continued research in aeronautics and biological warfare.35

The most important thing that Tizard and Mackenzie could agree on what Canada should do during the war was act as a liaison node between the United Kingdom and the still neutral United States. Canada already had existing links to the United States as well as the UK in the form of junior permanent attachés at embassies, special liaison missions relating to specific projects, and personal networks for each of Canada’s foreign-trained scientists and engineers (which were still the majority of those with doctorates). By exploiting these links to their maximum potential Canada could serve as a lynchpin in the scientific efforts. Independent Canadian contributions to the scientific effort were of course welcomed, but not much was expected given the relative positions of the three nations.36

35 Clark, Tizard, 259, 261-262; Stacey, Arms, Men and Governments, 507; Zimmerman, Top Secret Exchange, 158; Avery, The Science of War, 52-54.
Canada was only a temporary stop on the Tizard Mission. The rest of the members of the Tizard mission went directly to Washington to meet with the Americans. Only Tizard stopped in Canada and then flew on to Washington to meet his companions.

Tizard brought with him a cavity magnetron, which he showed to the Canadians and Americans during his trip. This degree of trust was abnormal in the history of military technologies. In general, countries are unwilling to share their military secrets with other countries for reasons of national interest and defence. In both the United States and the United Kingdom the various services have long histories of refusing to share information about new weapons with each other. This conflict boils down to self preservation in the budgeting processes of democracies. The Tizard mission temporarily defied this trend of distrust by sharing important radar information with all the armed forces in both countries.

The result of the Tizard Mission was increased defence sharing directly between the United States and the United Kingdom. Radiation Laboratory at the Massachusetts Institute of Technology was launched in October and November 1940 because of the shared cavity magnetron. Canada’s radar production also increased as a result of the mission. The successful implementation of radar is generally credited with saving the British in the Battle of Britain and also in the bombing raids of Germany that contributed to the Allied victory in Europe.37

2.3.3 Wartime Projects: Operational Research

A new field of scientific military research was born prior to the Second World War to implement radar. It became known as operational research in the United Kingdom and Canada, and operations research in the United States. Because the United States Navy and Army, and the Royal Navy, Air Force and Army were all working independently on radar prior to the Second World War all five services in the two nations saw the need to research ways to apply the new technology to military operations.38

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Either because of Watson-Watt’s self promotion or the success of Chain Home in defending the United Kingdom, priority is usually credited to the Royal Air Force Fighter Command for developing both radar and operational research. The earliest operational research was done at Bawdsey Research Station as part of the effort to perfect Chain Home starting in 1937. The projects included statistics, troubleshooting and what would later be known as systems analysis.  

The first connection to Canada in pre-war operational research was an electronics specialist named Harold Larnder. Larnder spent much of his childhood in Canada and was educated at Dalhousie University in Halifax. When he was brought into the Bawdsey facility he was told by Watson-Watt that radar required young and untainted researchers to work with the new technology and science. Larnder was the group leader when war broke out, and he participated in the study that expanded operational research’s scope of practice beyond radar. 

During the Battle of France in 1940, Air Chief Marshal Hugh Dowding asked Larnder and Eric Williams for support in his belief that no further squadrons should be sent to France. Larnder and Williams ran the numbers and showed that the rate of loss of fighter planes in France exceeded the rate of production of planes in the United Kingdom. With these statistics in hand, Dowding was able to convince Churchill that the fighter squadrons in France needed to be withdrawn in order to defend the UK in the increasingly inevitable Battle of Britain. 

The Royal Air Force was not the only British service pushing scientific methods into the application of radar and other military operations. The Royal Navy and Army placed their efforts in operational research under the command of Patrick Blackett.  

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Blackett’s Circus and the other operational research units trained and employed many Canadians during the early stages of the war. One Canadian rose through the ranks of operational research quickly. Omond Solandt was brought into the Army Operational Research Group in December 1940, because of his training in physiology, to study tank personnel operations. Prior to joining the Army Solandt worked for the British Medical Research Council as the Director of South-West London Blood Supply Depot where he coordinated blood banks for transfusions for those wounded in the war.43

Solandt made quick work of the early problems his physiology group was assigned by the Army Operational Research Group. In 1943 he became the Deputy Superintendent of the Army Operational Research Group. When the South African Basil Schonland left Army Operational Research Group in May 1944, Solandt took over as the Superintendent. In 1945 Solandt was promoted yet again, this time he became one of the Scientific Advisers of Louis Mountbatten who was Commander in Chief of the Allied Forces in Southeast Asia, but he only visited Mountbatten once before the war ended in August 1945. David Grenville accurately points out that Solandt’s skills and meteoric rise through the British scientific establishment opened up a large network of scientific and military contacts that few other Canadians possessed.44

2.3.4 Wartime Projects: Canadian Contributions to Tripartite Work

The bombs dropped at Hiroshima and Nagasaki to end the war in the Pacific were the results of the best known application of science to war, the Manhattan Project. Canadians participated directly in the Manhattan Project, but also indirectly on the Manhattan Project by working with the British who brought their nuclear research, Tube Alloys, to Montréal in 1942.

43 DHH, File “Biographical file on Omond McKillop Solandt,” “Biography by David Grenville of Sutton, Québec, 3 October 1992,” 2; Ronald W. Shephard, “The Influence of Solandt on the Development of Early Operational Research in Britain,” 30-46 in Grenville, Law and Lindsey, Perspectives in Science and Technology, see also pages 7-9; Lindsey, No Day Long Enough, 264.
The tumultuous collaboration shows the importance of personalities like Mackenzie and American General Leslie Groves in the making of history.45

Collaboration between the Atlantic Triangle allies was much smoother on other research projects like radar, RDX, proximity fuses, chemical and biological warfare, and gas masks. Several laboratories and facilities were established by the National Research Council and the Canadian Armed Forces in response to these tripartite (American, British, Canadian) research projects.

The application of radar (Cathode Ray Direction Finders) to naval problems in Canada was taken up before the war by Robert Boyle, Director of Physics and Electrical Engineering at the National Research Council and his former student (and leader of the acoustics laboratory) George Field. The submarine and mine threat that had never been suitably solved in the First World War reemerged in 1939. Boyle was a member of the original British ASDIC team in the First World War.46

Two professors from Dalhousie University, George Henderson and John Johnstone were recruited by the Royal Canadian Navy to tackle the problem of degaussing as a countermeasure to magnetic mines in February, 1940. By 1941 the team of Henderson and Johnstone had expanded and was under the direction of the National Research Council. The facilities became known as the Scientific Research and Development Establishment of the Royal Canadian Navy; the Navy assumed control of the facilities in March 1943, and in January 1944 it was renamed the H.M. Canadian Naval Research Establishment or NRE.47

The earliest work of the Naval Research Establishment was furthered by two liaison trips to the United Kingdom. In the summer of 1940 Henderson visited the UK for advice and guidance on how to accelerate Canadian research to respond to the growing threat from submarines and mines. In the spring of 1941 Field visited the UK for further collaboration on problems of acoustics (mines, torpedoes and ASDIC – now known as sonar). For the remainder of the war there was constant collaboration on naval research problems.48

Similarly, the Army required liaison with the British since armaments manufactured in Canada had to be compatible with British specifications. To guarantee that armaments not only met specifications but also worked as desired they had to be tested and proved. What was eventually to become known as the Canadian Armaments Research and Development Establishment (CARDE) at Valcartier outside of Québec City began work as a testing and proving establishment in 1941-42. Prior to this Valcartier was a notoriously muddy Army camp which was also the home of the Québec Arsenal.49

CARDE was an Inspection Board run establishment. Starting in 1942 several scientists were assigned to the establishment from the National Research Council, the Army, and the University of Manitoba. From NRC came Malcolm MacPhail and Keith Ladler; from the Army came Gordon D. Watson, and Stanley Fultz came from Manitoba. These four men formed the core of a ballistics research and development team, and ballistics has been at the heart of CARDE activities ever since.50

The Army also operated several research facilities in Ottawa. One was the Vehicle Design and Development Establishment, which it retained after the creation of the Defence Research Board. The Chemical Warfare Laboratories (CWL) was absorbed after the war by the DRB; the CWL was affiliated with the Respiratory Assembly Plant; the two facilities produced gas masks and researched other clothing as part of the tripartite.51

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50 The Inspection Board was a joint Canada-UK agency created in January 1941 responsible for inspecting and proofing ammunitions; Goodspeed, *A History of the Defence Research Board of Canada*, 113.
51 CWL was the main production facility for DDT, but mustard gas was manufactured in Cornwall; A.M. Pennie, “Chemical Warfare Research in Canada in World War II,” 143-144 in Lindsey, *No Day Long Enough*; Eggleston,
Another Ottawa laboratory, the Canadian Signals Research and Development Establishment, was split after the war between the National Research Council which held the primary responsibility for radar research and the Defence Research Board which began work in electronics and communications. At the time, many of the communications and electronics being developed seemed to have only military applications, whereas the potential application of radar to all aviation, especially commercial and personal, meant that the NRC could reasonably justify assuming responsibility for all radar research, including what was needed for the military. The arrangement did not last long, as the DRB was heavily involved in the research, development, testing and maintenance of the lines of radar that were built in the 1950s. 52

The Royal Canadian Air Force had numerous research and testing facilities. The one with the closest affiliation to the Defence Research Board after the war was the Institute of Aviation Medicine. Originally housed at the Eglinton Hunt Club and comprised of University of Toronto medicine faculty including Wilbur Franks, the Institute of Aviation Medicine was the home of the first human centrifuge in an allied nation. The result of Franks’ work with the human centrifuge was an anti-gravitational flying suit that was used by all Allied pilots to prevent black-outs in high-gravitation maneuvers. 53

Three laboratories run by the National Research Council were inter-service and tripartite in nature. At Grosse Île in the mouth of the St. Lawrence River the War Disease Control Station built up a stockpile of vaccine for rinderpest disease. Work commenced at Grosse Île in 1942 based on discussions between Canada, the United States and the United Kingdom in 1941. The

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Canadian representatives on the Joint Commission were E.G.D. Murray from McGill University, Guilford Reed from Queen’s University, James Craigie from the University of Toronto and Charles Mitchell who was the Dominion Animal Pathologist.54

In Kingston, Reed ran a laboratory in support of the trials at Grosse Île. Reed’s laboratory was one of many at universities across Canada. However, it was the only university-based laboratory that the Defence Research Board turned into a research establishment after the war. Several laboratories at McGill and the University of Toronto were given financial support after the war, but because of the biologically hazardous nature of the work in Reed’s laboratory there had to be a more formal arrangement that protected lives and information.

A third facility at Suffield was operated jointly by Canada and the United Kingdom for the benefit of all three Atlantic Triangle allies. The site for the Chemical Warfare Experimental Station (also known as the Suffield Experimental Stations – SES) was chosen by Emlyn Llewellyn Davies in collaboration with Otto Maass, G.P. Morrison and E.A. Flood. Davies was loaned to Canada to run the SES from the UK where he had previously been the Superintendent of Experiments at Porton Down (the location of the British chemical warfare laboratory). After the war Davies was persuaded to stay in Canada in a senior position with the Defence Research Board.55

Both chemical warfare research facilities in Canada worked closely with the facilities at Porton Down in the United Kingdom and the Edgewood Arsenal in Maryland. The United States Army Chemical Warfare Service sent a permanent liaison officer to Suffield, and a Canadian from the Directorate of Chemical Warfare and Smoke (Maass’ unit) stayed at Edgewood throughout the war. Flood, Morrison and Maass all visited the UK starting as early as 1937 to facilitate and expedite collaboration on defence research; the normal liaison channels had to be supplemented from time to time by more senior scientists visiting each other.56

54 Eggleston, Scientists at War, 104; Goodspeed, A History of the Defence Research Board of Canada, 153-155; Bryden, Deadly Allies, 97-107; Avery, The Science of War, 152.
2.3.5 Canadian Scientists and Engineers in the War

Numerous Canadian scientists and engineers participated in the war effort. Many of them were established experts like Maass, Frederick Banting and Charles Best; others like Solandt, Franks and Harry Thode established their reputations based on their war work. The man who organized all of these scientists and engineers was the acting President of the National Research Council, Chalmers Jack Mackenzie.

Mackenzie was born in St. Stephen, New Brunswick in 1888. He attended Dalhousie University where he obtained an undergraduate degree in civil engineering and was taught by C.D. Howe. Before serving in the Canadian Army in the First World War, he obtained his Ph.D. from Harvard and started working at the University of Saskatchewan. After the war Mackenzie returned to Saskatchewan where he was the Dean of Engineering from 1921 to 1939. Mackenzie first joined the National Research Council’s advisory body in 1935, and was chosen by McNaughton to be the acting President starting in 1939. In 1944, Mackenzie officially replaced McNaughton as the President of the National Research Council.  

As acting President of the NRC, Mackenzie oversaw all of the scientific efforts in Canada. This included the laboratories listed above (Naval Research Establishment, Chemical Warfare Laboratories, Suffield Experimental Station, etc.) as well as the work done at universities across Canada. Mackenzie is probably best known for his delicate job of handling the joint Canada-Britain-France atomic research project and its collaboration with the Manhattan Project. As President of the National Research Council after the war, and then as President of Atomic Energy of Canada, Limited, Mackenzie oversaw the birth and growth of Canada’s nuclear capacities.


2.4 Preparing for the Postwar World

2.4.1 Canada at War’s End

Because of men like Mackenzie and C.D. Howe, who was the Minister of Munitions and Supply and organized Canada’s war effort, Canada played an important part in the victory in Europe and Japan. As that victory began to look inevitable throughout 1943 and 1944, the Atlantic Triangle Allies planned for the post-war world. It was obvious, even before the Russians began occupying nations in Eastern Europe in their drive to Germany, that there was tension between the Russians and their English-speaking allies. The Americans and British refused to share all of their scientific secrets with the Russians, particularly those around atomic weapons and radar. In Canada, Russian scientific liaison officers often tried to bypass the established exchange channels by showing up unannounced and unwelcomed at Research Enterprises Limited (a Crown corporation responsible for development and production of electronics and other precision technologies like radar) in Toronto and various other facilities across Canada; they were turned away at the door and told to proceed through the normal channels of liaison. Canada made it quite clear that in any future conflict it would be aligned with either the United Kingdom or the United States, preferably both. 59

For most Canadians the war essentially ended with the fall of Germany on 8 May 1945. Canada had not been the site of any battles, and while its landscape was affected by the war based on the hasty construction of camps, laboratories and other military buildings, Canada was unharmed compared to Europe.

Canada had the fourth largest military in the world at the end of the war. The separation between Canada and the Big Three was substantial. About 1.1 million of 11.5 million Canadians enlisted throughout the war and peak strength in 1944 was about 800,000 men and women. Approximately 100,000 Canadians were casualties (killed, missing, wounded, absent without

59 LAC, Record Group (RG) 28 Series (S) A Vol 140 File 3-R1-9 “A Letter from the Deputy Minister of Munitions and Supply to Mr Ross the Deputy Minister of National Defence regarding Radar Equipment, 17 January 1945;” Robert Bothwell and William Kilbourn, C.D. Howe: A Biography (Toronto: McClelland and Stewart, 1979); Reginald Whitaker and Gary Marcuse, Cold War Canada: The Making of a National Insecurity State, 1945-1957 (Toronto: University of Toronto Press, 1994), 6-13; Avery, The Science of War, 78; Bothwell, Alliance and Illusion, 358-359; I prefer the term ‘Russia’ over ‘Union of Soviet Socialist Republics,’ because it is clear that the Soviet Union was dominated by Russian interests and that the USSR bore more resemblance to an empire than a socialist utopia.
leave, captured, etc.); by contrast, both the United States and the United Kingdom enlisted ten times the number of servicemen and women and suffered ten times the number of casualties (including civilians in the UK). The best estimates for the Russian led Soviet Union’s casualties run in the tens of millions, including civilian as well as military, which is roughly ten times what either the British or American lost and one hundred times the number of Canadians.  

Canadian industry was running at its maximum by the end of the war, and was significantly improved and modernized from 1939. Defence research, which was nonexistent in 1934 and a minor concern in 1939, was a substantial enterprise in 1945. The question at the end of the war was how much national defence and defence research capacity Canada would retain.

2.4.2 Science and Technology at the End of the War

The bombs that dropped at Hiroshima and Nagasaki on 6 and 9 August 1945 made the case for many politicians, scientists, diplomats, engineers and generals that defence research could not be abandoned. The role that science played in the Allied victories in Europe and Japan, and the expected tension with Russia, meant that Canadians like Mackenzie, Howe and Charles Best wanted to remain prepared in national defence and defence research, rather than having to start from scratch again.

The atomic blasts at Hiroshima and Nagasaki had a second effect on the formation of Canadian defence science. Omond Solandt was scheduled to make his second visit as a scientific adviser to Mountbatten when the war ended in August 1945. Solandt still travelled to the Pacific, but as part of the British contribution to the joint scientific survey of Hiroshima and Nagasaki. Solandt was responsible for assembling medical data from the blasts which resulted in a computation of lethality radii with Jacob Bronowski.

Not only did Solandt make a scientific contribution to the survey, but he also benefited from being a part of it. He already had an excellent network of contacts within the British

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scientific and military community because of his meteoric rise through their operational research and scientific advising apparatus. Cecil Law points out that Solandt most likely gained an even larger network of scientists and generals by participating in the scientific survey. As we will see, Solandt’s personal international connections supplemented the existing contacts that served post-war Canadian defence research well.64

2.4.3 Preparing for the Cold War

The scientific and technical complication of new weapons meant that defence research was essential if a war was imminent. War did not seem entirely imminent in 1945. The creation of the United Nations, and the agreement of both the United States and Russia to participate in a Security Council, provided they were given veto power over United Nations actions, created the promise of legitimate post-war peace in 1944 and 1945. However, two sets of events between 1943 and 1947 suggested that another war could erupt at any time between Russia and its former allies (UK, USA and Canada).65

The first set of events to show that there were cracks in the alliance were the three conferences held by the Big Three. The first two meetings were held at Tehran and Yalta respectively; they were attended by Winston Churchill, Joseph Stalin and Franklin Roosevelt. Fissures in the alliance showed when the three allies attempted to negotiate the opening of a second front and the presumed to be ensuing occupation of liberated countries. Stalin insisted that the Russians should be allowed a heavily controlling hand in Eastern Europe where they wanted to establish a cordon to protect Russia from further invasion. There was little militarily that the Americans and British could do to counter Stalin’s domination, but where Roosevelt sought conciliation on other matters Churchill appeared determined to oppose the Russians at every turn, because of his rabid anticommunism and his desire to repair the British Empire’s economy as quickly as possible.66

64 Grenville, Law and Lindsey, Perspectives in Science and Technology, 28.
65 Bothwell, Alliance and Illusion, 19-22.
Canadian planners expected, based on the advice of American generals, that post-war tension was inevitable. Churchill’s recalcitrance led Canadian and American planners to consider the possibility that another war would erupt, initially between the United Kingdom and Russia, but eventually embroiling Canada and the United States, and American planners were not optimistic about their odds of repelling a Russian invasion of Western Europe.67

However, events turned in 1945 in time for the final conference at Potsdam. Prior to the conference Roosevelt died and his Vice President, Harry Truman, took over. During the conference an election in the UK resulted in Clement Attlee replacing Churchill as Prime Minister. These changes in leadership led to rather drastic reversals in the roles played by the two Atlantic allies. Stalin still pushed and bullied, but Truman took a much firmer stance than Roosevelt had, while Attlee was softer than Churchill had been. Another war was still possible, but the primary combatants were now likely to be Russia and the United States, and atomic weapons were a potential equalizer to Russian ground forces. Whatever promise the creation of the United Nations offered was largely dashed by the deep incompatibilities of geopolitics between the three allies and the personalities of the three leaders.68

The second set of events that dashed hopes of peace were the revelations of Russian espionage. During the war Russian agents made blatant attempts to learn scientific and technical secrets. A Russian agent showed up at the radar plant in Leaside (Toronto) expecting to be thoroughly vetted of all the relevant secrets. This sort of espionage, as well as the activities of public communists was easy enough for the Royal Canadian Mounted Police to track and thwart.69

Moreover, shortly after the war the Canadian authorities were forced to face the reality that Russian agents were not always obvious. Igor Gouzenko, a cipher clerk from the Russian embassy in Ottawa showed up at a series of doors in Ottawa including the office of the Minister of Justice with evidence of a spy ring that had been operating in Canada and had been stealing

68 Leffler and Foner, The Specter of Communism, 46-47; Leffler, For the Soul of Mankind, 41; Paterson, Clifford and Hagan, American Foreign Relations, 253-257; Gaddis, The Cold War, 25; LaFeber, America, Russia, and the Cold War, 27.
atomic secrets. A thorough investigation by a Royal Commission of Inquiry led by Justices Robert Taschereau and Roy Kellock revealed the truth behind Gouzenko’s claims and a vast spy network in Canada, the United States and the United Kingdom.  

Several scientists who had participated in the Manhattan Project and/or Tube Alloys were implicated in the post-war counterespionage sweep: Klaus Fuchs, Allan Nunn May and Julius and Ethel Rosenberg. It is almost certain that the Russians would have acquired a bomb eventually, based on their determination and abilities, but the espionage appears to have shaved years off the program by letting the Russian scientists avoid several dead-ends. As it turned out, the quality of Russian espionage meant that the existence of an atomic project was not a secret; the only secret was whether it would work and this was confirmed with the use of two bombs in Japan in August 1945.

The Gouzenko affair publicly confirmed what was already widely believed by the leadership in the United Kingdom and the United States; compromise and conciliation with Russia was impossible. Predictably, the Russians accused Canada of fabricating the whole affair at the insistence of the Americans to fuel a conflict between the two nations.

In Canada the Gouzenko Affair had two unique effects. First, after William Lyon Mackenzie King failed in his attempts to simply make the whole issue disappear he was forced to accept the divisions of the Cold War and Canada’s continued alliance with the UK and America. When Churchill delivered his “Iron Curtain” speech in 1946 King responded favourably but noncommittally. Second, the revelation that defence science was worth pilfering confirmed that defence research was a worthwhile activity, especially during a period of tenuous peace.

2.4.4 Towards an Establishment for Defence Research in Canada

Throughout 1944 the Canadian military and C.J. Mackenzie gave serious consideration to the postwar structure of Canadian science. All were in agreement that the military needed a defence research apparatus. The Army, at least, was contemplating what to do before a

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72 Bothwell, Drummond and English, *Canada since 1945*, 42.
73 Smith, *Diplomacy of Fear*, 126-128.
memorandum arrived in Canada from the First Lord of the Admiralty recommending that all Dominion governments follow the British lead and survey the defence research prospects for the postwar period.\textsuperscript{74}

Real progress in the planning process began in Canada on 4 July 1944 when Air Vice-Marshal E.W. Stedman, Director General of Air Research suggested that the Chiefs of Staff Committee request the War Committee of Cabinet look into the problem. The matter reached Cabinet on 3 October 1944 and on 10 August 1945 C.D. Howe was put in charge of the Committee on Research for Defence, which also included Mackenzie and the Chiefs of Staff.\textsuperscript{75}

Before the Committee on Research for Defence ever met, there were several informal meetings between Mackenzie and Lieutenant-General Charles Foulkes who was Chief of the General Staff (Army). They discussed the various possible arrangements for defence research, especially the proposals coming from Colonel Wallace Goforth and his team, which included Alec M. Fordyce, in the General Staff’s Directorate of Staff Duties (Weapons).\textsuperscript{76}

By the time of the first and only meeting of the Committee on Research for Defence on 4 December 1945 there were only two things to be accomplished. First, a formal approval of the Goforth proposal was needed. The Goforth proposal was for an interim defence research agency that would survey the current state of Canadian defence research and then make a full recommendation for the future organization. Rather than creating a new government department devoted to research (which would subsume the National Research Council and defence research), or leaving defence research as a subset of the NRC, the best option was believed to be the creation of a coordinating agency within the Department of National Defence (DND) that had equivalent status to the three existing Services. Since this was only an internal reorganization of DND, the matter required no further political action.\textsuperscript{77}

The second item on the agenda of the Committee on Research for Defence was the nomination for the leader of this interim Defence Research Board. Charles Best, who was one of the Council members advising Mackenzie throughout the war, knew of the work his protégé,

\textsuperscript{74} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 13-14.
\textsuperscript{75} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 13-16.
\textsuperscript{76} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 28.
Omond Solandt, was doing in England. Mackenzie had also heard of Solandt and was suitably impressed. Based on their recommendations, Solandt was nominated. When he stopped in to visit Best and Mackenzie in Ottawa on his way from Japan to England he was offered the position. Solandt accepted and was confirmed by the Privy Council on 28 December 1945. He returned to England to complete his duties there and became the Director General of Defence Research on 25 February 1946.78

Solandt’s first task was to survey the state of Canadian Defence Research. In this task he was aided by a staff that included Goforth and Fordyce. He was also assisted by a board that included the inner circle of wartime advisers within the National Research Council – Otto Maass, Charles Best, C.J. Mackenzie and Paul Gagnon from the Université de Laval. Solandt took a brief break from this planning to attend the Commonwealth Conference on Defence Science in London in June 1946.79

Solandt hammered out an organization for defence research that included a Board in addition to the establishments and headquarters. Unsurprisingly, given the groundwork laid by Goforth and the need to appease Solandt’s patrons (Howe and Mackenzie), this structure mimicked that of the National Research Council (which copied the Department of Scientific and Industrial Research). Despite resistance from the Royal Canadian Air Force, and to a lesser extent the Royal Canadian Navy, Solandt’s organization was accepted by Minister of National Defence Brooke Claxton. Claxton introduced it to Parliament as an amendment to the National Defence Act of 1927 on 7 February 1947. It was approved on 28 March and the Defence Research Board came into existence on 1 April 1947. To unify the original National Defence Act with its various amendments a new National Defence Act was drafted starting in 1947 and it was adopted by Parliament on 7 June 1950. At the time it was thought that the Defence Research Board was going to be a permanent fixture in the Department of National Defence.80

2.5 Conclusion

The National Research Council, and C.J. Mackenzie, laid the groundwork for much of what the Defence Research Board would do under Omond Solandt, Hartley Zimmerman, Robert Uffen and Léon L’Heureux from 1947 to 1977. Mackenzie’s role in the Second World War in Canada was central in both Canadian defence research and scientific liaison between Canada, the United States and the United Kingdom. Mackenzie earned the respect of the Chiefs of Staff, retained the trust of C.D. Howe and the rest of Cabinet, and established an international reputation for effective management. Omond Solandt matched Mackenzie in international reputation, especially in the UK, and it was fortuitous that Solandt was willing to take on the task of creating and running the Defence Research Board. Where the NRC and Mackenzie laid the groundwork, Solandt put his own impressive stamp on the DRB over his decade of leadership.

What cannot be forgotten is that defence research as a government activity was envisioned in the First World War, but bureaucratic and political delays meant that the National Research Council filled a different need once it was finally created in the 1920s. The NRC’s priorities shifted along with its leadership in 1935, and made a drastic return to its military roots in 1940.

The importance to victory of large-scale science and engineering projects leading up to and during the Second World War taught politicians three lessons. First, the application of science and technology to military problems was expensive in terms of resources, especially human labour. Second, because of this expense and the rarity of innovative scientists and engineers, collaboration with allies was ideal, even if it was difficult at the best of times. Third, the time needed to catch-up to the military technologies of other nations at the outset of war was increasing, but those same technologies were also decreasing the time available; one could not design and build fighter-interceptors to defend against intercontinental bombers in the time it took those bombers to fly from Russia to North America. Defence research in times of peace was the only way to avoid losing a war before it even started, and was also seen as a means of deterring war.

In a polarized Cold War world, fresh out of the deadliest conflict in human history, the creation of the Defence Research Board was easy to justify.
Chapter 3
The Golden Age of Canadian Defence Research

3 Omond Solandt, 1947-1956

3.1 Introduction

3.1.1 Biography

Born in Winnipeg, Manitoba 25 September 1909, Omond McKillop Solandt was a forceful intellect who had a knack for earning the respect of everyone he met. Solandt came from an auspicious family. His parents were Edith (née Young) and Donald McKillop Solandt, who was a Presbyterian minister and graduate of Queen’s University. His older brother, Donald Young Solandt, was born in Ottawa in 1907. The family moved to Toronto in 1921.81

Both brothers attended the University of Toronto, in spite of their father’s preference for his Alma Mater. As it turned out, the University of Toronto was a much better opportunity for the Solandt’s to network with Canada’s leaders in politics, business, science and medicine. Within the University of Toronto, Omond Solandt chose Victoria College, where his football coach was Lester Pearson. A few years later, while studying medicine at the University of Toronto, he met William Lyon Mackenzie King, because King’s nephew was his peer. While the University of Toronto was the place to go to form these kinds of meaningful connections, Solandt’s intelligence and abilities earned him respect and confidence, which is how he continued to lead a highly successful and charmed life.82

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Solandt obtained his undergraduate degree in biology and medical sciences in 1931, earning the G.A. Cox Gold Medal. He stayed at the University of Toronto to work as a graduate student and medical research assistant until 1933 when he was stricken with polio. At the urging of his mentor, Charles Best, Solandt started medical school in 1934 and graduated in 1936. Best and Solandt both won the Gold Medal and six other major prizes at their graduations, making them the two most distinguished graduates of the University of Toronto medical school.83

From Toronto Solandt moved to England to pursue post-graduate studies at Cambridge, including teaching human physiology. He was in England in 1939 when the Second World War started. Solandt spent a year with the British Medical Research Council before moving into operational research and scientific advising in the British Army. His meteoric rise in the war was a continuation of his successes at the University of Toronto, but on an international scale; Solandt was well-connected and respected, and at war’s end, as with the rest of his life, he had a variety of opportunities and countless influential supporters.84

While there were other Canadians in the defence research field who might have been eligible to apply for the job of Chairman of the Defence Research Board, none of them had the same kind of confidence, reputation and respect as Solandt. He was the only one considered for the job and, in retrospect, probably the only one who could have accomplished what he did over his decade-long tenure.

3.1.2 Themes

Solandt’s ten years with the Board played to his key strengths. He had an international reputation, as did Canada, and he was keen to avoid a future war by making basic preparations to deter Russia from attempting to spread communism. He was methodical and forceful, traits that occasionally annoyed his equally forceful colleagues on the Board and within the headquarters of the Defence Research Board and the Department of National Defence. He had an excellent

working relationship with C.J. Mackenzie and C.D. Howe, which meant that the three men worked harmoniously to devise Canada’s policy for science and technology.\textsuperscript{85}

Solandt also had a knack for knowing when to delegate and how to persuade competent men and women to work within the Defence Research Board. The Board, and its various committees, was a who’s who of Canadian scientists and engineers, like Mackenzie’s National Research Council. Of course the community of distinguished defence researchers in Canada was relatively small, so Solandt had few scientists and engineers from whom to choose.

Assuming one agrees with Solandt’s outlook on the world, and how the Defence Research Board should function within Canada as part of a tripartite alliance with the United States and United Kingdom, then one likely believes that the first ten years of the DRB’s existence were its Golden Age. The world looked unstable with the nuclear arms race and the Korean War, Canada was a player on the world stage thanks to Lester Pearson and his colleagues at External Affairs, and the Defence Research Board worked on projects of relevance and importance. It was something of a coincidence that Solandt left the DRB at the same time that Canada turned inward, and the resultant navel-gazing undermined the DRB’s usefulness and eventually led to its demise.

3.2 Getting Started, 1947 to 1950

3.2.1 Administrative Formalities

The Defence Research Board’s first official day of existence was Tuesday, 1 April 1947, the start of the government’s 1947-48 fiscal year. However, many of the details regarding membership of the Board and Omond Solandt’s confirmation as Director General of Defence Research (head of the Defence Research Board) and Chairman of the Board were delayed in Cabinet until later in the week.\textsuperscript{86}

Solandt’s official duties were given the following priorities by Cabinet.

\textsuperscript{85} DHH, Collection (Col) 82/185, “Eighth Annual Birthday Address, Dr OM Solandt, CDRB, DR 93, August 1955,” 4-5.
\textsuperscript{86} Goodspeed, A History of the Defence Research Board of Canada, 70-71; LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Volume 1, “Minutes of the First Meeting of the Defence Research Board held at 2:30pm Wednesday, 16 April 1947.”
1. Advise the Minister of National Defence;

2. Advise the Chiefs of Staff;

3. Administer the Defence Research Establishments with the assistance of a Board.\(^87\)

The first meeting of the Board was convened 16 April 1947. The meeting’s attendees included the *ex officio* members of the Board. At the time these were Omond Solandt as Chairman, C.J. Mackenzie as President of the National Research Council, Vice Admiral H.E. Reid as Chief of the Naval Staff, Lieutenant-General Charles Foulkes as Chief of the General Staff (Army), Air Marshal Robert Leckie as Chief of the Air Staff, and W. Gordon Mills as Deputy Minister of National Defence. The term members included carry-overs from the interim Board of 1946-1947 Charles Best from the University of Toronto, Paul Gagnon from Université Laval, Otto Maass from McGill University, and Colonel R. Dickson Harkness who was Vice-President of the Northern Electric Co. Ltd. based in Montréal. Acting as Secretary was Major Robertson G. MacNeil.\(^88\)

The first meeting set the tone for the work the Defence Research Board was to undertake. Maass was placed in charge of a temporary Selection Committee (it would be formalized a year later), which was responsible for the first wave of hiring and promotion. Garnet Dunn was introduced at this meeting as the Chief Administrative Officer and was on loan from the Dependents’ Allowance Board (see Appendix E for tables of organization).\(^89\)

Recommendations were made for two new appointments to the Board at the second meeting of the Board on 14 May 1947. Solandt laid out two desires for the diversity of the Board’s members. First, he desired representatives from all of the major geographic regions of Canada (Maritimes, Québec, Ontario, and the West); if Solandt was not already aware of this cardinal rule of federal politics, he was reminded by the Minister of National Defence who had been scolded by Member of Parliament Robert Winters. Second, Solandt wanted representation

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\(^{88}\) LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Volume 1, “Minutes of the First Meeting of the Defence Research Board held at 2:30pm Wednesday, 16 April 1947;” see Appendix C for list of Chiefs of Staff and Appendix D for list of other Board members.

from industry and academia; this split was never even and in these early years Harkness was the only representative from industry. This latter requirement fit the mould created by the Department of Scientific and Industrial Research and was likely relayed to Solandt by Mackenzie of the National Research Council.  

Gordon Shrum from the University of British Columbia and John Johnstone of Dalhousie University were recommended and appointed by Order-In-Council in June 1947. As with all the members of the Board at this point in time, the new members had made distinguished contributions to the war effort, in Shrum’s case he was also a fighting veteran of the First World War.  

At the first meeting Wally Goforth’s resignation was received. Goforth had accepted an offer in the civilian sphere, and was keen to resume his career as an economist. To serve as his temporary replacement, Emlyn Llewellyn Davies was asked to become the Deputy Director General at the third meeting of the Board, 14 June 1947. E.Ll. Davies was on loan from the British defence research establishment at Porton Down, England and was the Chief Superintendent of the Experimental Station at Suffield; his temporary stay as Deputy Director General and then Vice Chairman lasted until 1955, at which point he was given his second farewell party.  

With the new National Defence Act in 1950, all references to 'Director General of Defence Research' were removed. The Deputy Director General became the Vice Chairman and a member of the Board in addition to holding administrative responsibilities in Defence Research Board headquarters; also with the new National Defence Act the Chairman lost the additional

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title of 'Director General.' However, the Chairman position and now the Vice Chairman position held the dual responsibility of being Board members and also managing the internal research program including the defence research establishments.  

3.2.2 Converting the Wartime Establishments

When it was created in 1947, the Defence Research Board spent a year absorbing seven existing establishments that were dedicated to defence research. The seven establishments were: the Naval Research Establishment (NRE) in Halifax, the Canadian Armament Research and Development Establishment (CARDE) in Québec City, the Grosse Île Experimental Station in the St. Lawrence River, the Chemical Warfare Laboratories (CWL) and the Radio Propagation Laboratory (RPL) in Ottawa, Guilford Reed’s laboratory in Kingston and the Suffield Experimental Station (SES) near Medicine Hat. Solandt and Goforth wanted to leave administration to the staff in headquarters and the scientific research to scientists in the establishments. This arrangement lasted until the late 1960s when the Defence Research Board undertook a policy and organization internal review.

Most of the establishments were housed in temporary wartime construction and needed permanent homes in 1947. In the case of Suffield this also included plans for the construction of a village for the staff. The village was named Ralston, in honour of the Minister of National Defence Colonel James Layton Ralston who oversaw the creation of the Suffield laboratory. The lack of available housing was not, of course, exclusive to Suffield. Construction of new homes had all but stopped during the war, and with nearly a million veterans returning to civilian life in Canada in 1945 and 1946, many with young families in tow, houses were in demand.

When the Defence Research Board took over control of the Suffield facility 30 April 1947 it was the only establishment not located in or near an urban centre; Medicine Hat is about 50km away. The facility had a maximum capacity in the budgetary allocation for 46
professional personnel and 341 support staff; as with the rest of the DRB, this maximum capacity was not reached until the early 1950s. In order to provide a place for the staff to live, the village of Ralston was conceived and constructed from the fall of 1947 until 1953. The first set of construction was 60 prefabricated houses that the Defence Research Board commissioned for $483,000. Afterwards a school, recreation centre and other utilities and community buildings were erected. Ralston was one of the few places where the government took an active financial role in the construction of houses during the postwar reconstruction period.  

Suffield was one of two laboratories that the DRB absorbed that came with buildings. The other establishment with a permanent home was Canadian Armaments Research and Development Establishment (CARDE) in Québec. The two were valued at a combined $6,350,000 in April 1947. Donald Goodspeed summarizes the amounts the Defence Research Board spent on construction and equipment over its first ten years in his history of the DRB. The DRB spent $27,189,000 on new buildings from 1947 to 1957. New building peaked in the 1952-53 Fiscal Year at $6,363,000, which is summarized in Table 3.1.

In 1947 the DRB absorbed $3,450,000 worth of scientific equipment from Suffield Experimental Station, Canadian Armaments Research and Development Establishment, Radio Propagation Laboratory and Chemical Warfare Laboratories. Neither Grosse Île nor Kingston came with buildings or equipment. Over the next decade the DRB spent a further $23,168,000 on new equipment (see Table 3.1). The peak fiscal year for acquisitions was 1955-56 when $19,058,000 was spent on equipment as well as materials, and supplies. In the period that Goodspeed summarizes, this is the largest allocation in the research component of the Defence Research Board’s budget.

In contrast, Table 3.1 shows that the amount spent on salaries and wages increased from $1,695,000 in 1947-48 to $11,750,000 in 1956-57 for a total expenditure on salaries and wages from April 1947 to March 1957 of $63,977,000.

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Table 3.1 Expenditures for the Period 1947-48 to 1956-57 (Rounded to nearest thousand dollars)

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3.2.3 Initial Recruitment

Attracting suitable candidates to work for the Defence Research Board from 1947 to 1950 was its toughest challenge in those years. The credit for the success the DRB had in this period of growth is unanimously attributed to Solandt. The problem that Solandt and the DRB faced in 1947 was twofold. First, the wartime scientific research effort was never intended to be permanent. Most of the recruits were drawn from university laboratories and the projects they took on were seen as short-term with immediate applications to the war effort. Longer term projects were not seriously considered, because the researchers were expected to return to their interrupted academic careers when the war ended.  

Second, when the war ended the scientific recruits were demobilized as rapidly and thoroughly as the military recruits. Operational researchers within the military, although highly regarded, were no longer needed, and scientists at military laboratories and National Research Council wartime establishments were cut back to skeleton staffs. Regular NRC laboratories were continued, but not at the engrossed levels they attained in the Second World War, nor as low as the reduced levels of the Depression. Demobilization of the military and its laboratories was particularly thorough. The military laboratories were in a state of uncertainty with no new projects, no desire to request money since the status of the military was tenuous, and no clear vision of the future. In 1947, Solandt and the DRB had to start from scratch, but unlike 1939 and 1940 Solandt had to create a defence research apparatus that would meet immediate military needs as well as predict and serve longer term needs. To achieve results that would meet the military’s needs Solandt had to recruit scientific veterans of the Second World War as well as new graduates, and he had to do this over a few years.

The starting point of the Defence Research Board’s plan to hire a wave of new employees was setting entry salaries that were attractive to top graduates and a scaling that would entice established experts. Scientific and engineering graduates, especially those with post-bachelor degrees, had four broad sectors to which they could apply for employment: industrial research,

government laboratories, university professorships, and teaching at the high school or elementary school level. Industrial careers, especially on the management side, were generally the most lucrative; university was an attractive alternative for those who wanted more freedom to explore diverse interests in combination with teaching. The Defence Research Board, like the National Research Council, wanted to offer a middle ground with competitive salaries and intellectual freedom.

The Defence Research Board sought to employ two groups of research candidates in its early years. First, the DRB needed senior scientists to fill roles in the management structure from project leader through to superintendents of establishments and administration of planning and policy at headquarters. These scientists and engineers had to be convinced to leave the careers to which they had returned after the war. Aside from those who could be persuaded for patriotic reasons, or those who were genuinely more interested in secret defence work than they were in their existing careers, the only carrot the DRB could offer was a better salary and better long-term opportunities than these candidates for senior positions currently had.

One example of a senior scientist who was enticed to join the Defence Research Board in this early period was N. Whitman Morton. Morton was professor of psychology at McGill University with a pre-war expertise in personnel and employment. He served in the Canadian Army in the Second World War where he conducted further research into personnel selection. At the first meeting of the Board Morton was hired as a consultant on psychology and personnel. Two years later he became the Director of the newly formed Operational Research Group. Morton remained with the DRB for the rest of his career working as a Director, Division Head and Chief of Personnel.  

Second, the Defence Research Board wanted junior scientists to work the lab benches. Solandt knew that he needed to attract the best graduates if he wanted quality work done in the DRB and for there to be any chance for these junior employees to become senior managers later on.

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in their careers. Again, salaries and career opportunities had to be competitive with industry, university and other government establishments to fill these positions.

Three junior scientists hired in these early years fitted the mould that Solandt established. John Chapman, George Lindsey and Robert Sutherland were hired between 1949 and 1951 after they completed their doctoral degrees. All three graduated at or near the top of their classes, and all of them worked their way through the ranks and assumed senior positions within a decade. Furthermore, all three were veterans of the Second World War. Chapman interrupted his studies to serve in the Royal Canadian Air Force, while both Lindsey and Sutherland graduated from university before joining the Canadian Army as operational researchers. Their status as veterans of the Canadian military was shared by the majority of employees of the Defence Research Board in these early years.101

A small but significant source of senior scientists was those specifically recruited from the British military or scientific services. Given the relative economic outlooks of the two nations, many British citizens left the United Kingdom for Canada in the hopes of improving their lots in life, and a few of these found their way to the Defence Research Board. Most of the rest of the early employees were drawn from the Canadian scientific services, including those who were drafted to the scientific effort in June 1940.102

One obvious pool of employees for the Defence Research Board to select from was the National Research Council. However, instead of developing a rivalry, Solandt and C.J. Mackenzie came up with consistent policies for the two research institutions. Mackenzie was an ex officio member of the Board, and the two men had direct access to Howe and the rest of Cabinet through the Advisory Panel to the Privy Council Committee on Scientific and Industrial Research, of which Mackenzie was the Chairman. The first fourteen Board meetings were


102 Bothwell, Alliance and Illusion, 121.
scheduled to coincide with Council meetings in an attempt to simplify the travel plans of Solandt, Mackenzie and all other dual members.\textsuperscript{103}

The DRB immediately adopted the National Research Council’s pay scales, and when the NRC increased the wages of its employees, the DRB imitated it. Junior scientific officers of the DRB were paid over $2200 per annum. The salary scale went from grade 1 to grade 14, with Solandt being the only grade-14 employee; his salary was $10,000 and the Vice Chairman’s salary was $9,000. Similar to the National Research Council and after 1952 Atomic Energy of Canada, Limited scientists employed by the DRB were considered as special civil servants. They received superannuation benefits, but their pay scales were handled separately from the rest of the civil service.\textsuperscript{104}

Moreover, the support personnel were considered civil servants for both pension benefits and wage setting. These non-scientific staff members, including technicians, assistant technicians, clerks and administrative assistants, were scheduled to earn between $1,500 and $3,000 in the 1947 tables of organization. Salaries were determined by the Treasury Board and were identical to similar civil servants in other departments.\textsuperscript{105}

At the sixteenth meeting of the Board held in Ottawa and Chalk River between 16 and 17 October 1950 the Board discussed a lingering difficulty in the comparison with the National Research Council and its pay scales. NRC employees were free to publish; DRB employees were not in most cases. The Board authorized the Selection Committee to offer higher salaries to incoming employees than were being offered by NRC to compensate for the lost opportunities for publication. The Selection Committee was, however, strictly forbidden from advertising this possibility to draw potential employees.\textsuperscript{106}

\begin{flushleft}
\textsuperscript{105} LAC, RG 24 S F1 Vol 11997 File 1-0-181 Vol 1, “Salary Schedule for Scientific and Technical Personnel Employed on Defence Research (Amended and submitted 18 Jan 47).”
\textsuperscript{106} LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 4, “Minutes of the 16\textsuperscript{th} Meeting of the Defence Research Board held at Ottawa and Chalk River, 16 and 17 October 1950,” 3.
\end{flushleft}
At Board meetings from 1952 and 1953 Solandt summarized the continuity in the Defence Research Board’s changing salaries. The meeting on 18 October 1952 was held in Halifax, Nova Scotia; at this meeting of the Board Solandt delivered his Annual Report. He stated that all employees would be given raises in line with both the National Research Council and the civil service, which was standard practice for the DRB. At the meeting held in Ottawa on 17 February 1953 Solandt raised the possibility of paying the Board members in the same manner that members of the Advisory Council to the National Research Council were compensated for their attendance at meetings. He raised the matter with the Treasury Board and was able to secure per diem compensation for Board members. Board documents from later in 1953 show that even the lowest rung of scientists paid by the Defence Research Board, research assistants hired by faculty to work on grants awarded by the DRB, were to be paid the same amount as similar research assistants working on NRC grants.  

The Defence Research Board looked at two sources of employees. The bulk of the men and women they targeted were in universities, but a small minority were drawn from industry and other government departments. The DRB employed three basic strategies to attract applicants. The first of these strategies was the only one used for non-academic researchers, but was also used heavily in recruiting from universities. Personal networking filled the majority of senior positions from Board membership down to Superintendent. Whenever a Board member’s tenure was up Solandt requested that the Board submit suggestions and nominations for replacements, which started at the first meeting of the Board when Solandt wanted to add two more members (eventually Shrum and Johnstone). The Board’s original members (Maass, Gagnon, Harkness and Best) as well as the first two additions (Shrum and Johnstone) were all associated with the National Research Council and Mackenzie. Their replacements were always esteemed academics or industrialists who were known either personally or by reputation by the Board. 


The personal recruiting method permeated to lower levels of the DRB. In 1949 when the Operational Research Group was formed the majority of its recruits were either known personally by Solandt or he knew of them based on their wartime work. Solandt’s two chief contacts in learning about Canadian operational researchers were Board members Mackenzie and Johnstone.

Whitman Morton, who was already under contract with the DRB before the creation of the Operational Research Group, was also well connected to Canadian operational researchers. As the first Superintendent of the Operational Research Group, Morton had an important role in recruiting. Two of his former Army colleagues were among the first recruits. George Lindsey and Robert Sutherland both received some of their training in the United Kingdom in the Army Operational Research Group; the lifelong friends both returned to school after the war to obtain doctorates and were happy to join the DRB in the early 1950s.

Harold Larnder, formerly part of the first operational research team, was persuaded by a combination of Solandt, his former Dalhousie professor Johnstone, and John Abrams to leave the British Ministry of Supply to join the Defence Research Board. Larnder was recruited to work on the pressing problems associated with North American air defence in December 1951. In 1949 the Russians tested their first atomic bomb, and they managed to reverse-engineer three B-29s that they had interned during the Second World War; the later development of true intercontinental bombers that could return to Russia pushed the United States and Canada to consider North American air defence in 1950 and 1951.109

Similarly to Larnder’s recruitment, John Abrams was personally drawn to the Operational Research Group by Solandt, Johnstone and Morton. Born and raised in San Francisco, Abrams crossed the border and enlisted in the Royal Canadian Air Force in 1940 a year after completing his PhD. Abrams trained navigators until 1942 when he was chosen to be among the first Canadian operational researchers and was attached to the Royal Air Force in the United Kingdom for training from 1942 to 1944. As with many other veterans, he met his wife while

stationed in the UK and the two returned from the UK for his final tour of duty on the Pacific Coast of Canada. After the war Abrams worked as a physics professor at the University of Manitoba and Wesleyan University, but in 1949 he was hired by the Defence Research Board as an operational researcher. Because Abrams already had plans to undertake graduate-level study in the history and philosophy of science at University College in London, Solandt worked out an arrangement with the British Admiralty to loan Abrams to them for consulting work for two years. In 1951 Abrams returned to Canada and spent the next ten years in a variety of senior operational researcher and scientific adviser posts.\footnote{LAC, MG 31 J 16 Vol 1 File “John W Abrams, Curriculum Vitae, 1968,” and File “Confidential Information Relating to Government Employment (1953);” LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 3, “Minutes of the Thirteenth Meeting of the Defence Research Board held at the University of Toronto, 1 December 1949,” 4; UTARMS, B 93-0041/031 File “Solandt; John W Abrams Memorial Lecture, 1983.”}

The second recruitment method that the Defence Research Board employed, after personal networking, was sending recruiting officers to universities. This practice started in 1946 in anticipation of the creation of the Defence Research Board. John Chapman was first attracted to the DRB because of a recruiting officer visit to the University of Western Ontario (UWO) in the fall of 1946. The first round of recruiting officers was sent out to find summer students to work on projects for the DRB laboratories. Chapman wrote a letter to the Director General of Defence Research on 14 December 1946 requesting more information about the summer study at Churchill, Manitoba. After several months of delay while the Defence Research Board waited for Treasury Board approval of their scheme to hire summer students, Chapman was brought to the Radio Propagation Laboratory in Ottawa on 29 May 1947. Chapman worked at RPL for two more summers while completing a master’s degree before he was hired in 1949; he was given leave without pay until 1951 when he finished his Ph.D.\footnote{LAC, MG 31 J 43 Vol 4 File 4-4 “DRB – Employment 1946-1950,” “Letter from Chapman to Director General of Defence Research, Attention: Combined Services Survey Team, 14 December 1946,” “Letter from ES Spohn for DGDR to Chapman, 22 February 1947,” “Letter from Spohn to Chapman, 16 April 1947,” “Letter from Spohn to Chapman, 6 May 1947,” “Letter from Chapman to Davies, 2 January 1948,” and “Letter from Chapman to Davies, 23 February 1948;” ; LAC, MG 31 J 43 Vol 1 File 1-3, “Curriculum Vitae, John Herbert Chapman.”}

This early use of visits by DRB recruiting officers to universities was largely limited to those universities with connections to the Defence Research Board. The University of Western Ontario had two of Canada’s premier radio physics and radio propagation experts, both of whom had lengthy histories of working with the National Research Council and the Defence Research
Board: Raymond Compton Dearle, a graduate of the University of Toronto who was the head of the UWO physics department from 1919 to 1949, and the polymath Garnet Woonton, who left UWO for McGill in 1948 and was therefore Chapman’s instructor throughout his undergraduate career at UWO and graduate career at McGill.\textsuperscript{112}

The practice of sending recruiting officers to universities soon expanded to include all universities with reputable science and engineering programs, irrespective of their personal connections with the DRB.

The third and final method used to recruit employees from universities appears to have started in 1953. The Defence Research Board created an information pamphlet that year that served the dual purpose of public relations and job advertising. Pamphlets might have been used prior to 1953, but none survive nor is there an extant paper trail recording the ordering process. Starting annually in 1958 the DRB began to produce pamphlets with the singular purpose of recruitment.\textsuperscript{113}

3.2.4 The Selection Committee

The task of deciding which applicants should be offered employment was the Board’s. Official offers had to be approved by the Minister of National Defence and be arranged by Order-In-Council; for the most part this was a rubber stamp. However, following bureaucratic tradition, a Selection Committee was formed from Board members and headquarters employees. The Selection Committee’s recommendations were accepted in nearly every single case by the Board, and subsequently they were passed on to the Minister for action. The Board, as it had better things to do, only considered the recommendations that either troubled the Selection


Committee or were for senior appointments. Even in the cases of senior appointments, the Committee’s recommendations were generally approved.

The Selection Committee’s first set of meetings coincided with the second meeting of the Board, 13-14 May 1947. Maass was the chairman, and from the Board Paul Gagnon also participated. Best was too busy, so an external adviser, William Line, a psychologist at the University of Toronto and formerly the Director of Personnel Selection for the Canadian Army during the Second World War, was appointed to the Committee. From DRB headquarters E.L.L. Davies, William Barton and Garnet Dunn attended as well as Frederick Rosser from NRC and James Warburton from the Department of Labour.\textsuperscript{114}

At this first meeting a wave of employees was approved. Focus was given to Canadian Armaments Research and Development Establishment (CARDE) and Chemical Warfare Laboratories (CWL), and their superintendents, D.C. Rose and John Dacey respectively, were present for the relevant discussions. The first round of summer students, including Chapman and Marcel Chaput, was approved at this meeting; they were paid according to the scale established by the Department of Mines and Resources. Administrative staff scientists for headquarters (HQ) were given positions, and the Suffield Experimental Stations (SES) was also staffed. In the case of HQ, CARDE, CWL and SES, the bulk of the staff were already working at the establishments and their positions within the Defence Research Board were merely formalized with a salary and gradation.\textsuperscript{115}

When he was appointed to the Board, John Johnstone became a member of the Selection Committee. In 1948 the membership of the Selection Committee became regularized with a Chairman and three other members. At least one member or the Chairman was a member of the Board as well. In 1948, Maass was the Chairman, Gagnon and Johnstone from the Board were


members; all three were drawn from the academic temporary members of the Board. The external member was Line from Toronto, who continued until 1952 because of his expertise in education and personnel. Administrative support came from the staff at headquarters. Expert opinion was given, when requested, by the various advisory panels and committees of the DRB that supported both the Selection Committee and the Standing Committee on Extramural Research. Consultants for the Selection Committee were the executive assistant to the President of the National Research Council, Frederick Rosser, and James Warburton from the Department of Labour of the federal government.

Maass relinquished the chairmanship of the Selection Committee in 1951 to Andrew Gordon. Gordon was appointed to the Board from the University of Toronto where he was the Dean of Graduate Studies and Professor of Chemistry. When Gordon took over for Maass, the Defence Research Board had gone through its initial period of planned growth, as well as the unplanned growth in response to the Korean War. After Maass left, the Selection Committee faced one essential problem for the remainder of the existence of the DRB, how to balance retention of current staff and replace those that leave.116

3.3 Canada, 1947 to 1950

3.3.1 Domestic Politics and Board Membership

Because Solandt had to satisfy his needs for a breadth of expertise and geographic representation with only six Board members there were times when the Board had to sacrifice one or the other for a year. Gordon Shrum was the western Canadian representative in the early years, but his term ended in 1950. To regain a western contingent amongst the term members of the Board, Shrum was reappointed 1 April 1951 after a year off, which established a precedent of forcing Board members to take at least one year off between appointments; this rule faded after Solandt left the Board due to its impracticality. Additionally, Shrum returned as the only physicist and he replaced one of the two Québec chemists, Maass and Gagnon. To replace the

116 Adrian G. Brook and W.A.E. McBryde, *Historical Distillates: Chemistry at the University of Toronto since 1843* (Toronto: Dundurn Group, 2007), 110.
outgoing chemistry expertise, and central Canadian representation on the Board, Gordon was brought in. However, this left the Board with no Québec francophone representation.\(^\text{117}\)

The Defence Research Board’s first brush with francophone nationalism came in 1951 as a result of Gagnon’s retirement from the Board. Writing for *Le Droit*, a Hull-based daily newspaper that was read widely enough in civil service circles on the other side of the river in Ottawa to come to the attention of the Board, journalist Georges-Henri Dagneau objected that Gagnon had retired and that he would have to wait a full year to be reappointed. In looking at the representatives on the Board, Dagneau pointed out that only four positions, the academic representatives, were open to francophones. The two industrial positions were closed because no francophones ran industries of defence interest; the three Chiefs of Staff, President of the National Research Council, Deputy Minister, Chairman and Vice Chairman were all anglophones.\(^\text{118}\)

By contrast, lamented Dagneau, the advisory council of the NRC had three francophones in 1951. Dagneau, as a result, complained that even when Gagnon was one of four possible representatives, the numbers were too low. At the very least, one of the *ex officio* members ought to be Québécois according to Dagneau.\(^\text{119}\)

The federal government, or at least the Liberal Party (sometimes known as the “Government Party”), has a long-standing tradition of alternating anglophone and francophone leaders. The Prime Minister at the time, Louis St-Laurent, had an anglophone lieutenant in C.D. Howe, and had himself been the Québec lieutenant for William Lyon Mackenzie King. Dagneau must surely have been thinking of this example when he suggested that a francophone should be inserted as an *ex officio* member of the Board.\(^\text{120}\)

\(^{117}\) LAC RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 3, “Minutes of the Ninth Meeting of the Defence Research Board held at Ottawa, 20 December 1948,” 4; see Appendix D below for list of Board members.


\(^{119}\) LAC, RG 24 S F1 Vol 19995 File DRBS 1-0-43, “Représentation canadienne-française by Georges-Henri Dagneau (newspaper clipping and translation).”

The problem was that Québec’s lineage in scientific and engineering research was shorter than the rest of Canada. Most Québec universities grew out of Catholic seminaries and based their curricula heavily in the humanities. The exception was McGill University in Montréal, but it had always been a university for the anglophone residents of Québec. Québec also had a stronger anti-military bent than the rest of Canada, especially when it came to wars in support of the British. Experts in topics of defence interest, who happened to be francophone, were few and far between in Québec particularly and Canada generally.\footnote{LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-1 Part 2, “Memorandum from RH Lowe (Executive Secretary / Grants & Contracts) to the Chairman of the Defence Research Board through the Chief Scientist regarding Letter from Bonneau and Gaudry, 6 April 1964;” Bothwell, The Penguin History of Canada, 37, 304, 345.}

Geographically, which was the way that Solandt termed the diversity of Board members, Québec was represented. Wallace, an Irishman, and Montréal businessman was the Québec representative. However, even having one representative from Québec was a far cry from the original Board that had Maass, Gagnon and Harkness from Québec. A year after Gagnon retired eminent pathologist and cancer researcher from the Université de Montréal and Notre-Dame hospital, Louis-Charles Simard, was named to the Board 1 April 1952. In terms of expertise Simard was a replacement for Ray Farquharson who had replaced Charles Best. This replacement started a new tradition of drawing the Board’s medical expert from Québec, rather than Solandt’s Alma Mater, the University of Toronto. Simard was replaced by Louis-Paul Dugal, a physiologist from Laval and former member of the advisory council of the National Research Council, 1 April 1955.

3.3.2 Demographics

Attitudes within the Defence Research Board towards hiring women were probably consistent with a popular consensus. Women contributed significantly towards the war effort by either entering the work force, or by moving from traditional jobs to essential manufacturing work to replace the fighting men. The same process had occurred in the First World War and the mobilization of women had resulted in women’s political enfranchisement. The tangible benefits for women (education and employment) following the Second World War took much longer to materialize. The expectation following both wars, despite favourable reviews of the calibre of
their work, was that women would return to traditional jobs (domestic service, teaching, libraries, trade, foods and textiles) or the home.\textsuperscript{122}

Women were not expected to want to pursue careers. The Board expressed this belief that women were not career-minded in a roundabout way. At its Twentieth Meeting, held at Valcartier on 29 September 1951, the Board addressed the hiring of women, and fixing of starting salaries, in response to a discussion arising at the meeting of the Selection Committee. “It was agreed that although the policy of equal pay for equal work must apply, as a general rule women scientists were of less continuing value to the organization, and they could therefore be job-rated at a lower level than men with similar qualifications.”\textsuperscript{123} In other words, some women were finishing university and looking for jobs. However, the Board felt that these women were only short-term solutions, because they believed that the inevitable progression was marriage and children, which were presumed to preclude the possibility of employment for women.

Immigration changed the face of Canada after the war, but it was not a sudden or drastic change. After the war about 50% of Canadians were descendents of immigrants from the British Isles; those of French descent accounted for 31% of Canadians. Other European descendents made up about 18% of the population, with the remaining 1% being native, African or Asian. 124,000 new Canadians arrived in 1948, the peak year for immigration in the immediate postwar; by contrast, two years later only 74,000 people immigrated to Canada. These numbers were not enough to immediately shift the ethnic make-up of the country; it would take decades and a more drastic switch in the sources of immigrants from Europe to Asia and Africa.\textsuperscript{124}

3.4 Germans and Missiles

3.4.1 Expatriates

Canada, the United States and the United Kingdom absorbed more than a few Germans after the war. Enemy combatants were a problematic minority within these German immigrants. In Canada, displaced persons accounted for 223,299 immigrants between 1946 and 1958. Of the

\begin{thebibliography}{124}
\bibitem{122} Bothwell, Drummond and English, \textit{Canada, 1900-1945}, 158, 379.
\bibitem{124} Bothwell, Drummond and English, \textit{Canada since 1945}, 14.
\end{thebibliography}
enemy combatants that were accepted from Germany by the US and the UK, and to a much lesser extent Canada, the majority were scientists, and a blind eye was turned most frequently for scientists from the German rocketry program at Peenemünde. The most high profile of these was Wernher von Braun, who aided the Americans in their related races for both space and Intercontinental Ballistic Missiles (ICBM).\textsuperscript{125}

Where the United States was enthusiastic to hire former scientists of Hitler’s Germany, Omond Solandt was adamantly opposed regardless of the skills those Germans might offer. The Defence Research Board formed a policy that prohibited hiring German scientists at the seventh meeting of the Board 20 to 21 June 1948 when it considered the prospects of hiring a German by the name of Paul Steffen. This explicit policy against hiring enemy combatants was reviewed by the Board at its twentieth meeting, held 29 September 1951 in Valcartier. At this meeting of the Board they considered the possibility of hiring Rolf Engel, an S.S. officer who was part of the Peenemünde project and had been working for the French since the end of the war. Engel wanted to move to Canada, so the Board agreed that Engel should be interviewed by the Defence Research Member in London; whether the interview happened is not clear, because he never joined the DRB. Engel returned to Germany briefly before moving to Egypt to work on their missile program. No further cases of enemy combatants were raised at Board meetings.\textsuperscript{126}

Among the immigrants that came to Canada after the war were many British. It is easy to understand why they would come, especially veterans. Canada had been the location of the training facilities for the British Commonwealth Air Training Plan, including Radio Direction Finding Schools, as well as less famous radar training for the Royal Navy and Royal Canadian Navy. Many of these men saw Canada as a land of opportunity.


By contrast, the United Kingdom was razed by the war. Bombing raids had devastated the landscape of many towns and cities. The British were also broke and struggling to pay for reconstruction. By 1947 the British government had borrowed $960 million from Canada and owed far more on the sterling balances to the rest of the British Empire. The situation threatened to unbalance not just the UK, but most of Western Europe, which was relying on the UK to pick up the reconstruction tab in the immediate postwar. In 1947 President Harry Truman and his Secretary of State George Marshall laid out the premise and the financing for long-term American involvement in Europe and the world at large; the Truman Doctrine articulated on 12 March 1947 pitted the United States against communist aggression, and the Marshall Plan (properly, European Recovery Program) enunciated on 5 June promised to infuse American money to keep Western Europe’s economy afloat. A buoyant European economy also meant that Western European nations would be less likely to be lured into communist experiments.\footnote{Bothwell, \textit{Alliance and Illusion}, 33.}

The rocky relationship between the United Kingdom and its former colony, Canada, in the postwar period is best illustrated by the example of Suffield. The facility had been chosen by the British for tripartite testing of chemical weapons during the Second World War. Prior to the Defence Research Board taking control of the facility in 1947, the British withdrew financial support from Suffield in 1946. Some staff including E.Ll. Davies remained on after this. In 1949, Suffield exchanged its Chief Superintendent, Hugh Barrett, with Porton Down (the Chemical Defence Experimental Establishment in England). Barrett became the Chief Superintendent at Porton Down and in return the British establishment sent E.A. Perren who had previously been the Superintendent of Research at Porton Down. The exchange lasted until 1951.\footnote{LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 3, “Minutes of the Twelfth Meeting of the Defence Research Board held at Ottawa, 17 September 1949,” 6; Avery, \textit{The Science of War}, 272.}

Many times the exchange between the United Kingdom and Canada was one-sided with a British scientist crossing the Atlantic to Canada to fill an immediate need on a project or in upper management. More often than not, that scientist wound up staying in Canada the way industrialist and Board member F.C. Wallace had after participating in the Tizard Mission during the war. Other examples that have already been covered include Harold Larnder and E. Ll. Davies, but there are three others that are worth mentioning.
Archie Pennie moved to Canada in 1948 to take a job as head of the chemical engineering branch at Canadian Armaments Research and Development Establishment. He was born in Scotland and trained in Western Canada through the British Commonwealth Air Training Plan. In 1951 he was promoted from his initial appointment to be the head of the Chemistry Wing at CARDE.129

The second example of a senior scientist poached from British defence research was Alexander Longair. Longair was born in Scotland and joined the Department of Scientific and Industrial Research after graduating from the University of St. Andrews. He participated in the Tube Alloys project during the Second World War in a recruitment and liaison capacity, because he had a knack for getting information out of people. Longair joined the Defence Research Board in 1953 as an expert in special weapons, and his previous experience with the British program made him ideal for the limited Canadian needs in atomic weapons.130

The third interesting example of a senior appointment that was given to a British scientist is John Keyston. Keyston was born in Nottinghamshire in 1908 and rose to the position of Deputy Director of Research Programs and Planning for the Admiralty Scientific Service by the end of the Second World War. After the war he was loaned to Southern Rhodesia and India to aid in the development of scientific and defence research establishments in those two countries. Shortly after being recalled to the United Kingdom in 1950, Keyston was again loaned by the Admiralty, this time to the Defence Research Board as the Superintendent of the Naval Research Establishment. He replaced John Johnstone who had temporarily acted as Superintendent after the death of George Henderson in August 1949. However, Keyston’s initial appointment had caused Solandt and the Board to consider their policy of recruiting British scientists.131

George Lindsey addresses the issue of personnel exchange with the United Kingdom in his tribute to Omond Solandt’s tenure as Chairman of the Defence Research Board. Lindsey writes, “The exchanges with Britain were terminated by the British when most of their men were

129 Lindsey, No Day Long Enough, 106.
offered and accepted permanent jobs in DRB and did not return home.\textsuperscript{132} Prior to a British embargo the Board imposed a limit on the number of British scientists that could be offered permanent employment with the DRB. Solandt may have taken the initiative on this with some prompting from E.Ll. Davies, but it is more likely that they became aware of the British attitude through the semi-official channels that connected both Solandt and Davies with the senior defence researchers in the UK.\textsuperscript{133}

3.4.2 Renewing Wartime Liaison

Not only was the UK seen by the Defence Research Board as a potential source of personnel, it was also a potential source of information. At the second meeting of the Board it was agreed to re-establish the demobilised liaison offices with Canada’s two chief allies: the United Kingdom and the United States. In London the first liaison officer was Colonel G. Milroy Carrie who was housed at the Canadian Joint Staff building starting in the summer of 1947; this meant that Carrie, along with his bureaucratic staff was integrated with the military liaison officers in the UK (rather than the High Commission). The experience in Washington was slightly different. The office was in the Chancery in Washington instead of with the Canadian Joint Staff, and there was more wide-reaching travel to research establishments spread across the US. A.L. Wright was the first liaison officer in Washington, but he experienced early difficulties because of the lack of integration with the military liaison officers and also because of the broad differences in the American system compared to the smaller and simpler Canadian system.\textsuperscript{134}

Liaison, of course, was as essential for Canadians after the war as it had been during the war. The Defence Research Board had a limited budget and needed all the information it could acquire. There were two reasons why the DRB needed information from its allies. First, the DRB could only select certain projects on which to work. Second, Solandt had a responsibility to provide the Chiefs of Staff and the Minister of National Defence with the most complete

\textsuperscript{132} Lindsay, No Day Long Enough, 89-90.
\textsuperscript{133} LAC, RG 24 S F1 Vol 4210 File DRBS 69-180-262 “Operational Research Group, Operational Research, Policy,” “Memorandum from Morton to File regarding Key Senior Staff, ORG, 2 August 1951.”
scientific and technical advice possible, which could only be achieved with British and American information.

In order to maximize their research efforts the Defence Research Board had to know if it was worth devoting resources to a project by discovering what work had been done or was currently underway in the other two countries. Rather than starting from scratch on projects, the DRB preferred to have a running start based on existing reliable information. The DRB also had to know whether they would be competing with American or British teams. Competition might be healthy for pure science or industrial research, but in the late 1940s competition between defence research and defence weapons was seen as detrimental to the combined efforts of the three allies.

A planning document from 31 October 1945 signed by the three Chiefs of Staff demonstrated the Canadian attitudes towards liaison and avoiding unnecessary competition with the United States and/or the United Kingdom. In addition to summarizing Vannevar Bush’s musings on post-war defence research in the United States, they wrote, “Unlike the United Kingdom or the United States of America, it is neither economic nor desirable to attempt to develop a complete system of defence weapons which are peculiar to this country; the reasons for this are evident.” They continued, “It is neither essential nor economical that we should maintain applied military research on the entire field of service requirements, but we must contribute our part if we are to share in the experience of these other countries.” In short, it was too expensive for Canada to match the US and the UK, but Canadians were obligated to contribute if they wanted the Americans and British to share the most important information.

A general attitude in the Defence Research Board developed as a result of this guiding attitude laid out by the Chiefs of Staff. If the United States, more so than the United Kingdom, set its mind to develop some weapon or weapon system, then Canada was better off offering support to the Americans and then purchasing the weapon when it became operational.

135 LAC, RG 24 S F1 Vol 11997 File DRBS 10181v1, “HQS 24-7 FD 4, 31 October 1945, To the Cabinet Committee on Research for Defence Post-War Policy for Scientific Research for Defence,” 4.
136 LAC, RG 24 S F1 Vol 11997 File DRBS 10181v1, “HQS 24-7 FD 4, 31 October 1945, To the Cabinet Committee on Research for Defence Post-War Policy for Scientific Research for Defence,” 4.
Despite this guiding principle, the three allies often attempted to develop similar weapons or weapon systems. In nearly every case each country (and each service within that country) determined that it had unique requirements that could only be met by an individual project rather than a standardized weapon. The most important unique requirement that led to competition was the national prestige and associated financial windfall that would result from a successful project.

3.4.3 Guided Missiles

The weapon that all three nations were compelled to develop was the guided missile. The Defence Research Board limited itself to one type of guided missile, an air-to-air missile with conventional explosives for use in fighter-interceptors. The other types of missiles available were air-to-surface, surface-to-air and surface-to-surface; within each broad type there are several further variations including different range requirements and different warheads. The United States explored every option, the United Kingdom investigated a handful and Canada just one.

The DRB project was born in October 1946 when Solandt, as Director General of the Interim Defence Research Board, arranged a Guided Missile Advisory Committee; the first meeting of this Committee was 19 March 1947. Later that year a Guided Missile Advisory Panel was established to report to the Committee. The project, known as Velvet Glove, officially started on 1 April 1951 at Canadian Armaments Research and Development Establishment, with Gordon D. Watson overseeing the scientific work.\(^\text{137}\)

By 1955 Velvet Glove was in the final stages of development. However, a problem had arisen for the missile, and the problem did not bode well for the Avro Arrow – the new fighter-interceptor that was intended to carry the Velvet Glove missiles. The Velvet Glove was originally intended as a missile to intercept bombers. The speed of bombers had increased to match the speed of existing operational interceptors, and the Velvet Glove could not meet the new operational requirements. The Arrow was expected to meet the Royal Canadian Air Force’s needs, but it needed a new missile. The Board and the RCAF opted to adopt an American missile, the Sparrow II, rather than continuing with further research and development within the

\(^{137}\) Goodspeed, *A History of the Defence Research Board of Canada*, 128-.
Defence Research Board. However, the Arrow’s days were numbered as well in the face of competition from American weapons and Canadian budgetary constraints.\textsuperscript{138}

To those within the program it was a devastating blow. There was a sense of personal, institutional and patriotic pride attached to the Velvet Glove. In their history of the Canadian Armament Research and Development Establishment historian Alain Gelly and defence scientist Henri Tardif argue that the government’s choice was between the “more effective weapon and the future of a Canadian industry that had been so meticulously created to have the capacity of developing any guided missile right from preliminary design through to final production.”\textsuperscript{139} This overstates the choice, but the government opted for the more effective weapon while awarding the contract to produce the Sparrow in Canada to Canadair. The relevant industrial capacities from CARDE were gradually transferred to Canadair in order to take on the production.\textsuperscript{140}

Goodspeed summarizes the DRB’s justification for entering the field of guided missiles even though the Board knew that the project had little hope of ever leading to an operational weapon, “Canada believed that it was important for her at least to keep abreast of the latest technical developments in the field and to train a nucleus of personnel in guided missile technology.”\textsuperscript{141} When the project was cancelled, the experts at CARDE moved from a role of design to “evaluation of future guided missile weapons systems.”\textsuperscript{142} For Solandt, expertise was more important than weapons in fulfilling his obligations to the government.

The replacement project, the Sparrow II, was being designed to meet the needs of the United States Navy. It was one of many guided missile projects in the United States, ostensibly all of these projects were intended to meet different operational requirements, but between 1945 and 1975 the majority of guided missile projects were cancelled before ever becoming functional because the operational requirements changed as a result of each new advance in military science.

\textsuperscript{139} Gelly and Tardif, \textit{Defence Research Establishment Valcartier}, 97.
\textsuperscript{140} Gelly and Tardif, \textit{Defence Research Establishment Valcartier}, 96-96.
\textsuperscript{141} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 128.
\textsuperscript{142} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 132.
and technology. The expected conduct of war altered so rapidly during the Cold War that most weapons and weapon systems were obsolete before they ever left the drawing board.\textsuperscript{143}

Besides the need to know what its allies were doing in order to tailor its own research agenda, the second reason that the Defence Research Board needed scientific liaison was that the DRB had a responsibility to provide the Minister of National Defence and the Chiefs of Staff with the best and most current defence research available. Even if the DRB or Canadians were not developing a weapon or weapon system, the Canadian military might have wanted or needed to acquire and use these weapons or systems. Scientific appraisal of the weapons being developed by the United States and United Kingdom was an essential part of Solandt’s legislated responsibilities, especially advising the Minister and the Chiefs of Staff.

3.5 The DRB within the DND

3.5.1 Departmental Duties – Scientific Advising

Board meetings were not the ideal time and place for rigorous scientific and technical advice from the DRB to the Chiefs of Staff. Board meetings were largely devoted to the overall research program and matters that contributed to the effectiveness of the Defence Research Board (recruitment, grants, salaries, budget, etc.). Even though the Chairman of the Board was a member of the Chiefs of Staff Committee, this was similarly problematic as an avenue of rigorous scientific appraisal. The Chairman had the responsibility of providing scientific advice to the Minister of National Defence and the Chiefs of Staff, but with limited time the Chairman delegated scientific advising to the Chiefs of Staff to three senior scientists of the DRB in 1947. The arrangement was similar to wartime arrangements in Canada and the United Kingdom.

The first three scientific advisers had an expertise in the fields that interested their respective Chiefs of Staff. All three men served as an advising link between the Board and the three branches of the Canadian military; the role was considered a part time one. Otto Maass took on the role of scientific adviser to the Chief of the General Staff (Army) in addition to his Board membership and his responsibilities with both the National Research Council and McGill University. In 1951 Milroy Carrie returned from his posting as the Defence Research Member

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\textsuperscript{143} David K. Allison, “U.S. Navy Research and Development since World War II,” 315-320 in Smith, \textit{Military Enterprise and Technological Change}. 
(London) to replace Maass as the scientific adviser to the Chief of the General Staff (see Appendix E for tables of organization).

George Field was loaned from the National Research Council to the Defence Research Board to act as scientific adviser to the Chief of the Naval Staff in 1947. Throughout the Second World War Field was one of the leading Canadian experts in naval research. Field’s loan to the DRB was made permanent later in 1948 when he became the Deputy Director General with a responsibility for the scientific management of the DRB; he continued acting as the scientific adviser until 1953 when he was replaced by Frederick Sanders.

Finally, Air Vice-Marshal (retired) Ernest Stedman was the scientific adviser to the Chief of the Air Staff. Stedman immigrated to Canada after being posted in Canada during the First World War by the Handley-Page aircraft company. He joined the Canadian Air Board as a technical adviser, and his final posting before retiring from this work was as Canada’s observer to the Bikini Atoll atomic trials of 1946 (see Appendix E for tables of organization).

By 1954 the scientific advising arrangement needed to be adjusted. The Defence Research Board had grown to the point that headquarters required full time scientific managers. Scientific research, both in Canada and abroad, had expanded to the point that the Chiefs of Staff needed full time scientific officers. Sanders continued to work as the advising officer for the Chief of the Naval Staff, but Carrie and John Green (an aeronautical engineer who had worked for the National Research Council, Royal Canadian Air Force and Air Transport Board before replacing Steadman as the Scientific Adviser to the Chief of the Air Staff) gave up their advising duties to assume full time responsibility for scientific management in HQ. A year later, Green went to Washington as the Liaison Officer. To replace Carrie, Whitman Morton was made the full time adviser to the Chief of the General Staff in a reorganizational shuffle that also dealt

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with the DRB’s growth in the Korean War. John Abrams was promoted from the Operational Research Group and replaced Green as the scientific adviser to the Chief of the Air Staff.\textsuperscript{147}

3.5.2 In Enemy Territory

The transition to full time scientific advisers was one of many moves that the Defence Research Board made in its attempt to fulfil its duty to the military. Advising was just part of the DRB’s overall role of meeting the scientific and technical needs of the Department of National Defence. Unfortunately, the relationship between the DRB and the three branches of the military was never ideal. As Goodspeed explains, the Army had to be persuaded to accept a separate, civilian, defence research apparatus in 1946 by Foulkes. The Navy was not thrilled by the prospects of losing their research facilities to a fourth service, but in the interests of compromise and efficiency, it was willing to accept the DRB. The Air Force was adamantly opposed to the creation of the Defence Research Board in 1947 since it was jealously carving out a space for itself within the military structure. Additionally, Middleton argues that the Air Force felt that losing its research and development capacities to a new agency would stall and prevent new development, a prospect that made the burgeoning Canadian air industries wary. Thrust into this competitive environment, the Defence Research Board did everything it could to appease its military clients.\textsuperscript{148}

In his 1951 Birthday Address to the Defence Research Board, Solandt suggested that relations with the military were improving. The theme was repeated each subsequent year. In 1954 Solandt explained that scientific advising had to be separated from routine administration, because there had to be separation between the needs of the establishments and the needs of the military. Each year Solandt claimed that relations with the military were improving, and each year between 1951 and 1954 Solandt reorganized the personnel and positions in headquarters in an attempt to improve interactions with the military. In his 1951 address Solandt expressed a


desire to retain some degree of tension with the military merely for the sake of maintaining independence. He said,

When a military and a scientific group are in complete agreement on any major problem, it means that one side or the other has yielded to pressure and given up its distinctive point of view. Real progress results from the continual interplay of the viewpoints of the military expert and the scientist and even heated debates should be encouraged as long as each side respects the other and is willing to listen to the other’s arguments.\textsuperscript{149}

While Solandt’s statement concerns the desirability of tension, with the same words he has also made an implicit argument that any delays in progress were either the result of a lack of competing ideas or a lack of respect in expressing those competing ideas. The DRB and the military appear to have never lacked in tension.\textsuperscript{150}

3.6 The Atlantic Triangle

3.6.1 Tripartite Tensions

Another ongoing source of friction for the Defence Research Board was the supply of information coming from research agencies in the United Kingdom and the United States. Part of the problem that Canada faced was navigating the delicate balance between the US and the UK. This was by no means a new problem for Canadians, but the Second World War drastically shifted the balance of power to the US. Furthermore, the US showed a willingness to accept and define its responsibilities in the global community. In fact, the political and military fallout of the war gave American leaders a brazen confidence and a very short memory.

Understandably, the United States sent no permanent defence research liaison officer to Canada. The Canadian liaison officer in Washington was expected to relay the relevant information about American programs back to Ottawa. When it was necessary, this liaison officer was also supposed to pass along the limited information that the Defence Research Board was producing that might be of use to the Americans. This is indicative of the power status of

\textsuperscript{149} DHH, Col 82/185, “The Defence Research Board the First Four Years: An Address to the Staff of the Defence Research Board in Ottawa marking the Occasion of the Board’s Fourth Birthday by OM Solandt, 30 March 1951, Report No. DR 34,” 24.

the two countries, but also an indication that the US had no truly centralized defence research agency comparable to the Defence Research Board.

This second reason fills in part of the justification for why the British sent a liaison officer to Washington, but the Americans did not send one to London. However, the British and Americans had similar defence research systems that emphasized management by individual services and some upper-level inter-service coordination, rather than a mostly centralized system like Canada’s Department of National Defence. The real reason for the liaison arrangement was that the Americans believed (probably justifiably) that they had ascended to a position of dominance, at least in defence research matters and likely all defence issues as well.

American over-confidence led to many working-level disputes with both the British and Canadians. The weapon that all three nations attempted to develop after the war was the guided missile. Because of their own research program and the success of Operation Paperclip (that netted the Americans a significant portion of German knowledge on guided missiles), the Americans had a significant lead in the race to acquire guided missiles. However, the Americans were loath to share this information with their former allies in 1946 and 1947. By 1948 the Americans were willing to share some of their information with Canada and the United Kingdom in the interests of mutual cooperation. The sticking point for the United States Navy was the involvement of Australia in the UK project. The British were testing missiles in Australia and felt they needed to involve the Australians, but the Americans did not like the idea of information they generated being passed to a third party.151

Another problem that Canada and the United Kingdom faced was the varying interpretation of exchange that the United States embraced. The Canadians and the British believed that all three countries should exchange all of their defence research results. The benefit to the Defence Research Board would have been tremendous under such an arrangement. The Americans estimated in 1952 that they were producing ten times as much defence research as the Canadians and two to three times what the British were generating. Understandably, the

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151 National Archives at College Park, Maryland (NACP), RG 330 Entry 341 Box 331 File 33 “Executive Council Annexes,” “Memorandum from DZ Beckler (Chief, Technical Intelligence Branch) to RL Clark (Director, Programs Division) regarding Exchange of Guided Missile Policies with Great Britain, 23 February 1949.”
Americans favoured a slightly different interpretation of *quid pro quo*, 100% of British knowledge was worth 50% of American knowledge.\textsuperscript{152}

This interpretation was popular but not universally held in the American defence research community. Some prominent Americans like James Forrestal and Vannevar Bush favoured complete exchange along the lines that the British and Canadians desired. Unfortunately, the influence of both men was diminishing and was not enough to persuade the administration to accommodate the British and Canadians.\textsuperscript{153}

In 1952 Canada was still seen as thoroughly enmeshed with the British to the point that the Defence Research Board was locked out of all the same information that the British were. The British raised particular ire that year by passing along defence research information to a commercial interest, which pre-empted a lucrative American-based contract. The result of this American attitude, British pride and the several layers of bureaucracy in each of the countries led to a significant volume of complaints from both the British and Canadians about the slow speed with which they received American information.\textsuperscript{154}

Moreover, the British and Americans had to come to an understanding of personnel hiring practices. In 1948 Vannevar Bush wrote to Alwyn Crow of the British Joint Service Mission in Washington regarding the practice of targeting and hiring personnel from each other’s defence research establishments; the British lured away some American researchers. Bush and Crow agreed that any future incidents should be cleared by the head of the research establishment from which the new recruit was targeted. One year later Karl Compton revisited the issue with Charles Wright, when the Americans approached British scientists.\textsuperscript{155}

\textsuperscript{152} NACP, RG 330 Entry 341 Box 599, “Memorandum from Charles J Tanenbaum (RDB Member of SDMCC) to Mr Price regarding Exchange of Information, 26 February 1953;” NACP, RG 330 Entry 341 Box 598 File 120 “Exchange of Technical Information,” “Study Summary by McKay Donkin and Memorandum to Dr Eric A Walker regarding Exchange of Info with UK, Canada and NATO, 9 April 1951.”

\textsuperscript{153} NACP, RG 330 Entry 341 Box 331 File 33 “Executive Council Annexes,” “Memorandum from Forrestal to Bush regarding Interchange of Information with Britain and Canada, 7 April 1948.”

\textsuperscript{154} NACP, RG 330 Entry 341 Box 598 File 120 “Exchange of Technical Information,” “Study Summary by McKay Donkin and Memorandum to Dr Eric A Walker regarding Exchange of Info with UK, Canada and NATO, 9 April 1951.”

3.6.2 The McMahon Act and Tripartite Tension

The American reticence that the British and Canadians experienced at the working levels had its origins at the top levels of American democracy. Harry Truman, who became the President when Franklin Roosevelt died in April 1945, attempted to protect the secrets of American weapons after the war. Primarily, this was directed at atomic weapons, but it extended as far as guided missiles and chemical warfare.

The first attempt by the Truman administration to protect American military secrets was a series of Executive Orders from 1945 to 1947. These Executive Orders ranged from government control, through a Publication Board of classified scientific and technical information, to protecting American patent rights. The spirit of these Executive Orders returned a sense of American isolationism and ignored the recent fortuitous scientific exchanges with Canada and the United Kingdom.\(^\text{156}\)

The legislation that strengthened these Executive Orders made liaison difficult for the skeleton Canadian defence research establishments immediately following the war. The first attempt at legislation to protect atomic secrets was the May-Johnson bill, which was introduced in both Houses of Congress on 3 October 1945. The bill contained provisions for the creation of a part-time atomic commission that would be largely made of members of the military; it also imposed heavy restrictions on sharing information outside of the American government, including foreign nationals like Canadians, or within the United States to industries or universities.\(^\text{157}\)

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The bill had a polarizing effect within the United States, especially the scientific community. Critics of the administration, the administration’s handling of atomic research during the war or the implications of the bill opposed it immediately. In his biography of Vannevar Bush Pascal Zachary points out that Bush’s main reason to support the legislation publicly was his desire for swift and decisive action. When the scientific community voiced objections to the heavy-hand the government was playing in the idealised universal endeavour of science, they included criticism of both Bush and his wartime lieutenant James Conant.\textsuperscript{158}

Political opponents in the Senate blocked the bill long enough for Truman to reconsider. Rather than caving to pressure within the administration from Bush, or to external demands from the scientific community, Truman decided that he wanted something stronger. Truman was even less inclined to share information internationally by the end of October 1945 and he ordered Secretary of the Treasury, John Snyder, to recast the debate as technological progress rather than a fissure between the military and civilians. Two of Snyder’s staffers wrote a new bill, which was introduced by Senator Brien McMahon through the Special Committee on Atomic Energy that he chaired.\textsuperscript{159}

The McMahon bill, slightly revised, became law on 1 August 1946; its official name is the Atomic Energy Act. The McMahon Act maintained elements of the rigorous security restrictions from the May-Johnson bill, but it now allowed for a thoroughly civilian full-time commission to oversee all aspects of atomic energy in the United States. The Act had an adverse, but expected, effect on America’s wartime allies, Canada and the United Kingdom.

The British saw the McMahon Act as an inconvenience, a serious one, but one they were determined to overcome. Margaret Gowing claims the Act “destroyed general Anglo-American collaboration in nuclear energy.”\textsuperscript{160} Collaboration or not, the British were determined to acquire atomic weapons, and had been since the start of their own research program. The British recalled their scientific and technical expertise from Chalk River and embarked on their own


\textsuperscript{159} Zachary, \textit{Endless Frontier}, 299.

\textsuperscript{160} Gowing, \textit{Britain and Atomic Energy}, 301.
course towards atomic weapons and nuclear power. Howe learned of the decision from the newspaper on 5 November 1945.\textsuperscript{161}

Mackenzie and Howe retained administrative and ministerial control of Chalk River, and ensured that aside from producing weapons-grade fissionable materials Chalk River would be entirely devoted to creating medical isotopes and power. Howe’s statement in the House of Commons on 5 December 1945 that Canada had never made a bomb and never would established the precedent in both the interpretation of Canada’s role in the building of atomic weapons during the war, and as a prescription that Canada would remain non-atomic. Howe’s statement only applied to Chalk River and not to the Defence Research Board which was, technically, outside of his ministerial fiefdom. However the DRB never considered the possibility of developing atomic weapons, nor would it have been able to mobilize the required resources.\textsuperscript{162}

The Defence Research Board was thoroughly informed of the work done at Chalk River, especially whenever there were military or civil defence applications. There was close collaboration between the DRB and Mackenzie, who was asked to remain on the Board even after he was no longer the \textit{ex officio} representative of the National Research Council because of his move to the newly created Atomic Energy of Canada, Limited. Chalk River integrated two or three scientists from the DRB so that they could participate in atomic research as well as transfer the knowledge being acquired to the DRB for other projects and military planning. The DRB never developed atomic weapons, but because of Solandt’s mandate to inform the Minister and the Generals, he strove to stay informed in spite of tripartite tensions.\textsuperscript{163}

Liaison and exchange between the three countries, which had been tenuously successful after the Tizard Mission, stalled after the war. This extended beyond atomic weapons to guided missiles and also to chemical warfare. Until 1946 when the British withdrew their funding, Suffield was a site of tripartite testing of chemical weapons. Chemical warfare, or rather

\textsuperscript{161} Bothwell, \textit{Nucleus}, 69, 71.
\textsuperscript{162} NACP, RG 330 Entry 341 Box 534 File 111.7 “Defence Research Board of Canada (second part),” “Memorandum from William Webster to Secretary Forrestal with copies to General Gruenther and Dr Compton regarding Canadian Atomic Research, 3 February 1949;” Bothwell, \textit{Nucleus}, 73.
\textsuperscript{163} LAC, RG 24 S F1 Vol 11997 File DRBS 1-0-43-2 Vol 7, “Minutes of the 28th Meeting of the Defence Research Board held at Toronto, 12 February 1954;” 1; Longair, \textit{Early Defence Atomic Research in Canada}. 
defences against chemical weapons, was not given a particularly high priority in the United
States or the United Kingdom. As a result, Canada’s spending and contribution to chemical
defences was comparable to the UK and the US both during the war and immediately

3.6.3 Chemical Exchanges

One man who assumed a prominent role in the Defence Research Board, especially its
chemical defence program was John Arnell. Arnell earned a Ph.D. in 1942 from McGill
University and immediately joined the National Research Council where he was stationed with
the Canadian Army at the Chemical Warfare Laboratories in Ottawa.\footnote{DHH, Col 85/333, Finding Aid for Dr. J.C. Arnell Papers.}

In a speech entitled “United States – Canadian Relations in the Defence Field” that he
delivered to graduate students at the University of Ottawa on Wednesday on 10 May 1965,
Arnell discussed two episodes in the history of scientific liaison with the United States. The first
episode was the signing of the Ogdensburg Declaration in August 1940, which is usually cited by
historians of Canadian defence as the creation of the Permanent Joint Board on Defence and the
mutual assurance of Canada and the United States to protect each other in the event of an
invasion. Arnell added another dimension to the importance of the Ogdensburg Declaration.

The Ogdensburg Agreement provided the authority for American defence information to
be exchanged with Canada. It took very little imagination to extend this concept to allow
Canada as a joint participant with Great Britain in the war in Europe to make such
information available to Britain as necessary. The British in their turn provided Canada
with information as a fellow-belligerent, and Canada in turn was expected to exchange
this information with the United States for their mutual defence.\footnote{DHH, Col 85/333 (Box1) File 260 S III “Text of Speeches, Volume 2, 11 January 1962 – 8 May 1967,” “United States – Canadian Relations in the Defence Field: Prepared for delivery to a graduate student group at the University of Ottawa on Wednesday, 10 March 1965,” 19.}

Arnell suggested that Canada acted as a liaison link between the United States and the United
Kingdom before December 1941.

The second episode that Arnell spoke about was the difficult period immediately
following the war when the United States attempted to sever the lines of scientific and technical
collaboration with Canada and the United Kingdom. Arnell recounted that Truman’s Executive Orders extended beyond atomic weapons to chemical weapons.

Following the war and under the false impression that the many major military developments, including the atomic bomb, were uniquely American, President Truman ordered a cessation of all exchanges of technical information with Canada and Great Britain to protect the United States. As might be expected, this caused dismay in all quarters because it was as unrealistic from the American point of view as it was unfair from the British and Canadian. While most people formally obeyed the order, at least one to my knowledge refused to. The Commanding General of the Chemical Warfare Service of that day stated openly that they had obtained from the British and Canadians far more than they had given or were likely to be able to repay from future work in many areas and that he stood to lose far more from any stoppage in the flow of technical information than might be kept uniquely within the United States. As a result, when all other such liaison was stopped, he refused either to send home the Canadian Army officer residing in his major establishment in Maryland or to recall his own liaison officer in Ottawa. Thus, in the field of chemical warfare and related subjects, the flow of information continued, and within a very short time the effect of the loss of information to the United States in other military fields became so evident that the order was rescinded and normal relations were once again established.\textsuperscript{167}

The episode highlights the difficulty faced by defence researchers in Canada immediately after the war, except, according to Arnell, for those working on defences against chemical weapons. The availability to Canadians of American information depended on the diplomatic and reasonable attitudes of the commanding and information officers in the United States, and this had never been a certainty.

Just as there were difficulties during the war with information exchange, there were problems after the creation of the Defence Research Board. Omond Solandt wrote a letter to an American official on 18 November 1948 regarding the “Free Exchange of CW and BW Information.” In this short letter Solandt pointed out that the DRB learned from Chemical Corps’ Quarterly Progress Report and standardization lists that the United States was not sharing all of its information on respirator development. Solandt lamented the decline of free exchange

\textsuperscript{167} DHH, Col 85/333 (Box1) File 260 S III “Text of Speeches, Volume 2, 11 January 1962 – 8 May 1967,” “United States – Canadian Relations in the Defence Field: Prepared for delivery to a graduate student group at the University of Ottawa on Wednesday, 10 March 1965,” 21.
and reminded the Americans that the DRB was also working on respirators and that it could not afford to waste valuable resources doing duplicate work.168

There are countless examples of such complaints from both the Canadians and British in the first five or ten years following the war while the three nations established a set of fluid working arrangements. Given the size of the establishments in question and the variety of interests and stakeholders, this information exchange was never ideal, nor could it have been expected to be.

3.6.4 Service Rivalries and Defence Research and Development in the Tripartite Alliance

One of the problems for Canadians trying to exchange information was the complexity of the organizations in both the United States and United Kingdom. In the Defence Research Board liaison, like administration, was centralized. The Defence Research Board was responsible for the bulk of military research in Canada; the services retained some research capacities, especially where it could be justified as development. Development was part of the DRB’s budgetary allotment, but effective control of development remained with the Services. Solandt described the Board’s involvement in development in 1952 as “general coordination and financial supervision.”169

Because of this role in development the entity in the United States that bore the closest resemblance to the Defence Research Board was the Research and Development Board (RDB). Originally chaired by Vannevar Bush, the RDB was responsible for mediating inter-service development. It existed from 1947 to 1953; following Bush as chair were Karl Compton, William Webster and Walter G. Whitman. Unlike the DRB the RDB assumed no responsibility for research or managing research establishments. The RDB produced no new knowledge of its own. Once the DRB discovered that the RDB did not have the authority or ability to exchange

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168 NACP, RG 330 Entry 341 Box 534 File 111.7 “Defence Research Board of Canada {second part},” “Letter from Solandt to Dr Hafstad regarding Free Exchange of CW and BW Information, 18 November 1948.”
the kinds of information that the DRB wanted the DRB was forced to explore different methods of direct liaison with the American services facilities.\textsuperscript{170}

The research facilities in the United States were firmly ensconced within each of the Services. During the war the entire American research and development effort was centralized around Vannevar Bush who reported directly to the President. After the war the emergency powers granted to Bush vanished and research and development returned to its former style of management. Each Service was responsible for its own establishments and interests, and central management, if it could be called that, rested with the Joint Chiefs in the Pentagon who reported to the Secretary of Defense. The Defence Research Liaison Member in Washington had a tough job. There was no liaison position in the Pentagon. If the Liaison Member needed information he had to make arrangements with the various facilities scattered across the country.

The situation was similar in the United Kingdom. The only difference was the limited geographic space available to disperse research facilities throughout the British Isles. Each Service in the UK had its own Minister and Ministry in addition to the Ministries of Supply and Production who had vested interests in Service research and development.

In an attempt to centralize and coordinate defence research a Defence Research Policy Committee (DRPC) was created in 1946. A joint committee had existed in the latter part of the war, but with the removal of Churchill and Lord Cherwell (Frederick Lindemann) from office in 1945 the direction of both defence research and government scientific research was up in the air. The military sought the advice and leadership of Henry Tizard; Tizard temporarily declined to give leadership, but he did offer advice in the form of a paper on “The Central Direction of the Scientific Effort.”\textsuperscript{171} Tizard suggested, and the military agreed, that a central committee made up mostly of Deputy Chiefs of Staff should be organized with a Scientific Adviser as chairman who would consider both military and civilian scientific needs and present his findings to both the Chiefs of Staff and the government.\textsuperscript{172}

\textsuperscript{171} Clark, \textit{Tizard}, 375.
\textsuperscript{172} Clark, \textit{Tizard}, 376.
Before the government could agree to Tizard’s proposal Attlee wanted further consultation. In the spring following this paper the British hosted a Commonwealth Conference on Defence Science in London. Solandt attended as a representative for Canada. Tizard gave the opening address. Tizard argued for continued scientific research to prevent wars and continued collaboration with the rest of the commonwealth. Following this conference the British began to reorganize along the lines that Tizard had suggested. They moved to create a Defence Research Policy Committee and also to replace the Scientific Advisory Committee of the Cabinet with a Scientific Advisory Council. Only one man was considered for the chairmanships of the Committee and the Council, Tizard. Once an agreeable salary was set and he was able to navigate his way out of Oxford Tizard assumed his dual post as the top scientist in the country at the start of 1947.\textsuperscript{173}

His assumption of the dual post coincided with the creation of a new Ministry of Defence in the United Kingdom that was responsible for the creation of policy and organizing the three separate Service Ministries. It was to this Minister that Tizard reported as head of the Defence Research Policy Committee. While similarly charged with coordinating the direction of defence research in their respective countries, there were two key differences between the DRPC and the Board of the Defence Research Board. First, the Board had members from universities and industries. Second, the Board controlled the DRB, which was responsible for all defence research in Canada. The Board ran its own laboratories whereas the DRPC did not run any establishments.\textsuperscript{174}

Of the three allies, the centralized Defence Research Board was unique. Neither the Research and Development Board in the United States nor the Defence Research Policy Committee in the United Kingdom held the purse strings of research and development. The DRB was a product of the precedent set by the success of the National Research Council and also a fear of spreading resources too thinly by following the British (and American) model of creating service-based establishments rather than inter-service project-based establishments. The British and Americans had more resources and were willing to attack several pressing problems.

\textsuperscript{173} Clark, \textit{Tizard}, 378-385.
\textsuperscript{174} The National Archives of the United Kingdom (TNA), DEFE 9/36, “Memo\-randum from Secretaries of the DRPC to Minister of Defence regarding Annual Report of the Canadian Defence Research Board, Note by the Secretaries, 3 October 1950,” 1.
at once. Because of the relative size and organization of defence in Canada, the DRB was created to continue the centralization of defence research that had begun during the war under Mackenzie’s NRC.

3.6.5 Three of a Kind: Solandt, Bush and Tizard

A result of the 1946 Commonwealth Conference on Defence Science was the creation of a Commonwealth Advisory Committee on Defence Science, which was housed in London. The Committee was scheduled to meet in 1947 in Canada, but the meeting was held in the United Kingdom with a promise that the 1949 meeting would be held in Canada. The meetings continued to occur every other year, and there were several conferences and committees that reported to the Advisory Committee. These sub-committees included: clothing and general stores, service psychologists and aeronautical research. Members of the military research establishments attended the first meeting of the Commonwealth Advisory Committee on Aeronautical Research, but the Defence Research Board opted to have the National Research Council represent Canada at future meetings since the NRC was invested more heavily in aeronautical research than the DRB, and since the meeting appeared to have more civilian than military applications. The biennial Commonwealth Advisory Committee conference was an important venue for liaison that supplemented the normal liaison activities of the Defence Research Member in London, who organized the Canadian participation.\textsuperscript{175}

To make up for not hosting the Commonwealth Advisory Committee’s meeting in 1947 the Defence Research Board invited Tizard and three scientists of his choosing to attend a special meeting held the same day as the fourth meeting of the Board. For the 16 September 1947 meeting Tizard brought along three of his colleagues from the Defence Research Policy Committee: Owen Wansbrough-Jones (Scientific Adviser to the Army Council), John Carroll (Scientific Adviser to the Admiralty) and Ben Lockspeiser (Chief Scientist of the Ministry of Supply). For the DRB the visit had an honest, if slightly naive, motivation. The DRB wanted to show Tizard their capabilities, they wanted to ensure that the British continued to collaborate

\textsuperscript{175} LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 1, “Minutes of the Third Meeting of the Defence Research Board held at 10:00am, Saturday, 14 June 1947,” 2; Goodspeed, A History of the Defence Research Board of Canada, 85.
with them, and they wanted to glean what they could from Tizard about defence research and organizing for defence research.  

The British listed two similar honest motives for accepting the invitation to visit Canada; they also listed two ulterior motives that were driven by the harsh reality they faced financially and internationally. First and foremost they were interested in fact-finding in terms of the DRB’s resources, personnel, finances, etc. Second the British were interested in exploring the potentials of exchange. Because both the DRB and the Commonwealth Advisory Committee on Defence Science, not to mention the Defence Research Policy Committee, were all relatively new, the British were cautiously optimistic about entering binding exchange agreements. Primarily they were interested in setting up the foundations for later exchange agreements by discussing what the agreements should look like and what could and should be exchanged, including information, costs and people. The desire to share costs gives the first hint of a more pressing British need. The British were worried that the costs of the war were going to limit their abilities to do scientific research after the war.

In order to keep abreast of the most recent developments from the United States, Tizard and the rest of the scientific advisers wanted to be certain that they would have direct access, or at the very least third party access via Canada. Any independent research the DRB provided on top of American information was likely to be a pleasant surprise for the British.

The other fear the British had was their direct vulnerability to air raids. During the Second World War they had moved their atomic project to Canada to protect it (and to keep it close to the United States); they also moved a significant amount of production to the Commonwealth as well as training facilities. Tizard was to explore the possibility of setting up provisional plans with the Defence Research Board for the location of research facilities in the


177 TNA, DEFE 9/36, “Note from Scientific Advisers (circulated by AH Thorold, I Montgomery and RS Courtice) to Tizard, Chiefs, Brundrett, Dr OH Wansbrough Jones regarding Brief on Canadian Visit, 31 July 1947,” 1-2.

178 TNA, DEFE 9/36, “Note from Scientific Advisers (circulated by AH Thorold, I Montgomery and RS Courtice) to Tizard, Chiefs, Brundrett, Dr OH Wansbrough Jones regarding Brief on Canadian Visit, 31 July 1947,” 2.
Commonwealth, which could be implemented if war broke out. This also extended to the possibility of moving some research facilities to the Commonwealth in peacetime as well.\(^\text{179}\)

Tizard and the advisers were interested in six topics of exchange, and they expected the DRB to have a similar set of interests. These included: atomic and biological warfare, the Arctic, radio and radar, and operational research. In the case of operational research the British were aware that the entire Canadian operational research apparatus had been dismantled after the war. With the exception of Solandt and Morton, no one in the DRB had expertise, and of the two only Morton was actively engaged in research activities. The British knew that the Americans had retained their capacity for operational research and were actively engaged in new work. In their opinion, the best option would be for both the DRB and the Defence Research Policy Committee to consult the Americans.\(^\text{180}\)

As an embodiment of this belief Tizard, Wansbrough-Jones, Carroll and Lockspeiser and Solandt visited Vannevar Bush in Washington as part of Tizard’s trip to North America. Between attending the Board meeting and visiting Bush, Tizard and company were treated to a tour of Canada by Board members W. Gordon Mills (the Deputy Minister of National Defence) and Gordon Shrum. This tour gave the British representatives the chance to see the research facilities of the DRB for themselves. After their meeting with Bush, Solandt reported at the next Board meeting in December that Bush expected security to be more relaxed in the future. The leaders of defence research in all three countries came away from the meeting expecting scientific information to flow more freely than it had been immediately following the war. Unfortunately for Tizard and Solandt, Bush was not in a position to enforce a foreign exchange policy.\(^\text{181}\)

Seven months after Tizard visited Canada, Vannevar Bush came. Bush attended a special afternoon session of the Board in conjunction with its sixth meeting on Friday, 19 March 1948.

\(^{179}\) TNA, DEFE 9/36, “Note from Scientific Advisers (circulated by AH Thorold, I Montgomery and RS Courtice) to Tizard, Chiefs, Brundrett, Dr OH Wansbrough Jones regarding Brief on Canadian Visit, 31 July 1947,” 2.

\(^{180}\) TNA, DEFE 9/36, “Note from Scientific Advisers (circulated by AH Thorold, I Montgomery and RS Courtice) to Tizard, Chiefs, Brundrett, Dr OH Wansbrough Jones regarding Brief on Canadian Visit, 31 July 1947,” 3.

That evening he gave a lecture attended by members of the Board, Lester Pearson from External Affairs and many other government officials. The meeting was mutually beneficial. Bush learned a little about the Defence Research Board; unfortunately his influence over defence and science policy had significantly diminished and he was a mere six months away from leaving the government out of frustration and illness.\textsuperscript{182}

The DRB, within its first year of existence, heard directly from the two most public and influential managers of science coming out of the Second World War. The good feelings wrought by visits from Bush and Tizard were only useful if real scientific exchange resulted. It did not. Neither official visit improved the exchange or lessened the American restrictions. Aside from the liaison officers the only other opportunities for exchange were the aforementioned Commonwealth Advisory Committee and a series of tripartite conferences.

The annual tripartite conferences started during the war to deal with special weapons as a result of the tripartite organization of Suffield. By the end of the war there was an additional conference dealing with armaments and explosives. These continued after the war, and when the DRB was created in 1947 it assumed responsibility from the Services for sending representatives. Additional conferences and topics were added starting in 1950. This was the result of two things. First, the Korean War had erupted, and the utility of tripartite collaboration was rediscovered. Second, by 1950 the DRB had built up an establishment and research capacity to discuss a wider variety of topics.\textsuperscript{183}

\section*{3.7 The Program}
\subsection*{3.7.1 Research at the DRB}

Each establishment had unique capabilities and projects between 1947 and 1950. This is one point on which Goodspeed’s account is an excellent resource. He covers each of the different fields of research in detail, including the key people and significant projects. A very brief summary follows, which has been supplemented with additional information or context that was not available to Goodspeed.


\textsuperscript{183} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 84.
Canadian Armaments Research and Development Establishment (CARDE) in Québec worked with explosives and armaments. Three of the projects it undertook are worth mentioning.

The pot sabot projectile was designed to obtain better penetrating power than normal shells, because of its delivery of a higher amount of energy in a smaller package, which is obtained by shedding a carrier mid-flight. It was both safer and more accurate than other anti-armour weapons. It was the first Canadian-designed weapon endorsed under the Tripartite Standardization Agreement. However, in 1948, the projectile was made of tungsten carbide, an incredibly strong material that was in short supply.\(^{184}\)

A second project that scientists and engineers at CARDE worked on was the Heller. Like the sabot shot, the Heller is an anti-tank weapon, but designed for infantry rather than a tank or artillery. Because the Heller burns its propellant entirely within the hollow tube it is more accurate than a Bazooka; for the same reasons it is also safer because there is no back-blast.\(^{185}\)

The Canadian Army accepted the weapon, but tripartite acceptance was much harder to come by. In their analysis of the trials of the Heller for the Research and Development Board in the summer of 1953 the American Committee on Ordnance did not look at the Heller favourably in comparison to the Bazooka and the Recoilless Rifle. The Committee’s Panel Director, Melvin Bell, acknowledged the admirable features of the Heller, but discussed at length the exorbitant costs of the improved accuracy and materials. Bell suggested that neither the United States Army nor the Marines were likely to accept the Heller. The preference in the US was for weapons developed in the US, despite trials’ performance and in spite of promises not to duplicate efforts within the tripartite.\(^{186}\)

Tripartite standardization remained an issue for the Heller into 1961. The UK was leaning towards a Swedish model (Karl Gustav 84), because it was outperforming the Heller in

\(^{186}\) NACP, RG330 Entry 341 Box 424 File 215, “Memorandum from Melvin Bell to Executive Director, Committee on Ordnance regarding CJS letter to Mr Whitman of 16 June 1953, 3 July 1953,” and “Memorandum from Melvin Bell (Panel Director, Committee on Ordnance) to Chairman, RDB regarding Project Heller, 19 June 1953.”
trials. The Minister of National Defence, Douglas Harkness, and Chairman of the Defence
Research Board, Hartley Zimmerman, did their best to sell the Heller to the British Minister of
Defence, Harold Watkinson, even promising that minor adjustments could be made that would
certainly allow the Heller to outperform the Swedish weapon. The British, sceptical of Canada’s
balance of trade problems with both the United Kingdom and the United States, remained
unmoved. 187

A third and final example of a project undertaken by CARDE, in conjunction with the
Consolidated Mining and Smelting Company (long known by its acronym COMINCO) of Trail,
British Columbia, was improving the production of picrite. Picrite, also known as
nitroguanidine, began to be used extensively in propellants for navies during the Second World
War. It is ideal for heavy fire situations because picrite allows gunpowder to burn cooler, which
reduces both wear and fouling inside gun barrels; it does not flash, nor does it increase the
amount of smoke associated with firing. 188

Throughout the Second World War a government-owned facility, Welland Chemical
Works, Ltd., in Welland, Ontario was the only producer of picrite in the world. Because of the
effectiveness of picrite-based munitions, the Board expected demand for picrite to rise in the
next war. During the Second World War the Welland facility was using 6500kW to produce a
ton of picrite and it could produce 700 tons per week. Estimates for the combined use of the
tripartite allies in the next war started at a low of 9000 tons of picrite each month and increased
significantly from there; Ontario was not producing enough electricity at the time to allow that
much consumption by a single plant, which was purchased after the war by North American
Cyanamid, Ltd. The only feasible solution was to search for a less power intensive production

“Discussions with Mr Harkness, Canadian Minister of National Defence, 31 October 1960. Note for the United
Kingdom Minister of Defence,” 1-5, “Brief for Minister for his Visit on Canadian Equipment Proposed for Adoption
by the UK, undated,” 1, “Record of Meeting between the Rt Hon Harold Watkinson, MP, United Kingdom Minister
of Defence, and the Hon Douglas Harkness, MP, Canadian Minister of National Defence, in Ottawa on Saturday,
18th March, 1961,” 5-6.
188 LAC, RG 24 S F1 Vol 11995 File DRBS 1-0-43-1 Vol 4, “Memorandum from AW Duguid (Research
Coordination (Armament)) to VDG and Sec/DRB regarding Picrite, 12 October 1950.”
method and to apply the limited amounts of picrite-based propellants where they were most useful.189

The Canadian Army requested that the Defence Research Board begin looking for a more efficient production process in August 1948. By the time of the special meeting of the Board to discuss the research program of Canadian Armaments Research and Development Establishment on 26 September, picrite research results were already on the agenda. What CARDE discovered in their preliminary research was that a process involving natural gas, which was plentiful in Canada’s West, would be the most efficient.190

By April of 1949 the Defence Research Board had brought Consolidated Mining (COMINCO) into the research collaboration with a $15,000 contract, the first industrial contract awarded by the Board. COMINCO’s early research from December 1949 suggested that their process would be about 70% effective, which they were able to boost to 90% in April 1950 after an additional input of $3,000 from the DRB. Funding for a pilot plant was setup immediately ($50,000), and the DRB and COMINCO negotiated funding for full scale production of $300,000 to cover the period from 1950 to 1952, plus ongoing funding for research. The advantage for COMINCO, and to a lesser extent the DRB, was that picrite had applications in plastics (melamine), as well as ammunitions.191


From 1947 to 1950 Suffield Experimental Station (SES) continued working on chemical weapons. At the time that Goodspeed wrote his history of the Defence Research Board most of that work was still classified, but some of the materials have been declassified in the meantime, largely thanks to journalist and Member of Parliament John Bryden. Throughout the war Canada stockpiled mustard gas to test (both the gas and the defences against it) and to use in retaliation of any chemical attack by Germany or Japan. The Defence Research Board’s interest after the war was primarily in developing defences against the nerve agents developed by the Germans – GA (Tabun), GB (Sarin) and GD (Soman). Post-war testing at Suffield revealed that the G series were more toxic and acted faster, even when delivered in lower concentrations, than phosgene and mustard gas. 192

The preliminary tests of the G series conducted at Suffield required discussion by the Board. It was obvious to Otto Maass that the existing standard against leaks had to be improved by a factor of about 100, ideally obtaining a completely leak-proof mask; he detailed several other flaws with the current mask such as comfort and usability. Foulkes wanted the DRB to invest its effort into a mask that could be worn full time by fighting men, rather than a mask that was completely leak-proof; he was also convinced that the DRB’s research into an Arctic-use mask was going to be fruitless. Grant wanted perfect protection, which reflected the different operational environments in which the Army and Navy expected to use gas masks; the matter was put off until Maass and the Chemical Warfare Research Panel could investigate the matter and report to the Board. Maass attended a tripartite conference in the United Kingdom and missed the Twelfth Meeting of the Board, so the report waited until the Thirteenth Meeting held at the University of Toronto, 1 December 1949. The Board agreed to focus on Arctic respirators based on Maass’ memorandum and his claim that it is difficult to compare by quantification comfort, durability and effectiveness. 193

The continuing responsibility for respirator assembly rested with the team in Ottawa at the Respirator Assembly Plant which was established in 1936. Originally it was a collaborative project run by the Army with scientific input from the National Research Council, but building respirators to British specifications. Throughout the Second World War the plant became more independent of British specifications and was assumed by the Chemical Warfare Laboratories, which provided the research input to improve design. In 1947 authority for the Respirator Assembly Plant, as part of the CWL, was transferred to the Defence Research Board. Starting in 1950 the DRB attempted to divest itself of the plant, feeling that production was not its responsibility, and that the plant would be better as part of Canadian Arsenals Limited or a private enterprise. Neither Canadian Arsenals Limited nor any private industries saw a profit in the limited production and reconditioning of respirators for Canada, especially in the face of changing biological and chemical threats that would require constant scientific research. Respirator assembly and research remained a Defence Research Board responsibility in spite of misgivings.

Between the Chemical Warfare Laboratories in Ottawa, which was rechristened as the Defence Research Chemical Laboratories (DRCL) in late 1947 and the Suffield Experimental Station defence researchers explored the chemicals used in flame throwers and incendiary bombs as well as options in protective-clothing in addition to gas masks. Three of these projects were representative of the DRB’s interests and the direction of defence research at the time. First, based on observations that wolverine fur exhibits ideal hydrophobic properties, scientists worked with industry to develop nylon pile fabric to replace traditional coats in the Arctic. A second project was developing a thickening agent for flame thrower fuel; Harry Sheffer led a team that developed octal, which was a stable and reliable silica. To deliver this new and improved fuel from tanks the team at Suffield worked on a flamethrower, the Iroquois.

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Closely related to the work in defences against chemical threats was the research in defences against biological weapons. Guilford Reed in Kingston continued to work with biological and bacteriological agents from 1945 to 1947. The Grosse Île establishment (War Disease Control Station) was suspended in 1946, but authority to use the site was given to the Defence Research Board in 1947. After the war there was a shortage of specialists in the specific areas needed by the Kingston Laboratory so the professional staff working under Reed, who was still teaching at Queen’s University, was minimal. Reed continued to work on fundamental studies of the types of diseases and viruses that were likely to affect humans and ways to manufacture vaccines and toxoids.\textsuperscript{196}

In 1950 a Bacteriological Warfare Review Committee was formed under the chairmanship of Charles Best; after a short study this Committee decided that Canada was experiencing a drastic shortage of medical bacteriologists that extended beyond the needs of defence to all civilian requirements as well. The Defence Research Board sought to offer financial aid, post-doctoral support and employment to anyone who could be persuaded to pursue a career as a bacteriologist. The plan yielded a few candidates in its first year, but does not appear to have had a long-term presence in the DRB’s funding or priorities. The Defence Research Board preferred to work in fields where they could draw on uniquely Canadian expertise or on problems with the potential for unique Canadian application.\textsuperscript{197}

The Radio Propagation Laboratory (RPL) arose from the wartime Canadian Signals Research and Development Establishment. RPL was based in Ottawa but had field stations across northern Canada; scientists with RPL investigated the behaviour of radio waves in the Canadian Arctic, in particular the fluctuating electromagnetic properties of the ionosphere. The research began in the Second World War and its continuation was encouraged by Solandt and by United States’ Department of State, Armed Forces and Bureau of Standards. It was a unique scientific situation that only Canada, or someone operating on Canadian soil, could investigate

\textsuperscript{196} Goodspeed, \textit{A History of the Defence Research Board of Canada}, 153, 156.
for the Western allies. Sensitivity to protecting Canadian sovereignty in the Arctic that arose in the wake of the Northwest Staging Route demanded that Canadians, rather than Americans, should be the ones investigating the properties of the ionosphere in Northern Canada.198

The Naval Research Establishment (NRE) in Halifax worked on the most pressing problems for the Royal Canadian Navy. The transfer from the Navy to the Defence Research Board started in the calendar year 1948 and was fluid in terms of research initiatives and personnel. From Victory in Europe Day (8 May 1945) until October 1947 the staff at NRE was aided in their research of anti-submarine warfare by the use of two surrendered German submarines, U-190 and U-889, including acoustic towed array and acoustic torpedoes.199

The interest in the propagation of sound underwater continued after October 1947 with trials on sonar equipment (Sound Navigation and Ranging, formerly known as ASDIC), including a new invention – variable depth sonar. One thing that scientists at the Naval Research Establishment discovered in these early years was that sound propagates underwater differently depending on the frequency of the sound, the depth of the water, the temperature of the water (which also varies with depth), the currents and flow of the water and of course the depth and motion of both the target and the tracker. This was the type of basic scientific information that would be invaluable to the military as well as the advancement of oceanography.200

Many of these projects undertaken by the DRB in the first three years were geared towards improving basic and applied scientific knowledge. The Defence Research Board also undertook several projects on the development end of the research and development spectrum. The goal of these projects was to build a valuable weapon, while also learning about all the important sciences and technologies that were necessary for the production. The NRE worked on two projects that were on the development end of the spectrum.

The first project was retrofitting existing vessels. That metals corrode (rust) is a long established fact; that naval vessels exposed to saltwater and underwater organisms are particularly prone to oxidization has plagued the Royal Navy since they introduced protective

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199 Longard, Knots, Volts and Decibels, 35-39.
200 Longard, Knots, Volts and Decibels, 57-60; Gaede and Merklinger, Seas, Ships and Sensors, 12.
copper plates. Starting in 1946 the NRE was in a fortuitous position to make dry dock observations of corrosion over time and to devise a method to prevent hull oxidization. By turning the ship hulls into electric circuits with a cathode (the hull) and specially attached anodes (generally made of magnesium), the corrosion resulting from the saltwater could be concentrated on the magnesium anodes which were cheaper and easier to replace. After initial work by the Defence Research Board, during which the basic and applied scientific knowledge was established, the Royal Canadian Navy began retrofitting its existing vessels and incorporating the technique into new vessels. The knowledge was also declassified and shared with other countries and industries.  

The second project was the development of a hydrofoil. A hydrofoil uses lift generated by forward motion to raise the hull of a ship out of the water, which reduces drag. The faster the ship goes, the higher it is raised from the water. The result is boats that can travel at a higher speed more economically than similar vessels that lack hydrofoils. The most common hydrofoil design is an arrangement of two or more submerged pontoons attached to the hull. The Canadian versions used three hydrofoils, and those foils looked like ladders attached to the hull.

Canadian interest in hydrofoils started prior to the First World War; inventor and sometimes Canadian Alexander Graham Bell, along with F.W. Baldwin, experimented with hydrofoil designs at Bell’s summer home overlooking Bras d’Or Lake in Nova Scotia. Canadian military interest in hydrofoils started in the Second World War when then Major General George Pearkes discussed the requirement of a smoke-laying vessel to cover an amphibious assault with E.Ll. Davies. The Defence Research Board relied on the efforts of several men who had been involved in the production of four hydrofoil craft in the Second World War, including an American designer, Philip Rhodes; Rhodes designed a new hydrofoil craft for the DRB in 1947, and it was built by J.E. McCrea, the Robert Mitchell Company Limited and Ingersoll Machine and Tool Company.  

\[\text{References}\]


\[\text{Goodspeed, A History of the Defence Research Board of Canada, 220-221; Longard, Knots, Volts and Decibels, 85.}\]
The Naval Research Establishment did not get involved in the project until the craft, known as the Massawippi, R-100 or KC-B, was tested on Lake Massawippi in the Eastern Townships of Québec; the timeline of NRE involvement was unusual for the Defence Research Board that normally pushed projects to development and then scaled back its participation. Over the next five years NRE scientists ran trials with the craft both on Lake Massawippi and later in the Atlantic Ocean from Halifax; a replacement was built by the British company, Saunders-Roe Limited, in 1957 according to Naval Research Establishment specifications. The hydrofoil project is one example of close collaboration between industry and the DRB.²⁰³

In addition to the new projects at existing establishments the Defence Research Board also created four new establishments between 1947 and 1950. The first new establishment was started in 1947 in Fort Churchill, Manitoba. The Defence Research Northern Laboratory (DRNL) was created to meet the DRB’s contribution to tripartite defence research. The first winter only one employee was in Churchill, James Croal who was a veteran of the Royal Canadian Navy; Croal looked at ice core samples and made other preparations for the creation of a more permanent facility the following year. Once formally established in 1948, and with a laboratory building contributed by the Canadian Army who ran Fort Churchill, the staff at DRNL investigated cold survival, equipment and clothing for northern climates, and mosquitoes. The projects were largely focussed on human physiology – the response of soldiers under the duress of either the cold in the winter (scientists at DRNL invented the wind chill factor) or the mosquitoes in the summer. A report covering the history of DRNL compiled by Superintendent Archie Pennie illustrated the one thing that nearly everyone stationed at Churchill learned in their free time – alcohol is the key to surviving the remoteness and boredom. Although symbolically important to the DRB’s program, the DRNL was never a major part of that research program in terms of funding or personnel.²⁰⁴

Within three years the research program at Defence Research Northern Laboratory was either exhausted or superseded. The British, and presumably the Americans, began working with

climate controlled chambers, because advances in refrigeration and air conditioning had made it possible to replicate the extreme cold of a Churchill winter in a laboratory at a lower cost. A climate chamber was also more predictable and could be run year round. These advances in science and technology chipped away at the Defence Research Board’s ability to make a unique contribution to tripartite defence research.\(^{205}\)

The second new establishment was created to give the Defence Research Board geographic balance. The Pacific Naval Laboratory (PNL) was devoted to generic naval questions not being handled at NRE as well as research problems specific to the Pacific Ocean. Frederick Sanders was recruited to be its first Superintendent.\(^{206}\)

The first project that Sanders and his small team undertook at PNL was looking at how sonar equipment behaved in the Pacific Ocean. The new laboratory was located on the naval base in Victoria on Vancouver Island in 1948. The advantages of the Victoria location over Halifax were both climate and geography. Victoria is generally more temperate than Halifax, and it has the added benefit of being sheltered to the north by islands, sounds and straits, while still having access to ice floes and the Arctic Ocean.\(^{207}\)

The third new establishment was created at the beginning of 1949. For its first eight months it was known as the Operational Research Division, before being renamed as the Operational Research Group (ORG). Whitman Morton, who was already working for the Defence Research Board on psychology problems, was placed in charge of the ORG when it was created. Psychological research went with Morton to the ORG from the Biological Research Division.\(^{208}\)


\(^{207}\) Chapman, Alpha and Omega, 3-4.

Operational researchers during the war had frequently been integrated with military units. The laboratories for most operational researchers were battlefields, so it was logical to have them in uniforms. By the end of the war the military leadership saw the value of operational research in wartime. After the war operational research was dismantled in Canada, since its utility in peace was not apparent nor was the direction of Canadian defence entirely evident; the scientists who had participated returned to their academic careers.

When the Operational Research Group was created, its members were integrated with the military, and responsible to military commanders, but paid by the Defence Research Board. A small contingent of operational researchers responsible for inter-service problems and for operational research questions that arose within the DRB were housed at headquarters in Ottawa.²⁰⁹

Canada faced two basic long-distance threats in any future hostilities, especially any war involving Russia: submarines and bombers. The Operational Research Group, as part of the Department of National Defence, had to work through the ramifications of the two evolving threats and the new defences intended against those threats. In 1949 submarines were the more immediate threat since the Russians did not have intercontinental heavy bombers. John Abrams was loaned to the British Admiralty to work on problems associated with anti-submarine warfare. When he returned to Canada and the Defence Research Board he continued to work on both anti-submarine warfare and air defence. Abrams was one of only a handful of operational researchers that the Defence Research Board was able to convince to leave university and return to defence research permanently. It took several years to build up strength in ORG.²¹⁰

The fourth and final new establishment was the Defence Research Medical Laboratories (DRML) in Toronto. The most active medical research in the Second World War in Canada was conducted at the Royal Canadian Air Force’s Institute of Aviation Medicine (IAM). This was where Wilbur Franks, a former student of Frederick Banting’s, invented and tested the anti-g

flying suit using a human centrifuge. After the war the RCAF continued a research and
development program at IAM.\textsuperscript{211}

3.7.2 Extramural Research

It was not until 1948 that the Board began to consider its policy for medical research.
First Solandt had an informal meeting with Charles Best and James Bertram Collip on 6 March
1948. At the time Collip was the Director of the National Research Council’s Medical Research
Division; Collip and Best had previously collaborated on the discovery of insulin with Banting
and John J.R. Macleod in 1921. Later in 1948 Best and Collip, on behalf of the Board and NRC
respectively, attended the first meeting of the DRB’s Medical Research Advisory Committee; the
Committee was chaired by Toronto’s Ray Farquharson. The Medical Research Advisory
Committee included medical research representatives from the three Services, National Health
and Welfare (H.A. Ansley), the Department of Veterans’ Affairs (D.H. Starkey), the Directing
Consultant from IAM (Wilbur Franks), five members from universities (George Lyman Duff of
McGill, Joseph Doupe of the University of Manitoba, Guilford Reed of Queen’s University,
Louis-Paul Dugal of Université Laval and A. Lawrence Chute of the University of Toronto and
the Hospital for Sick Children), plus a secretary from the Defence Research Board’s fledgling
medical research staff (Morley Whillans). This distinguished team laid out the direction of the
DRB’s policy for defence medical research.\textsuperscript{212}

The first initiative was for the Defence Research Board to finally take over responsibility
for medical research from the Services, primarily the Institute of Aviation Medicine. Franks,
with the backing of the Chief of Air Staff Curtis, ran as much interference as possible to protect
the unique interests and needs of the Royal Canadian Air Force. It took two years for Solandt
with the assistance of Farquharson to work out what elements of IAM would be absorbed by the
DRB (primarily triservices research) and what elements would stay with Franks under RCAF

\textsuperscript{211} Defence Research and Development Canada – Toronto (DRDC-T), Franks Drawer 9 File “Curriculum Vitae 1;”
Expertise,” 128-133 both in Lindsey, \textit{No Day Long Enough}; Eggleston, \textit{Scientists at War}, 219-221; Goodspeed, \textit{A

\textsuperscript{212} LAC, RG 24 S F1 Vol 11995 File DRBS 1-0-43-1 Vol 2, “Agenda No 5.6 (Medical Research Advisory
Committee), Defence Research Board from MacNeill, 22 September 1948; Goodspeed, \textit{A History of the Defence
Research Board of Canada}, 227-228; Terence Moore, \textit{Joe Doupe, Bedside Physiologist} (Toronto: Hannah Institute,
1989); Alison I-Syn Li, \textit{J.B. Collip and the Development of Medical Research in Canada} (Montréal: McGill-
Queen’s UP, 2003).
control (primarily development and aviation medicine). Morley Whillans became the first Superintendent of the Defence Research Medical Laboratories and moved from Ottawa to Toronto to initiate research in 1950.213

The second policy initiative was to distinguish what work should be done by the Defence Research Board and what could be left to researchers at hospitals and universities. The DRB was primarily interested in problems affecting Service personnel. Problems of diagnosis and treatment, because of their broader applicability, were delegated to researchers at hospitals and universities. The unique occupational problems of the Services included training, response to environment and hazards, efficiency, protective clothing, food and equipment. Some of these problems overlapped with the research agendas of the Defence Research Northern Laboratory and the biological and chemical warfare initiatives.214

Where medical research undertaken at universities and hospitals had an overlapping interest for the Services the Defence Research Board agreed to supply funding through grants. One area that received heavy interest initially was studies of the medical aspects of cold on physiology. G. Malcolm Brown of Queen’s University received a grant for studies of Eskimos; Louis-Paul Dugal won a grant for “physiological factors involved in resistance and adaptation to cold environments.” Another grant appears, at first, to follow in this line of research interest, Wilfred Bigelow was awarded a grant for the study of “factors affecting survival and resuscitation from severe cold.” It was the first in a series of grants Bigelow received for research into hypothermia and resuscitation. Ultimately that work had little application to Arctic warfare, but it did result in the development of open heart surgery and the pacemaker.215

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Bigelow’s work was one of many examples that the Defence Research Board could point to as proof that their early funding priorities were having a global impact on the health of people. Not everything the DRB funded was as auspicious or beneficent.

Amidst the Arctic medical research was a grant to D. Ewen Cameron of McGill for “behavioural problems in the adaptation of white men to the Arctic.” Cameron also had an ongoing grant from the DRB for work looking at community responses to disasters, which had the endorsement of Morton and the Psychological Research Panel, as well as Solandt and the Board (contrary to Solandt’s later reckoning), but was resisted by the Minister of National Defence. Cameron was assisted in the project by James Tyhurst, and the line of research was similar to that being undertaken by their McGill colleague Donald Hebb who served on the Board’s Psychological Research Panel. The three men were interested in depatterning, also known as mind control or more popularly as brainwashing. In 1951 Cameron was removed from his project on community disasters and Tyhurst was given a limited amount of funding to complete it before being offered employment by the DRB. Forty years later both Cameron and Tyhurst were the subjects of court proceedings; Cameron’s former patients at the Allan Memorial Institute sued the Canadian government and the Central Intelligence Agency for what amounted to torture without informed consent (Cameron died in 1967, long before the proceedings), and Tyhurst was convicted of assault and sexual assault for incidents with patients later in his career.216

The Defence Research Board awarded grants to supplement all areas of its research program, not just medical research. The DRB was not the first government division to ask universities or hospitals to conduct research towards the government’s program. Nor was the DRB the first division to award grants for research conducted outside of the government. The National Research Council had been awarding grants and scholarships since its inception in the First World War. The NRC was merely copying the policies and process of the Department of Scientific and Industrial Research (DSIR) in the United Kingdom. In his overview of the DSIR Sir Harry Melville reviews “two early objectives of DSIR – to assure an adequate supply of properly trained research workers, and to support and extend research in pure science.” These same justifications applied to the NRC and the DRB.

Originally conceived at the Fifth Meeting of the Board, 15 December 1947, the Standing Committee on Extramural Research was formed in 1948. For its first three meetings it was known as the Standing Committee on Extra-Mural Grants. At the first meeting Solandt acted as chairman and the meeting was attended by Best, Gagnon, Johnstone, Maass and Shrum, all the academic members of the Board. The overlap of membership in the Board, the Selection Committee and the Standing Committee on Extramural Research both unified and concentrated the Defence Research Board’s policy and planning in the early years. The constitution of the Standing Committee formalized the membership: the Chairman of the Defence Research Board and all the academic representatives were obliged to participate in the Standing Committee.


217 Melville, The Department of Scientific and Industrial Research, 62.
Since the meetings of the Standing Committee were always scheduled to coincide with Board meetings, any other Board members could attend if they wanted.\textsuperscript{218}

Although the academic breadth of the Standing Committee was impressive, it could hardly be expected to judge the merits of the diverse applications it received. This was especially true given the volume of applications received and the potential fluidity of the composition of the Standing Committee. To ensure that the Standing Committee, the Selection Committee and the Board had sound advice on all scientific, medical and engineering matters of pertinence to the DRB they relied on the advisory committee structure. This structure was, of course, borrowed from the National Research Council, the Department of Scientific and Industrial Research and the military.

One example which has already been addressed briefly was the Medical Research Advisory Committee. It was the last major advisory committee to be organized. There were committees for every significant research area in which the Defence Research Board had interests, and the main committees were supported by subcommittees and panels in the most active subareas of research. Other committees struck in 1947 and 1948 included the Electronics Advisory Committee, the Special Weapons Advisory Committee, the Arctic Research Advisory Committee, the Clothing and Equipment Advisory Committee, the Guided Missile Advisory Committee, the Civil Defence Advisory Committee, the Canadian Radio Wave Propagation Committee and the Armament Advisory Committee. The men chosen as representatives were mostly academics, except where there was a nascent Canadian industrial ability, which at the time was limited mostly to electronics.\textsuperscript{219}


These committees and panels arose in a basically *ad hoc* manner. As the Defence Research Board learned that the Services had significant requirements in a certain discipline an advisory committee was erected. As the advisory committee began to wade through the applications for grants and the general requirements of the military and the DRB and realised that it had to devote a substantial portion of its resources to a more narrowly defined speciality, then a panel was proposed to deal with a subset of the advisory committee’s responsibility. The result, according to Goodspeed, was a criticism of the Board for devising committees and panels with overlapping responsibilities.  

For instance there were four different chemical panels, one each for Special Weapons, Arctic Research, Armaments, and Clothing and Equipment. Likewise there were multiple physical, entomological, physiological, psychological, and electronics panels. In 1951 the Board began to disband many of the advisory committees in favour of keeping only the research panels or forming ad hoc committees when they were necessary.

Extramural research was an important part of the Defence Research Board’s activity, and the guiding principles were laid out at the first meeting of the Standing Committee on Extramural Research. The Standing Committee listed thirteen regulations that would govern grants. Most of these regulations dealt with routine administration (reporting procedures, countersignatures and completion), but a few of the regulations were more interesting and problematic. Only in extreme circumstances could professors’ salaries be paid out of grants; the money was intended for equipment and student research assistants. The salaries that were to be paid to these assistants were dictated by a strict scale that depended on degree completion and was identical to the National Research Council scales.

Another problem in the making was the requirement that all work produced was claimed as property of the Defence Research Board and the Department of National Defence, as such any

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Equipment purchased for the research was the property of the Defence Research Board unless the project was successfully completed, in which cases the equipment would become the property of the university. Presumably these regulations were identical to those of the National Research Council, but they were questioned by the industrial member of the Board, Dickson Harkness.\textsuperscript{223}

The only regulation that differed from the National Research Council was the one governing what types of research would be sponsored. Because the NRC had a long-standing relationship with universities and funding projects, the Defence Research Board did not wish to duplicate this (it still happened). Projects of general scientific and industrial interest would be referred to the NRC. Research with unique defence interests or applications would be the only projects considered by the Standing Committee. At its first meeting the Standing Committee reviewed those projects currently being funded by the NRC that had a military aspect and decided which of those projects should receive continued support from the DRB, and which should be terminated.\textsuperscript{224}

Starting at its first meeting, the Standing Committee began to consider new applications. Unsurprisingly these early grants went to the same university professors who had worked on wartime research for the National Research Council. Because of the full mobilization of the country in 1941 every scientist and engineer in the country capable of defence research was actively engaged in the war effort. When the Defence Research Board started awarding grants in 1948 the only applicants were necessarily veterans of the Second World War.

During the Second World War George Wright, who was an organic chemist at the University of Toronto, was the manager of the research program into RDX (Research Department Explosive). After the war he continued working on projects of defence interest for the National Research Council and then the Defence Research Board. His ongoing project that


was originally funded by the NRC was on a “synthesis of new insecticides.” His new project, and far more lucrative gleaning $7800 in its initial year compared to the $2000 renewal, was simply called “explosives research.” At a time when faculty generally took summers off, Wright agreed and then backed out of spending the summer of 1947 working at the Canadian Armaments Research and Development Establishment. He was scheduled to make $500 a month in addition to travelling expenses. The granting procedure instituted in 1948 was more agreeable to Wright than actively working for the DRB.225

George Langstroth, unlike Wright, increased his participation in the Defence Research Board after the war. Langstroth graduated from Dalhousie University and then taught physics at the University of Alberta. During the war he collaborated closely with the Suffield Experimental Station. From 1945 to 1948 Langstroth was the head of the Department of Physics. In 1948 his grant that was initially approved at the first meeting of the Board in 1947 was renewed by the Standing Committee on Extramural Research at its second meeting. His project, DRB Grant 1, investigated “the ageing process in aerosols” and the renewal was for $1500. At the same meeting his new proposal for “the electrostatic properties of ice fogs” was granted $2500. In June he became the first and probably only grant recipient to leave academia for permanent employment with the DRB; he moved from the University of Alberta to SES where he became the Head of the Physics and Meteorology Section. In 1952 Langstroth became the Chief Superintendent at Suffield, a position he held for five years until he moved to the Naval Research Establishment as its Chief Superintendent.226

As with grant recipients, the only men that the Defence Research Board could recruit to be members of the Board or members of the advisory committees and panels that helped the Standing Committee on Extramural Research were veterans of the Second World War. This


resulted in a significant amount of overlap between applicants and reviewers. As an original member of the Medical Research Advisory Committee, and an eventual Board member, Louis-Paul Dugal received a grant for $5900 to investigate “physiological factors involved in resistance and adaptation to cold environments.” Otto Maas received grants at the first meeting of the Standing Committee for “rheology of non-Newtonian liquids” and “adsorption by porous media with particular reference to charcoal.” At the ninth meeting of the Standing Committee Gordon Shrum and a team of physicists from the University of British Columbia were awarded nearly $20,000 for “investigations of superconducting bolometers, [and] of the nature of the solid state at very low temperatures.” The network of defence researchers, especially the competent ones, was so small in Canada in the late 1940s that this overlap of interests was inevitable.227

However, how the Board handled these conflicts of interest scenarios was a topic of discussion at its sixth meeting. Mackenzie raised a concern with how the decisions were recorded in the minutes. He had no complaint with the results of the decisions, just how those decisions were made and recorded. The problem, and the sixth meeting of the Board is perhaps the only exception, was that when a conflict of interest situation arose the minutes of the meetings do not indicate that the member with the conflict of interest excused himself from the discussion. There were at least a few times when the member with the conflict of interest did not leave the room, but more often than not it was simply the case that the minutes were not meticulous on these procedural points. That the Board lapsed into its former recording habits after the sixth meeting indicates that Mackenzie was the only one who saw the issue and foresaw the difficulties it would pose.228

Ordinarily the Defence Research Board followed whatever precedents were set by the National Research Council. The NRC’s funding of grants was primarily for work done during

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the academic year (September to April). The summer was traditionally a down period for scientific research. The Second World War forced nearly universal exceptions and prior to that there were notable summer research projects (e.g. Collip’s participation in the discovery of insulin), but after the war there was an attempt to return to the old norm.

In 1949 the Standing Committee on Extramural Research criticised this tradition and the NRC’s support of it. Defence research came with a slightly different sense of urgency than normal scientific research, and losing summers (especially for seasonally dependent investigations) seemed to be a lost opportunity. The Standing Committee decided that if researchers were willing to devote their summers to projects, and could find students willing to work, then those students should be employed. The rates were not allowed to exceed what the DRB paid its summer students, nor what the funded university deemed appropriate. At the time the DRB (and the NRC) paid summer researchers finishing their third year of undergraduate honours studies $165 per month; the salaries were scaled all the way up to those who had completed a Ph.D., who made $250 per month.229

Funding of laboratories, year round or not, was part of Solandt’s plan to increase the overall Canadian capacity for defence research. The Defence Research Board’s funding was generally heaviest to the large research-intensive Canadian universities: McGill and Toronto. British Columbia, Western Ontario, Queen’s, and Dalhousie formed the core of the second tier of funding. The single biggest grants the Defence Research Board awarded from 1947 to 1950 were for the creation of new university laboratories. Both McGill and Toronto received funding from the DRB for two new laboratories apiece. Queen’s University already had a laboratory funded by the DRB for Guilford Reed, but this arrangement was unique. Reed’s work was a continuation of his bacteriological research from the Second World War, and the only funding available for such research was from national defence because of the security and hazards involved. The four new laboratories created from DRB funds were less hazardous and worked on projects that had non-defence applications in addition to their defence interest.

The first of these four laboratories was part of a burgeoning physics program at McGill. John Foster had secured funding arrangements from the National Research Council and the United States Air Force to build and operate a cyclotron in 1946, the first in Canada and third in North America. To complement Foster’s work in nuclear physics Cyril James, the long-time Principal of McGill, secured funding from philanthropist Lady Flora McCrae Eaton (the widow of Sir John Craig Eaton). Eaton’s money was used for the construction of a building adjacent to Foster’s cyclotron. It was to house electronics research, and Garnet Woonton was lured away from the University of Western Ontario to be its director.

Woonton had ties to the DRB from its inception. Both he and Foster were members of the Electronics Advisory Committee starting in 1947. Woonton, while still at Western, was the recipient of a small $500 grant in 1947 for a “study of broadband absorption of EM waves.” Over the following year, in anticipation of his move to the Eaton Electronics Laboratory, Woonton was awarded a $36,000 grant to acquire equipment for the new facility. In the first year he was unable to spend the entire allotment, but the award was carried forward and supplemented in the ensuing years. In 1949, for instance, the Eaton laboratory was provided with $25,000 by Solandt, in consultation with Mackenzie, to equip an instrument-maker’s shop, and an additional $15,000 for electromagnetic field measurements.

In 1950 both the Eaton Electronics Laboratory and Foster’s Radiation Laboratory were looking for additional funding, since they were operating over budget. By this time the Defence
Research Board had started funnelling money to the National Research Council in order to help fund the Radiation Laboratory. As a result, Foster and Woonton turned to the DRB, the NRC and the Atomic Energy Control Board for funding to bridge the budgetary shortfall; the three agencies shirked, and then shuffled responsibility. Cyril James and the Board debated the terms of grants in response. James wanted to reduce the work being done by the Eaton, while the Board wanted to make arrangements to ensure that their grants were not being used for building costs, but only equipment and research costs. Eventually the three government agencies transferred the funds to McGill.  

Other parties had an interest in the work at the Eaton. The Royal Canadian Air Force wanted Woonton to do radar measurements for them, which the Board had to contract, and raised the issue of Foster’s alignment with the United States Air Force who had funded Foster’s Radiation Laboratory. The physics laboratories at McGill were investigating the right questions at the right time to benefit from heavy government investment. The Eaton was part of a larger investment by the Board, on behalf of the Department of National Defence (mostly the Royal Canadian Air Force), into air defences.

In 1949 McGill University received more laboratory start-up funding from the Defence Research Board, this time for the Department of Mechanical Engineering. Mechanical Engineering and Physics at McGill were closely linked through the Engineering Physics program, and the experimental tradition that was infused into the Physics Department by Ernest Rutherford’s nine-year tenure as the Macdonald Professor of Experimental Physics. Donald Mordell obtained his first grant from the DRB at the first meeting of the Standing Committee on Extramural Research in 1948, $12,100 to study “the effects of turbulence and pressure on the

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spontaneous ignition of liquid and solid fuels in a hot gas stream.” Mordell’s laboratory was the second of four major investments by the Defence Research Board.  

A year after his initial grant Mordell received an additional $21,200 from the Standing Committee to help establish the Gas Dynamics Laboratory. McGill contributed money and space for the laboratory. That same year, 1949, Mordell was given a $7,000 RCAF contract, via the Defence Research Board, for research on the effects of combustion of different fuels on jet engines. He was an inaugural member of the Gas Dynamics Research Panel, which was chaired by D.C. MacPhail who was head of the Gas Dynamics Section of the National Research Council. Other members were drawn from the University of Toronto (Gordon Patterson and Edgar Allcut), Queen’s University (Frederick Goodspeed), the NRC (E. Alison Flood) and A.V. Roe, Limited. In 1950 the DRB’s yearly contribution to the Gas Dynamics Laboratory had increased to nearly $50,000. A decade later, in a request to Cyril James for funding for a new laboratory centred on Gerald Bull after Bull left the Defence Research Board, Mordell reported that Gas Dynamics had successfully drawn in $1,100,000 of external funding for projects.

The productivity of the two McGill physical laboratories, especially in terms of winning grants from the Defence Research Board, led the Board to implement a policy similar to the NRC. The process began at the Eleventh Meeting of the Standing Committee on Extramural Research, which was held 9 June 1950 in Trenton, Ontario. The Standing Committee made the decision to support research at the Eaton Electronics Laboratory, rather than the laboratory itself.

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To do this they used a consolidated grant, a multiple year large-sum grant. At this meeting they also considered the possibility of funding the Radiation Laboratory at McGill if the United States Air Force withdrew its support. At their next meeting at National Defence Headquarters the Standing Committee agreed to operate their consolidated grant to the Eaton similarly to the National Research Council’s operation of consolidated grants. They would exchange letters with McGill agreeing to a multi-year funding arrangement, where the DRB money would go towards research and McGill would fund operational costs. Covered by DRB Grant 230, Woonton was funded $90,000 over a three-year period.

Consolidated grants were revisited again at the next meeting of the Standing Committee on Extramural Research. The Thirteenth Meeting of the Standing Committee was held on the plane en route to Winnipeg from Ottawa on 6 December 1950. Solandt explained the reasoning behind the move to consolidated grants. The Department of National Defence was operating on a surplus that fiscal year, but was expecting to operate on a deficit the following year. Solandt wanted to set aside money now, while they had it available, for projects that they expected to be running over several years. The Eaton and Gas Dynamics were large-scale laboratories working on defence research projects that were likely to be ongoing.

At their last meeting before the end of that fiscal year, held 9 March 1951 at National Defence Headquarters in Ottawa, the Standing Committee expanded the number of consolidated grants beyond Woonton and Mordell to include several two-year projects. These included: Louis-Paul Dugal of Laval getting $30,000 for cold acclimatization, Balfour Currie of Saskatchewan getting $20,000 for radar reflections from the Aurora, Foster getting $20,000 funnelled through the National Research Council, E.A. Sellers of Toronto getting $50,000 for...
cold and radiation, R.J. Rossiter of Western getting $100,000 for cold and wounds, Charles Best getting $70,000 to add a radiation unit to his eponymous Institute in Toronto, and Joseph Doupe of Manitoba getting $36,000 for frost-bite and radiation research.238

Two laboratories at the University of Toronto were receiving similar funding to the Eaton and Gas Dynamics. The third of the four major laboratories financed by the Defence Research Board, and the first one started at the University of Toronto, was the Institute of Aerophysics. The founder and driving force behind the Institute was Gordon Patterson, who was short-listed for membership on the interim Board in 1946. Patterson’s first application for funding from the Board was in 1948, and it required special consideration given how much money he requested.239

The success of bombers and fighters in the Second World War led to increased responsibility and budgeting for the Royal Air Force, United States Air Force and the Royal Canadian Air Force. Canada was behind the other two in industrial research capacity, and the RCAF wanted to improve that after the war. What Patterson capitalized on was the need for basic aerodynamics research that could be used to fuel applied research and development for the RCAF in Canadian industries. He lobbied for money to found fundamental studies at the University of Toronto. The Board began to consider Patterson’s proposal in April 1948.240

E.L.I. Davies prepared a memorandum for the Minister of National Defence on 26 April. Davies suggested that the Board should supply $500,000 for initial start-up over two years, and then $50,000 a year for continued support of research. In this proposal the Board would have a member on the committee that oversaw the research direction of Patterson’s laboratory, but administration would be left entirely to the University of Toronto. The DRB would provide equipment, but the University would pay for salaries, professors and consumable supplies. There

were two potential options for a building, either the DRB would build something and lease it to the University, or the University would build something and the DRB would compensate the University.\textsuperscript{241}

William Barton, on behalf of Secretary of the Board R.G. MacNeill, circulated this memorandum to the members of the Board on 28 April soliciting their approval to go ahead with the plan that had already been discussed by the Standing Committee at its second meeting. By a memorandum on 28 May 1948 MacNeill reported that the proposal had been accepted and would be official recorded as a minute of the Seventh Board Meeting.\textsuperscript{242}

Approval was not without questions or difficulties. Harkness responded to MacNeill on 11 May wondering if the Institute of Aerophysics was a duplication of existing work at the National Research Council and whether there was enough money, personnel and equipment to proceed. MacNeill responded on the fourteenth claiming that the Institute was complementary to existing research and that funding a laboratory was the best way to keep Patterson in the country and working on projects of interest to the DRB. Patterson hinted that he might return to the United Kingdom or the United States if his demands were not met by the University of Toronto and the Defence Research Board. The foundation of the laboratory had ministerial support from Howe and Claxton, so Harkness’ reservations were simply dismissed.\textsuperscript{243}

Planning went ahead, but it still had further hurdles to overcome. In June 1948 Patterson submitted the dimensions and expected performance of the wind tunnel. Solandt relayed these to the Cabinet Committee on Scientific and Industrial Research (i.e. C.D. Howe). Solandt suggested that there was an ideal space in the Department of National Defence building at De Havilland Airport in Downsview (Toronto), Ontario. At the seventh meeting the mail-in vote

\textsuperscript{241} LAC, RG 24 S F1 Vol 11995 File DRBS 1-0-43, “Memorandum from Vice Chairman of the Defence Research Board to the Minister, 26 April 1948.”
was recorded with an addition from Air Vice-Marshall James who strongly supported the project.
The laboratory opened, in borrowed space within the civil engineering building, in 1948.\textsuperscript{244}

Each year the Institute was allowed three or four new students based on the funding coming from the Defence Research Board. One of the first students in 1948 was the eccentric prodigy, Gerald Bull. Another was Irvine Glass who went on to a long career working alongside Patterson at the Institute. Bull’s and Glass’ work on the model air tunnel revealed the cramped nature of the temporary quarters of the Institute of Aerophysics when Bull knocked out the wall between the graduate student office and Patterson’s adjacent office. The quest to co-locate the laboratory at De Havilland and the Downsview RCAF base became more determined in light of this space crunch.\textsuperscript{245}

At the Tenth Meeting of the Board it was reported that the RCAF had donated a building, for which the University of Toronto was paying a nominal lease of $1.00 per year. At the same Board meeting it was reported that Toronto’s President, Sidney Smith was prepared to exchange letters to formalize the arrangements. The Institute was located academically within the Faculty of Applied Science and Engineering, where it would report to Dean Kenneth Tupper. Within the Institute Patterson was the Chairman of the research committee, which would have representatives from the National Research Council, the Defence Research Board, the Royal Canadian Air Force and the University of Toronto. The expectation was that funding would end after three years (it did not), and that the research would be unclassified, except where essential. Construction at Downsview went relatively quickly and the building was ready to open in September 1950 with some last-minute help from Tupper to make the supersonic wind tunnel operational.\textsuperscript{246}


The fourth and final of the four major grants made by the DRB between 1947 and 1950 was to the Computation Centre at the University of Toronto. The history of the Computation Centre has been documented thoroughly by Scott Campbell. The Computation Centre was the only one of the four major laboratories funded by the Defence Research Board that was not solely devoted to flight studies. Aside from this, the most noteworthy aspect of the Computation Centre was its ability to secure funding from a variety of sources, which the Computation Centre’s committee began seeking in 1945. C.J. Mackenzie admitted that the National Research Council was interested in having computations performed, but expected there to be a greater demand and growth for computing in universities. Solandt and the Defence Research Board heard of the proposal in 1947 and also expressed interest. The danger from the government’s perspective was the Computation Centre getting overlapping grants from both the NRC and the DRB.247

Prudently, a meeting was arranged between the National Research Council, the Defence Research Board and the University of Toronto for January 1948 to discuss the arrangements and funding. Coming out of this meeting the DRB agreed to fund $20,000 and the NRC $10,000 to create the Computation Centre; the university was expected to supply sufficient funding for personnel, at the very least.248

Originally management for the Computation Centre fell to B.A. Griffith who had participated on the founding committee, but Mackenzie and Sidney Smith, the President of the University of Toronto, found Griffith’s management skills lacking and sought a replacement. The solution was found in recent physics graduate and wartime RDX researcher Calvin Gotlieb; Gotlieb was more affordable than the other options, since he was already working for the university as a lecturer in physics and would not command a top-scale salary. Like the Institute of Aerophysics a guiding committee was formed that included representation from the University of Toronto, the NRC and the DRB.249

247 Campbell, The Premise of Computer Science, 12, 32, 36.
3.7.3 Collaborating with the NRC and RCAF

After the Second World War, flight studies, including radar and aerodynamics received high priority in federal plans. Canadian industries, largely as branch plants of American or British airplane manufacturers, had expanded rapidly during the war, and this small but prominent part of the economy was seen as a potential growth area. With well-funded research, so the line of thinking went, Canadian aeronautical industries could fill national needs, attain self-sufficiency and potentially become competitive globally. The National Aeronautical Establishment (NAE) was created in 1950 to supply the research needed by industries and the National Research Council and Defence Research Board.  

The National Aeronautical Establishment was the responsibility of an inter-agency committee. In this case it was the National Aeronautical Research Committee, chaired by Mackenzie as President of the National Research Council. The other members were the Chief of the Air Staff, Chairman of the Air Transport Board, and Solandt; the secretary was supplied by the Defence Research Board. The NAE was administered as a separate agency, like the atomic project, by the NRC. The DRB contributed funding, in particular for the replacement of the Flight Research Laboratory facilities in 1951. The NAE, which was located at both the Montreal Road campus of the NRC and the Uplands airport in Ottawa, was intimately involved in the work on the Velvet Glove at both Canadian Armaments Research and Development Establishment and Defence Research Telecommunications Establishment. Plans to separate all of the NAE from the NRC, or at least to transfer authority for the Uplands facilities to the DRB, never came to fruition. The reasons and events remain unclear.

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3.7.4 Looking Forward Back: The Five Year Plan of 1949

The Five Year Plan, which was to cover the years 1950 to 1954, was submitted and discussed at the Thirteenth Meeting of the Board held 1 December 1949 at the University of Toronto. The Plan looked back at the original plans formulated in 1946 and 1947. The original plans called for a gradual growth to 300 scientists, plus supporting staff and a budget of $5 to $6 million. Solandt’s new Plan suggested that another 100 scientists were needed, and that the budget should increase by seven to ten million dollars in order to match increases in the United States and the United Kingdom and to continue the projects already underway in the establishments. These proposed increases brought the DRB’s budget up to between 1/5 and 1/6 of the civilian (NRC and others) expenditures on research and 1/20 of the overall national defence budget.252

The Five Year Plan revisited other goals of the 1946/1947 plans. The original plans set out five guiding principles of the Defence Research Board’s research initiatives.

1) Research only in what Canada was suited for based on geography or climate,

2) Service requirements that would not be met by other nations,

3) Research in areas where Canada had particularly competent researchers,

4) Support of Canadian industries that were most promising, and

5) Whatever basic research had to be done to keep up a working knowledge of work done in other countries for practical application and consultation in the future.253

Solandt acknowledged that this was an incomplete research agenda; the Board planned to rely on its allies with larger research programs to complete the research program in exchange for Canada’s unique contributions.254


The DRB’s role in collective defence received a boost from an unexpected source. The Americans placed a strong emphasis on atomic research and warfare in their military and defence research planning. The work of the Atomic Energy Control Board was consequently viewed highly favourably by the Americans, where it had previously been overlooked by the Defence Research Board because Chalk River had been designated ‘peaceful.’ Solandt’s Five Year Plan suggested that the Board should take a more active interest in the work done in order to maximize Chalk River’s defence capacities and further enhance Canada’s contribution to collective defence. This desired collaboration with Chalk River was part of Solandt’s determination to expand the DRB’s program.255

Solandt was convinced that the Board had adequate oversight of the Defence Research Board’s research program. What the Five Year Plan laid out were preparations to expand aeronautical research (i.e. three of the four university laboratories) and to assume more responsibility for development. Solandt and the Board created a Project Coordination Centre, which would be responsible for collecting production data and information. Oversight of the Project Coordination Centre, and review of the data it produced, was to be the responsibility of a Committee. The model for the Project Coordination Centre was the Research and Development Board in the United States. In a separate memorandum of 1 November 1949 Solandt suggested the chairman be the Deputy Director General of Defence Research (A), George Field, with two members from the development arms of each Service, an additional member from the DRB’s Research Coordination Staff and a secretary from the DRB. The Project Coordination Centre, and the entire Five Year Plan (especially the new emphasis on aeronautical research), were enthusiastically adopted by the Board at the Thirteenth Meeting.256

The Standing Committee on Extramural Research also engaged in some data collection and analysis of its progress over the past several years. The Ninth Meeting of the Standing Committee was held in conjunction with the Thirteenth Board Meeting on 30 November 1949 in


the Wallberg Memorial Building at the University of Toronto. At this meeting the Standing Committee produced a table summarizing the distribution of grants to universities across Canada for 1949 and 1950. Unsurprisingly the most grants in number and value were going to the University of Toronto (including the Connaught Medical Research Laboratories – the Canadian hub of polio vaccine work at the time) and McGill University. The University of Toronto (including the Connaught) received 20 grants and $125,286; McGill received 18 grants and $120,695. The smaller research universities all came in a distant second tier as evidenced in the following table.

Table 3.2 – Distribution of Grants to Universities in 1949-1950

<table>
<thead>
<tr>
<th>University</th>
<th>Number of Grants</th>
<th>Value ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of British Columbia</td>
<td>5</td>
<td>14,950</td>
</tr>
<tr>
<td>University of Alberta</td>
<td>1</td>
<td>500</td>
</tr>
<tr>
<td>University of Saskatchewan</td>
<td>4</td>
<td>19,055</td>
</tr>
<tr>
<td>University of Western Ontario</td>
<td>9</td>
<td>25,045</td>
</tr>
<tr>
<td>Ontario Veterinary College (Guelph)</td>
<td>1</td>
<td>3,000</td>
</tr>
<tr>
<td>University of Toronto</td>
<td>17</td>
<td>104,098</td>
</tr>
<tr>
<td>Connaught Medical Research Laboratories (UofT)</td>
<td>3</td>
<td>21,188</td>
</tr>
<tr>
<td><strong>Total UofT</strong></td>
<td><strong>20</strong></td>
<td><strong>125,286</strong></td>
</tr>
<tr>
<td>McMaster University</td>
<td>1</td>
<td>6,920</td>
</tr>
<tr>
<td>Queen’s University</td>
<td>4</td>
<td>22,062</td>
</tr>
<tr>
<td>McGill University</td>
<td>18</td>
<td>120,695</td>
</tr>
<tr>
<td>Université de Montréal</td>
<td>2</td>
<td>3,940</td>
</tr>
<tr>
<td>Laval Université</td>
<td>6</td>
<td>18,280</td>
</tr>
<tr>
<td>University of New Brunswick</td>
<td>2</td>
<td>1,925</td>
</tr>
<tr>
<td>Dalhousie University</td>
<td>4</td>
<td>17,150</td>
</tr>
<tr>
<td>Montréal Botanical Gardens</td>
<td>1</td>
<td>1,200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78</strong></td>
<td><strong>380,008</strong></td>
</tr>
</tbody>
</table>


The most successful of the second tier of universities in 1949 was the University of Western Ontario, which received half the number of grants of McGill and about 1/5 the amount of money. McGill’s and Toronto’s average grant amounts were inflated by the Gas Dynamics Laboratory, the Eaton Electronics Laboratory, the Computation Centre and the Institute of
Aerophysics. If Reed’s laboratory at Queen’s University had been run in a similar fashion to the labs at Toronto and McGill, then Queen’s might have matched UWO for third place in number of grants, but drastically surpassed UWO in dollar amounts.

At the same meeting the Standing Committee summarized their grants and contracts by discipline (see Table 3.3 below). The biggest expenditures were contracts and grants for electrical research. This was the work that was complementary to the largest part of the Defence Research Board’s internal program. Electrical research contracts were the single largest expenditure, accounting for over 70% of the budget for contracts and nearly 35% of the overall grants and contracts budget. Electrical grants were the second largest single expenditure, and the combination of grants and contracts for electrical work account for roughly 50% of the entire grants and contracts budget. The following table illustrates the division of priorities and finances in grants and contracts.

Table 3.3 – Distribution of Funds by Field of Research in 1949-1950

<table>
<thead>
<tr>
<th>Subject</th>
<th>Grants ($)</th>
<th>Contracts ($)</th>
<th>Total ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Research</td>
<td>130,950</td>
<td>257,937</td>
<td>387,887</td>
</tr>
<tr>
<td>(Includes contract carry-over of $86,737)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special Weapons</td>
<td>14,770</td>
<td>65,635</td>
<td>80,405</td>
</tr>
<tr>
<td>(Includes contract carry-over of $10,135)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Armament</td>
<td>33,780</td>
<td>35,000</td>
<td>48,780</td>
</tr>
<tr>
<td>(Includes contract carry-over of $15,000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion</td>
<td>32,983</td>
<td>32,983</td>
<td>32,983</td>
</tr>
<tr>
<td>Arctic</td>
<td>21,650</td>
<td>21,650</td>
<td>21,650</td>
</tr>
<tr>
<td>Entomology</td>
<td>8,400</td>
<td>8,400</td>
<td>8,400</td>
</tr>
<tr>
<td>Medical</td>
<td>123,720</td>
<td>5,000</td>
<td>128,720</td>
</tr>
<tr>
<td>Psychology</td>
<td>1,775</td>
<td>1,775</td>
<td>1,775</td>
</tr>
<tr>
<td>Civil Defence</td>
<td>2,480</td>
<td>2,480</td>
<td>2,480</td>
</tr>
<tr>
<td>Naval</td>
<td>9,500</td>
<td>9,500</td>
<td>9,500</td>
</tr>
<tr>
<td>Totals</td>
<td>380,008</td>
<td>363,572</td>
<td>742,580</td>
</tr>
</tbody>
</table>


Because of the large amount of electrical research contracts there was nearly a balance between grants and contracts. Goodspeed notes that as the electrical work wrapped up, or was
subsumed under the development components of the Services’ budgets, it decreased in importance in the extramural research program.257

The combination of the research conducted on special weapons, armaments, and the Arctic accounts for the other major elements of the DRB’s intramural program. The basic research done on grants and the preliminary development done on contracts in these fields was complementary to the applied science done at the establishments.

However, medical research grants are an anomaly in Table 3.3. They are the second largest line item after electrical research, but the Defence Research Board was conducting very little internal work on medicine. Medical research was supported because it was essential for the Canadian military and even more important for the entire Canadian population. The combination of DRB and National Research Council funding medical research was a post-war boon that supplemented funding from the Department of Health and Welfare, and eventually grew to the point that it needed a separate funding agency in 1960. The Medical Research Council (of Canada) was formed out of the medical research division of the NRC with Ray Farquharson as the first Chairman and driving force behind its creation.258

The Board’s interest in a review of its progress up to 1949 was not unique. This was a yearly element of Solandt’s Birthday Addresses as well as his reviews for Board meetings. An important element of the 1949 review, as with every year, was a comparison of the DRB with the National Research Council. The NRC was spending about five to six times as much on both its internal and extramural programs as the DRB. The Board started allocating $228,025 for grants and by 1950 it was granting $300,000 plus the additional special operating grants to the major research laboratories at McGill University and the University of Toronto. By 1952 the grants and contracts budgets were both fixed at $1,000,000; the DRB’s internal budget was nearly

$21,000,000 on top of the extramural research. The Defence Research Board grew steadily from 1947 to 1950, which was followed by this massive spike.\footnote{LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 3, “Minutes of the Thirteenth Meeting of the Defence Research Board held at the University of Toronto, 1 December 1949,” 6; Goodspeed, \textit{A History of the Defence Research Board of Canada}, 100.}

\subsection*{3.7.5 The Military-Academic Complex and the DRB}

The effect of the Defence Research Board’s funding between 1947 and 1950 amplified the funding of the National Research Council and the federal government’s involvement in research and education. It was not a return to the pre-war norms for universities. Professors were interested in research work, and in receiving funding to buy new equipment and to work on more expensive projects. The effect of the combined extramural programs was an increase in graduate training in the sciences in Canada as a result of more research being done by professors. Before the war only five universities offered doctorates in science; by 1950 the number had more than doubled to eleven. The new wave of home-grown Ph.D.-holders allowed universities to undertake more undergraduate education, and for the federal government to recruit more scientists to work in Atomic Energy, the NRC and the DRB. As universities grew, they needed increased funding from the federal government. The 1947 to 1950 period alone could not have produced these effects; they were the result of a prolonged program from the federal government through the NRC and the DRB.\footnote{W.P. Thompson, \textit{Graduate Education in the Sciences in Canadian Universities} (Toronto; Quebec: University of Toronto Press; Presses de l'Université Laval, 1963), 16-17, 73-74, 93-95; Eggleston, \textit{National Research in Canada}, x.}

The marriage of universities and the federal government was not a uniquely Canadian phenomenon, nor was it uniquely North American, although the most commonly studied funding scheme is the American military-industrial-academic complex. The United Kingdom’s Department of Scientific and Industrial Research, for instance, awarded 81 Research Studentships the year leading up to the Second World War, and 399 a decade later. Over the same period the amount spent on research grants to faculty members increased from £11,000 to £268,679. The post-war growth of the contributions to grants and studentships by the DSIR was enough for Melville to conclude “that there were few academic schools of research in the United
Kingdom whose work was not assisted in some degree by DSIR.”261 The civilian DSIR was not alone in sponsoring university-based research.262

The military was also a prime benefactor of British research. Throughout the Cold War British defence matched their American counterparts in spending on defence research as a portion of the Gross National Product. One half of government funding for research and development was spent by defence, and each government stimulated about half of the total national research and development economy. The level of the defence budget in the United Kingdom throughout the Cold War led David Edgerton to correct the traditional social history emphasis that the UK was merely a welfare state. Edgerton argues that the UK could also be called a ‘Warfare State’ because of the emphasis on defence, and defence research and development.263

Edgerton’s argument appears to be an application of Michael Sherry’s thorough and original analysis of American political culture since the Great Depression to British culture over the same period. The vast body of American literature on the question of the military-academic union has long since gone beyond detailing the basic trend and moved on to questions of the responses of the various actors to the trend as it was happening. Sherry quotes Paul Hoch’s argument that many scientists were hesitant to lose their professional autonomy; in opposition he borrows a Louis Ridenour quotation from Daniel Greenberg. Ridenour was a Dean at the University of Illinois and a frequent consultant for the United States Air Force. Ridenour claimed that accepting money from the federal government was actually preferable to accepting money from previous benefactors like philanthropies and corporations, because the money from the federal government would be consistent and because working for the federal government would contribute to the public and national good. Ridenour believed that the investigations would have been conducted by curious scientists and engineers regardless of federal funding. Working for the military merely gave the projects a sense of urgency and fulfilled a patriotic duty. There were parallels to Ridenour’s and Hoch’s reasoning in Canada.264

261 Melville, The Department of Scientific and Industrial Research, 73.
262 Melville, The Department of Scientific and Industrial Research, 67, 71.
264 Sherry, In the Shadow of War, 139-140.
The union of the government and universities in all three countries was far more than a simple case of curious scientists and engineers in need of funding. In the Second World War enrolment in universities and even high schools shrank as students sought out employment or entered the services. Contracts from the military helped to fill some of the lost revenue streams for universities, and also filled patriotic obligations. Not only did American universities take on research contracts from the National Defense Research Committee and later the Office of Scientific Research and Development, but they also agreed to offer training courses for servicemen and servicewomen in pressing fields like languages, science and engineering, and economics. The same economic rationale applied in Canada and the United Kingdom; universities needed the military’s money as much as the military needed universities’ expertise.265

The post-war period saw a continued union of the military and academia. American military personnel returned to, or in many cases entered belatedly, colleges and universities after the war thanks to the G.I. Bill of Rights (properly, the Serviceman’s Readjustment Act of 1944), which guaranteed veterans would have access to education and housing. Between 1945 and 1950 2.3 million American veterans attended college, half of the student population in that period. The subsidies that aided veterans, along with the savings that Americans (and Canadians) had amassed during the war fuelled the North American consumer economy, and avoided another depression. The differences between the North American neighbours were, of course, matters of scale.266

Throughout the Cold War the American population and Gross National Product (GNP) were ten to fifteen times larger than Canada’s. However, per capita the United States government spent between two and ten times as much on national defence, and consequently defence research, than the Canadian government. In 1963, for instance, the United States spent more on defence than Canada’s entire GNP, and the number of people employed directly or indirectly by the American Department of Defense equalled the entire Canadian labour force. Moreover, of the United States government’s contribution to research and development, nearly 90% was driven by defence interests; the Canadian government spent 33% on defence research

and development, and the United Kingdom 73%. While government funding of research at universities was important in all three countries, the contribution of the Defence Research Board to the transformation of postwar Canadian education was far less pervasive than in the UK or the US, because the DRB was just one among several funding agencies.  

A potential indicator of the success of the granting program was the number of graduate students who were hired to work under grants and then went on to either join the Defence Research Board or to receive grants of their own once they became professors. Unfortunately, the paper trail surrounding the research assistants is sporadic at best in both the DRB’s records and at the various universities. This only leaves anecdotal cases like John Chapman. Chapman was supervised by Garnet Woonton, who was funded by the Defence Research Board. Presumably Chapman was one of Woonton’s research assistants employed under the grant during the school year. During the summer, Chapman joined the Radio Physics Laboratory (the DRB’s new name for the Radio Propagation Laboratory) as a student research assistant. Given how many projects the DRB (and the National Research Council) funded, it is quite likely that there are many other examples of this kind of long-term training benefit arising from the Canadian grants programs.

Both the Defence Research Board and the National Research Council were able to support graduate training with scholarships directly to students in addition to the funding that indirectly worked its way to students from grants. The NRC had two mechanisms for awarding scholarships and fellowships. One was a general scholarship, studentship and fellowship program to any science and engineering graduate student. Countless DRB employees and grantees received NRC scholarships. The other type of scholarship was awarded to employees to upgrade their training. The DRB imitated the latter mechanism but not the former.

The Defence Research Board formulated a specific policy in 1947 opposing a general scholarship initiative. Primarily this was because the DRB had no intention of duplicating the existing NRC program. Additionally, there was no justification for a unique defence interest in awarding general scholarships. It was highly unlikely that any student supported by the Defence Research Board would end up working for them, if they were not already employed by the DRB.  

There was, however, a definite defence interest in upgrading the training of employees. The Selection Committee was given authority to determine which employees were allowed to return to school. There were two categories: recent graduates and long-term employees. The former were to be awarded a leave of absence and a scholarship comparable to what the National Research Council awarded to regular students. The assumption was that the recent graduate was upgrading his employment more for personal than professional reasons. The latter were to be awarded their full salary and a scholarship to cover tuition, travelling expenses, and some of the cost of living. The assumption was that the long-term employee was upgrading his education for the benefit of the DRB rather than personal improvement, and also that he would have family to uproot as well.

Two of the first recipients of a scholarship for tuition and travelling expenses were new employees who stayed in defence research for the duration of the DRB’s existence. By Order-In-Council PC112/4949 of 4 December 1947 Léon J.J. L’Heureux, who eventually became the Board’s final chairman in 1969, and Edward J. Bobyn, who went on to become the first Chief of Research and Development in 1974, were sent to Johns Hopkins University to take the courses offered on guided missiles.

Later recipients of a scholarship for tuition were John Chapman and John Abrams. Chapman converted his summer studentship with the Radio Physics Laboratory and school-year

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269 LAC, RG 24 S 1 Vol 11995 File DRBS 1-0-43-1 Vol 1, “Memorandum from Solandt to the Board regarding Policy Concerning Post-Graduate Training of Employess of DRB, 5 June 1947.”

270 LAC, RG 24 S 1 Vol 11995 File DRBS 1-0-43-1 Vol 1, “Note from MacNeill regarding Orders-in-Council Approved or Submitted for Approval, 8 December 1947.”
work with Garnet Woonton at the Eaton Electronics Laboratory into a leave of absence and a scholarship for the completion of his Ph.D. Abrams was hired as a summer professor in June 1949 to work in the start-up Operational Research Group. Rather than returning to Wesleyan University for the 1949-1950 school year to continue teaching physics and astronomy Abrams decided to take up studies at the University College, London in the history and philosophy of science. He was hired by the DRB and awarded a variation of the senior employee scholarship; in addition to his studies he was expected to earn his quarter salary by acting as a liaison consultant with the Royal Navy. The compromise was likely due to the fact that his post-doctoral studies in the history and philosophy of science were unlikely to contribute to the DRB’s research agenda, but they proved useful in Abrams’ university career once he left the DRB. 271

A concern was raised by Foulkes, the Chief of the General Staff, at the fifteenth Board meeting held in Trenton from 9 to 10 June 1950. Foulkes wondered if employees receiving scholarships were compelled to return to the Board upon completion of their studies for a fixed period. Solandt claimed that there were requirements in place for employees to return for a minimum tour that matched the length of their leave, but that it was extremely difficult to enforce these regulations legally, which left the scholarship-winners with a mere moral and patriotic obligation to return to defence research upon completion of their upgraded training. The regulations formulated by Solandt, and inspired by the National Research Council, stipulated that an employee must have worked two years with the Defence Research Board prior to receiving leave, which was a roundabout way of determining if the employee was likely to remain loyal and return to the DRB afterwards, and a way to ensure that the DRB at least received some value from the employee, even if it never gained anything from the employee’s improved training. 272

Another source of temporary employees was professors who were usually freed from university obligations over the summer. Those without a research project of their own running at

the university, or requiring travel, could take on extra work with the Defence Research Board. The Selection Committee hired these summer professors to tackle short-term projects, particularly seasonal ones like environmental studies in the Arctic that required the expertise of professors rather than the exuberance of students. Abrams and his wartime operational research colleague Colin Barnes of the University of Toronto were hired by the DRB to work on early operational research projects until the start-up units could be fully staffed.\(^{273}\)

The Defence Research Board’s grants system, along with all of its education policy, was formulated to be beneficial to a wide range of interests. Students of grant recipients got hands-on experience with projects in basic science with defence research applications. DRB employees who returned to university upgraded their education at no personal cost. With either grants or scholarships, it was an added bonus for the government if the recipients were veterans. Universities boosted their operating income by receiving grants and graduate students. The DRB gained valuable knowledge that it could have its employees apply to defence research problems; scholarships increased the versatility and value of employees, and grants increased the pool of potential defence researchers. There was no downside for anyone involved.

To attract and retain quality employees the Board implemented two academic devices to stimulate higher quality work. Starting in 1954 the Board considered the possibility of implementing a Classified Research Award for the best paper produced by an employee that could not be published because of security restrictions. The award was seen as compensating employees for the lost opportunities that would have been available to them if they had published their work: prestige and profit. The award was something that an employee could use on his or her curriculum vitae if he or she ever left defence research for academia or industry.\(^{274}\)

In December 1948 the Board created a yearly opportunity for employees to receive recognition for their work. The concept of an annual Defence Research Symposium was first announced by Solandt at seventh meeting of the Board in June 1948 in Suffield, Alberta. The

\(^{273}\) LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 5, “Minutes of the 22\(^{nd}\) Meeting of the Defence Research Board held at Ottawa, 14 March 1952,” Annexure A31 “Provisional Employment,” 2; LAC, RG 24 S F1 Vol 11997 File DRBS 1-0-43-2 Vol 7, “‘Minutes of the 41\(^{st}\) Meeting of the Selection Committee of the Defence Research Board held at 11:00 a.m., Thursday, June 10, 1954,” 2 and Annexure B41 “Applications.”

idea was for managers to select certain scientists to present their work at the Symposium to increase awareness of work being done internally and to generate discussions. Further planning of the first Symposium was put off until the next meeting in September when the full details for the December Symposium could be brainstormed.275

At the eighth meeting of the Board, held at Valcartier, Québec in September, the details were discussed. Gordon Shrum made three suggestions, presumably based on his experience with academic conferences and symposia. First, he wanted papers pre-circulated to experts so that there could be intelligent commentary. Second, Shrum wanted the talks kept shorter to allow more time for discussion. Finally, he was keen to use this as an opportunity for liaison, especially with the United States. Shrum wanted American experts invited, because it would be mutually beneficial. The Americans could quickly gauge the DRB’s entire research agenda, which would enable the Americans to weigh in with scientific and political opinions regarding what projects were desirable and what projects were repetition.276

The first Symposium was held from the fifteenth to the seventeenth of December 1948. The ninth meeting of the Board followed on the twentieth at which the Board members discussed some of the raw statistics of the Symposium. 70 papers were presented and 365 people attended. 124 of the Symposium attendees came from outside of Ottawa, including 15 Americans and 4 British scientists. Any British or American research officers stationed in Ottawa were counted as locals in the attendance.277

When it came time to plan the second Symposium, the Board had received advice from the Chief Superintendents of the establishments about what was successful and what needed to be changed based on the first Symposium. The Chief Superintendents met in May 1949 in Québec City and the results of their meeting were available to the Board at its eleventh meeting, 12 June 1949 in Halifax. The Chief Superintendents were generally unimpressed with the first Symposium and made four suggestions for improvement. First, they felt that the majority of the

papers should be given by Defence Research Board staff. Second, presumably to increase the value of the discussions by increasing the level of information that could be revealed, they suggested that everyone who attends the conference should have a minimum security clearance of secret. Third, “papers should only deal with original or relatively recent research on classified projects.” This concern reveals the perceived pace at which defence research was advancing in the period; it could also suggest that some of the presenters were discussing successful projects from the Second World War rather than their current work. Fourth and finally, the Chief Superintendents reiterated one of Shrum’s concerns that the papers should be shorter and there should be plenty of discussion.278

By the time of the thirteenth meeting of the Board, held at the University of Toronto 1 December 1949, it had already been decided to delay the second Symposium until the following year. March was obviously a better time for a large meeting than the beginning of December. The Symposium was set to coincide with the next Board meeting and the next meeting of the National Research Council. Whether the timing of the NRC meeting was mentioned in the minutes as a reminder for the members of the Board who were also members of the NRC, or whether the timing was mentioned because the Board hoped to increase their collaboration with the NRC is unclear.279

The immediate reaction of the Board at its fourteenth meeting in Ottawa on 20 March 1950 was only mildly more promising than the Chief Superintendents responses had been to the first Symposium. The Board felt that the quality of the research at the second Symposium was good, which was a marked improvement from the first. Unfortunately, the quality of the presentations was low, with the biggest issue being the inadequate use of visual aids.280

One year later at the eighteenth meeting of the Board in Ottawa on 10 March, the third Symposium was planned. Again it had been pushed back, this time until September 1951. Over the year since the last Symposium the Board and headquarters had tried to switch the format

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from a single large meeting to several specialized meetings held at each of the establishments. The establishments resisted, and another large meeting was attempted.  

By the next Board meeting held from 21 to 25 June between Ottawa, Ralston (Suffield) and Esquimalt, the third Symposium had been delayed yet again. It was moved to early December from September because of conflicts with the Tripartite Special Weapons Conference and the American Chemical Society meeting.

The Symposium continued to occur, although for the duration of Solandt’s tenure as Chairman of the DRB the planning and discussion the Symposium no longer occupied the time and energy of the Board.

3.7.6 Management Structures and Personnel

The Board had more pressing issues resulting from the growth of the Defence Research Board in personnel and budget. Solandt had to consider how to reorganize the management levels of the DRB so that it was operating optimally. When he started the DRB Solandt had three deputies; Solandt and his deputies were supported by three scientific advisers to the Chiefs of Staff and two liaison officers. E.Ll. Davies was the most senior deputy and filled the role of Vice Chairman. Garnet Dunn, a chartered accountant from Winnipeg and veteran of the First and Second World Wars, was the Administrative Deputy to the Director General of Defence Research – he was responsible for personnel and general services. George Field was the Deputy Director General of Defence Research; he aided Davies and Solandt in the management of the establishments and the research program. Field also acted as the Scientific Adviser to the Chief of the Naval Staff; Maass and Stedman were the other two Scientific Advisers, and Carrie and Wright were the liaison officers (see Appendix E for tables of organization).

By 1949 the entire organization had grown as predicted by the original Five Year Plan. John Green was hired as the Scientific Adviser to the Chief of the Air Staff and he was given the additional title of Deputy Director General B; Field was re-designated Deputy Director General A. Field essentially retained his duties, while Green was assigned the special and time-

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consuming task of coordinating the Royal Canadian Air Force and DRB development projects (long a source of tension, both before and after Green’s efforts), as laid out as a priority in the Five Year Plan of 1949. This task required an overview of Canadian aeronautical research and resulted in Green’s recommendation of the creation of the National Aeronautical Establishment (see Appendix E for tables of organization).\textsuperscript{283}

This arrangement lasted until 1951 when there was a minor personnel shuffle, but a more significant realignment of responsibilities. Milroy Carrie returned from London, England to assume Maass’ position of Scientific Adviser to the Chief of the General Staff. As with the other two Scientific Advisers, Field and Green, Carrie became a Deputy Director General. The addition of a third Deputy Director General meant that a significant realignment of duties was possible. Field, as Deputy Director General A was in charge of Division A, which consisted of naval research (Field’s expertise), electronics and the Operational Research Group. Green was Deputy Director General B and he oversaw aeronautics (his field), armaments and medical research. Deputy Director General C, Carrie, assumed responsibility for: coordinating liaison (Carrie’s most recent experience), scientific intelligence, civil defence and ABC defences (atomic, bacteriological and chemical).\textsuperscript{284}

With Carrie returning to Ottawa the Defence Research Member (London) position opened up. G.P. Morrison, a recently retired Brigadier from the Canadian Army, and important manager in the growth of the Canadian Armaments Research and Development Establishment, assumed the post as a reward for his hard work (see Appendix E for tables or organization).\textsuperscript{285}

The arrangement of Defence Research Board headquarters in three divisions did not last beyond the beginning of 1952. Whitman Morton, who was formerly the superintendent of the Operational Research Group, was promoted to Deputy Director General D. The new Division D

\textsuperscript{284} Goodspeed, A History of the Defence Research Board of Canada, 89.
absorbed the Operational Research Group from Division A, medicine from Division B, and new fields of environmental protection and human resources.286

3.8 Canada in the World

3.8.1 The Unstable Globe, 1947 to 1950

Unlike most decisions in Canadian politics, the civil service, and the military in particular, the growth (and consequent realignment of management) of the Defence Research Board was not a realisation of astute navel-gazing. To be sure, there was a healthy dose of introspection that drove the DRB throughout its history and this tendency increased as the worldview of Canadians grew increasingly accustomed to the reinvented world and decreasingly interested in that world. However, the managers and Board members, along with the majority of Canadians, were inclined from 1939 to 1959 to be globally-minded. For most Canadians the globe consisted of North America, Europe and the rest. Particularly vexing for Canadians, especially British émigrés and sympathizers, was the decline of the British Empire following the Second World War.287

The decline of the British Empire also had an impact on Americans and their foreign policy. On 21 February 1947 the British informed the dominions (including Canada) and the United States of their intention to withdraw their funding from Greece and Turkey. The Empire proper subsequently collapsed. The Jewel of the British Empire, India, was granted independence by the end of the year. Both the process of decolonisation and Russian meddling alarmed Canadian and American leadership, and contributed to the increasing tension of the Cold War and gave the Defence Research Board a sense of urgency in its mandate.

Truman and the Republican-led congress were convinced of the severity of the threat and forged a new course for the United States. Mere weeks after the British announced they were withdrawing support from Greece and Turkey Truman took action. On 12 March 1947 he went before a joint session of Congress and advocated for American military intervention whenever

287 Bothwell, Drummond and English, Canada since 1945, 140; Bothwell, The Penguin History of Canada, 379-380; Bothwell, Alliance and Illusion, 121-124.
liberty and self-determination were threatened by totalitarian regimes around the world. The failure of appeasement was fresh in Truman’s mind. A year later the Truman Doctrine, as the speech became known, gained financial clout with the passing of the Marshall Plan. Initially the Marshall Plan earmarked $12.4 billion in aid to Western Europe over a four year period. By 1952, the Plan’s fifth year, the expenditure had risen to $17 billion in aid.  

Stalin’s response to the Truman Doctrine and the proposed economic aid to Western Europe was instinctive self-preservation. Communist coups in Czechoslovakia and Hungary ensued in 1947 and 1948. The situation became more pressing from a Western perspective when Stalin imposed a blockade on land-locked West Berlin, which was deep within the Russian controlled half of Germany. Given Russian superiority on the ground in Europe, Truman had only one option – an air lift and the threat of using atomic weapons if the Russians attempted to stop the air lift or endeavoured to gain any more territories through aggression. Stalin conceded defeat, for the time being, and lifted the blockade. Truman’s firm and successful stance against aggression strengthened his resolve in the coming years.

Many Canadians supported Truman’s actions. In a January 1947 lecture at the University of Toronto the Secretary of State (Minister) for External Affairs and future Prime Minister, Louis St-Laurent, stated the case for Canadians. Canada had an obligation to be united as a country and to be united internationally with countries that hold similar values, like the United Kingdom and the United States.

The Truman Doctrine and the Berlin Blockade brought the West closer together. Western Europe was convinced that a war with the Russians was increasingly possible and wanted to obtain American assurances that they would not retreat to their previous isolationist tendencies once the initial storm had blown over. Throughout 1947 and 1948 the North American and Western European countries negotiated. At King’s insistence the Canadian representatives were seen, but infrequently heard. The result of the negotiations was the North


\[ \text{Paterson, Clifford and Hagan, American Foreign Relations, 286, 293.} \]

\[ \text{Smith, Diplomacy of Fear, 217; Bothwell, Alliance and Illusion, 237.} \]
Atlantic Treaty Organization (NATO), signed in May 1949. It protected Europe from a ground invasion based on the threat of American atomic intervention. In the highly unlikely event that North America was invaded it assured a second front in Europe to relieve the pressure. The alliance, and new military technologies, opened up a wide range of possibilities for strategists to work through over the course of the Cold War, and a new set of countries with which the Defence Research Board could collaborate.

The first kink in the strategic armour afforded by NATO came in August 1949. Astute espionage and a crash program resulted in an atomic blast in Russia. The immediate threat was Western Europe, since Russia did not possess bombers in sufficient quantity or quality to attack North America. The high profile aspect of the Cold War arms race had begun. The Defence Research Board played a minimal, nearly negligible, role in the development of nuclear weapons. Instead the DRB focussed on related, and more affordable, technologies in the arms race.

A hostile Russia was problem enough for the western allies. Matters become more complicated in 1949 with the victory of Mao Zedong’s communist forces in China. The fall of China had a negligible impact on Canada and Canadians. There was little trade or history between the two countries.

The Americans were more troubled by the situation. They had long coveted influence in China, as far back as 1899 when Secretary of State John Hay circulated the Open Door notes. More recently the United States had supported Chiang Kai-shek’s nationalists in their fight against the communists with guns and money, and had supported both rivals in their mutual fight against the Japanese during the Second World War. In the wake of the disaster of 1949, Republicans questioned Truman’s ability to lead the free world in its fight against communism, and the United States’ State Department came under intense scrutiny, particularly from Senator Joseph McCarthy and the House Un-American Activities Committee (HUAC). For domestic

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293 Bothwell, *Alliance and Illusion*, 74-75.
critics the question of who lost China could only be answered in the United States; Chiang’s mismanagement and Mao’s determination were irrelevant in the debate.\textsuperscript{294}

The only small diplomatic victory the United States could win during the fall of China was refusing to acknowledge Mao’s government in the United Nations. In protest the Russians boycotted the UN. Russian grand-standing proved costly in the next phase of the global communist revolution.

3.8.2 \textbf{The Korean War, 1950 to 1953}

Korea, like Germany, was divided into occupation zones in 1945. The southern tip of the peninsula below the 38\textsuperscript{th} parallel was controlled by the United States. The northern half was controlled by Russia. Between August 1945 and January 1950 the military control zones had become political control zones. North Korea (the Democratic People’s Republic of Korea) was communist-controlled; South Korea (the Republic of Korea) was democratic. Both Korean governments were keen to see the country unified under their preferred style of government. Mao and Stalin signed an alliance in January 1950 and turned their attention to guiding Korea to its inevitable fate of unification under communist rule. They assumed that the United States would ignore an invasion, and allow Korea to slip the way China had. They miscalculated.\textsuperscript{295}

Truman turned to the United Nations after the 25 June 1950 invasion. The Russians were boycotting and did not veto the ensuing resolution. A largely American multinational force landed in Korea and after two months of losing ground alongside the South Korean army the UN coalition forces flanked the North Koreans with an amphibious assault. By November the UN forces had reached the border with China, which threatened the Chinese and forced them to intervene. By March 1951 the UN forces and the communist armies were stalemated at the 38\textsuperscript{th} parallel; thousands died on both sides, but no ground was gained. Fighting continued for two more years as a truce was negotiated.\textsuperscript{296}

The Korean War produced long-term results in the budgeting of North American governments. The United States provided around 50\% of the forces for the Korean War; Canada

\textsuperscript{294} Paterson, Clifford and Hagan, \textit{American Foreign Relations}, 300-302.
\textsuperscript{295} Paterson, Clifford and Hagan, \textit{American Foreign Relations}, 316-317.
\textsuperscript{296} Paterson, Clifford and Hagan, \textit{American Foreign Relations}, 318.
sent a mere 10,600 troops as well as abundant supplies and equipment. The United States spent $54 billion on the effort and lost nearly 55,000 personnel. By contrast, only 403 Canadians were killed.  

Defence spending in both countries ballooned as a result. In the United States it roughly doubled from one third of the total federal budget to two thirds. In Canada the standing forces were doubled and $5 billion was set aside for rearmament. Defence became the largest budget item in the Canadian federal budget for a decade and a half, and the Defence Research Board was one of the beneficiaries of the increases in personnel and budget.

3.8.3 The DRB and the Korean War

Solandt’s annual reports give a picture of some of the statistics that track the growth of the Defence Research Board through these tumultuous years. The Annual Report of the Chairman produced for the eighth meeting of the Board held in September 1948 covers the growth in the budget of the Defence Research Board over its first three years. In fiscal year 1946-47 the DRB’s budget was $2.4 million; the next year it was increased slightly to $3.3 million. For the fiscal year 1948-49 it was projected to be between $6.0 million and $6.5 million, with around $1.5 million dedicated for capital expenditures (buildings and equipment). These budgets were 1.3 to 2.1 percent of the overall Department of National Defence budget (see Appendix B).

Starting the following September, Solandt and the headquarters staff began preparing a table of the growth of numbers of personnel. This is summarized in Table 3.4. From 31 August 1948 to 31 August 1949 the overall staff of the Defence Research Board grew from 1182 to 1429 people. The bulk of the DRB’s personnel were employed in administrative (clerks, stenographers, etc.) capacities; the number employed in these positions climbed from 813 to 918. Scientists jumped from 117 to 179, and there was also growth in the supporting technical staff, as

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well as casual and seasonal labourers. Administrative-scientific staff increased from 14 to 19. Seconded service personnel stayed nearly constant (37 to 38), while consultants decreased (6 to 4) in favour of military personnel on loan (7 to 10).  

From 31 August 1949 to 31 August 1950 the overall staff increased from 1429 to 1627 personnel. The largest increases were in scientific and scientific administrative staffs. The number of scientists grew to 242 from 179; while administrators (essentially the senior scientists) grew to 25 from 19. Seconded service personnel dropped to 29, and seasonal labourers also dropped as the DRB’s establishments became permanent fixtures. Casual labourers and the administrative and technical staff also grew.

Table 3.4 – Number of Employees, 1948 to 1953

<table>
<thead>
<tr>
<th>Year</th>
<th>Scientists</th>
<th>Technical Officers</th>
<th>Managers</th>
<th>Administrative and Technical Staff</th>
<th>Consultants</th>
<th>Military Seconded / On Loan</th>
<th>Seasonal / Casual</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>117</td>
<td>-</td>
<td>14</td>
<td>813</td>
<td>6</td>
<td>37 / 7</td>
<td>106 / 85</td>
<td>1182</td>
</tr>
<tr>
<td>1949</td>
<td>179</td>
<td>-</td>
<td>19</td>
<td>918</td>
<td>4</td>
<td>38 / 10</td>
<td>146 / 115</td>
<td>1429</td>
</tr>
<tr>
<td>1950</td>
<td>242</td>
<td>-</td>
<td>25</td>
<td>1020</td>
<td>4</td>
<td>29 / 12</td>
<td>135 / 160</td>
<td>1627</td>
</tr>
<tr>
<td>1951</td>
<td>352</td>
<td>41</td>
<td>22</td>
<td>1304</td>
<td>7</td>
<td>21 / 7</td>
<td>185 / 198</td>
<td>2137</td>
</tr>
<tr>
<td>1952</td>
<td>376</td>
<td>71</td>
<td></td>
<td>1988</td>
<td></td>
<td></td>
<td></td>
<td>2435</td>
</tr>
<tr>
<td>1953</td>
<td>387</td>
<td>97</td>
<td></td>
<td>2158</td>
<td></td>
<td></td>
<td></td>
<td>2642</td>
</tr>
</tbody>
</table>

The next year up to 31 August 1951 saw the most drastic increases in personnel. The total number of employees grew from 1627 to 2137. There were increases in all categories except seconded service personnel, personnel on loan and administrator-scientists, which all decreased; the reductions in the three categories accounted for 14 lost employees. The bulk of the growth of the Defence Research Board over this year was driven by a significant increase in

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scientists, up from 242 to 352. Increases in support staff, including counting technical officers independently for the first time, accounted for the rest of the increases in 1950 and 1951.\textsuperscript{302}

By 1952 the number of personnel employed by the Defence Research Board had levelled off. There were now 376 scientists, up from 352 the year previously; technical personnel were up to 71 from 41. Slightly less than 250 employees had been added in the administrative, casual, seasonal, or seconded service to account for a modest increase in the DRB’s staff. In presenting this report to the Board Solandt predicted that the number of employees were unlikely to increase in the future due to the DRB hitting its ceiling in terms of allowed employees and the budget being capped.\textsuperscript{303}

Solanrt’s predictions of restrictions on growth were overly dire. The Defence Research Board increased in personnel again in 1953, but only marginally. Just over 200 employees were added to the strength of the DRB, of which 11 were scientists and 26 were technical officers. The DRB exceeded 2600 personnel, but it was experiencing a new problem. In 1952 the DRB lost 8% of its staff, primarily to industry. In 1953 the proportion had increased to 12%, because of industry’s interest in experienced personnel. Solandt was also annoyed that the Treasury Board’s approvals of the increases in personnel were slow in arriving after the start of the fiscal year 1952-1953 and the DRB had missed recruiting some of the stronger candidates from the most recent graduating class as a result.\textsuperscript{304}

The early events of the Cold War between 1947 and 1950 had convinced the Canadian government that national defence and defence research were important parts of the budget. The events, and St-Laurent’s response to them, confirmed that Canada would side with the United States and the United Kingdom in any future conflict. As the pattern of the Cold War became more stable after the Korean War, the Canadian government held its defence expenditures steady. Scientists and engineers had been drawn to the possibilities of the Defence Research Board.
Board in droves between 1948 and 1951, because of the threat of war, and because of the career opportunities offered by the DRB. The rest of the Defence Research Board’s existence was the fight of retention against attrition.

Not only did the Cold War shape the growth of the Defence Research Board, it also moulded the research projects undertaken by the DRB and its patterns of international and multinational collaboration.

The Korean War accounted for the largest increases in budget and the peak years for recruitment also came during that conflict. International events, of course, were the primary cause for a recruitment peak in 1950 and 1951. However, there was a practical consideration in terms of the timing that was perhaps fortuitous for all involved. Veterans like John Chapman, George Lindsey and Robert Sutherland, who had completed all or most of their undergraduate education prior to enlisting, and had returned to university after the war, were nearing the completion of their graduate educations from 1949 to 1951. The Defence Research Board had no trouble finding and recruiting new personnel under the circumstances of an engorged cohort of university graduates and postgraduates.305

Sutherland, for instance, was recruited to the Canadian Army Operation Research Team of the Operational Research Group in 1951. His first posting, like the majority of his wartime service, was with the army in the field. Sutherland went to Korea to work on operational research problems as they arose for the 25th Canadian Infantry Brigade. He investigated questions of artillery barrages and the effectiveness of flame warfare.306

The main fields of research for the Defence Research Board were already largely determined before 1950. The influx of personnel diversified the projects undertaken and infused much-needed talent for progress on those projects. In preparation for the eighteenth meeting of the Board, held in March 1951, the headquarters staff collected and circulated statistics on the division of labour. There were tables produced by each establishment, for instance Canadian Armaments Research and Development Establishment was working on guided missiles, weapons

and munitions, explosives and propellants, ballistics, and proof and firing trials. Guided missiles were considered a single project, but that project occupied one quarter of CARDE’s staff. HQ produced a summary of all the establishments by field, which is reproduced below.\(^\text{307}\)

Table 3.5 – Division of Labour by Field of Investigation, 1951

<table>
<thead>
<tr>
<th>Broad Field of Investigation</th>
<th>Number of Projects</th>
<th>Percentage of Total Projects</th>
<th>Percentage of Scientific Staff Engaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arctic Problems (DRNL)</td>
<td>14</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Armament (CARDE)</td>
<td>22</td>
<td>11</td>
<td>20</td>
</tr>
<tr>
<td>Telecommunications and Electronics (DRTE)</td>
<td>7</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Medical (DRML)</td>
<td>36</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Naval (NRE, PNL)</td>
<td>31</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Operational Research (ORG)</td>
<td>28</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Special Weapons (SES, DRCL, DRKL)</td>
<td>61</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>199</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>


With nearly one third of the total projects and one third of the total staff, projects in special weapons were the most significant part of the internal research program. Unlike electronics and medicine, special weapons could only be researched in defence establishments, because of the inherent dangers, the level of secrecy and the lack of commercial application. The extramural program in 1950 had nearly 50% of its resources devoted to electronics, but a mere 5% to special weapons. Combining special weapons with traditional munitions, the two fields account for 41% of the projects and 53% of the personnel of the intramural program. Arctic research had the fewest projects and the fewest personnel, because of the difficulty of recruiting personnel to live and work in Churchill year-round, and because the work there was dedicated to the two seasons: summer (mosquitoes) and winter (ice and snow).\(^\text{308}\)

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\(^{307}\) LAC, RG 24 S F1 Vol 11995 File DRBS 1-0-43-1 Vol 4, “Agenda No 5.5 (for the 18\(^{th}\) Meeting) – Consolidated Research and Development Programme – Defence Research Establishments,” Sheet No 3 “Research and Development - CARDE.”

3.8.4 NATO and the DRB

International and multinational liaison was influenced by events as well. The basic tripartite arrangement emerged from collaboration during the Second World War, but the North Atlantic Treaty Organisation offered new opportunities to moderately expand the scope of liaison.

According to Goodspeed, prior to the creation of the North Atlantic Treaty Organisation several Western European nations had formed a Scientific Advisory Committee of the Western Union in 1947. Canada and the United States were present as observers. When NATO was created it was to have subsumed the functions of this Committee, but instead the Committee merely disbanded with one exception – the Advisory Group on Aeronautical Research and Development (AGARD) continued functioning under the auspices of NATO, with moderately more investment by the Canadians and Americans. One member of the Defence Research Board and one from the National Research Council were present.309

However, NATO’s official version of the creation of the Advisory Group on Aeronautical Research and Development does not coincide with Goodspeed’s account. According to NATO, and this account appears to be supported by the Defence Research Board’s Deputy Director General John Green, the driving force behind the creation of AGARD was Theodore von Karman, an aerospace pioneer affiliated with the California Institute of Technology and backed by Harry Guggenheim. Von Karman had the idea for AGARD in 1949 after the creation of NATO, began pushing for it in 1950 and had succeeded by 1952. It is clear that Green and John Parkin were present for the 1951 meeting, but it is not clear whether Goodspeed is mistaken about the existence of the Scientific Advisory Committee or whether NATO’s official version of the story has been modified to place emphasis on the efforts of von Karman. Regardless, scientific and technical work was never NATO’s primary interest.310

NATO’s main function was coordinating the defence forces of the signatories against a communist invasion from the East. The setup relied on individual nations contributing forces and equipment. In order to standardize the equipment used by its forces, NATO made recommendations of equipment it required, but it relied on existing defence industries and national research to fill these contracts.

The main defence science requirement of NATO was operational research. The command structure of NATO took shape in 1950. Dwight Eisenhower was named the first Supreme Allied Commander Europe (SACEUR) in December 1950. As the Korean War unfolded, Eisenhower created a headquarters structure called Supreme Headquarters Allied Powers Europe (SHAPE) to prepare for war in Europe. Operational research and scientific advisers had proved useful during the Second World War, so they took a prominent role in SHAPE. Members of the Defence Research Board’s Operational Research Group, like John Abrams and George Lindsey, served tours with SHAPE or other elements of NATO’s command structure in planning for the air defence of Europe and anti-submarine operations to protect shipping to and from North America.311

3.9 The DRB and the Bomb

3.9.1 Air Defence and Operational Research

The event that shaped North American defence more than any other in the early Cold War was the detonation of the first Russian atomic bomb. Defence and intelligence experts knew a Russian bomb was inevitable, but its detonation in 1949 was ahead of the predicted schedule. Communist, particularly Russian, activities in Europe and Asia confirmed that the peace would be uneasy, at best.312

North American defence planning took into account the variables and deduced the logical plan of action. The Russians possessed the resources of a large infantry, and the willingness to slaughter successive waves of that infantry until they occupied whatever land they wanted.

Resolve alone was not going to prevent the overrun of Western Europe by a communist invasion. The defence of Western Europe hinged on the American bomb and bombers, and their willingness to use them (in combination with traditional forces) to counter aggression. During the planning stages of NATO this was the uneasy balance that prevented war.\footnote{R.J. Sutherland, “Canada’s Long Term Strategic Situation,” \textit{International Journal}, 17, No. 3 (1962), 210-211; C.S. Burchill, W.H. Pope and W.H.F. Caloren, “‘Canada’s Long Term Strategic Situation’: Three Critical Views,” \textit{International Journal}, 18, No. 1 (1963), 75-86.}

In 1949 the Russians upset the uneasy balance by acquiring the bomb. It was only a matter of time before the Russians would be able build long-range bombers, because they had acquired several American bombers during the Second World War. In American estimations, if the world’s military forces were a chess board, then the United States’ Strategic Air Command (SAC) was the queen, able to move freely about the board. A Russian bomb and bombers gave the communists their own queen who was able to directly threaten North America and SAC. The cool logic of strategic planning and war gaming concluded that the security of the western world depended on the security of SAC. Politics, geography, history and alliances necessitated Canadian action to protect the queen. The Royal Canadian Air Force jumped at the chance to be a sacrificial pawn in the nuclear chess match; politicians pondered, and then pontificated to Canadians that the role the RCAF was adopting was more akin to something glamorous like the bishop in the nuclear chess match.

The perceived threat to North America reinforced the pre-existing American affair with air power. It brought that fascination north of the border, where the Royal Canadian Air Force lobbied for and received substantial increases in both budget and importance. The RCAF pushed for acquisitions and development of fighters and related air defence technologies. In 1954, the RCAF surpassed the Army in ceiling of allowed personnel. Throughout the late 1940s and into the 1950s the RCAF also pushed for a closer marriage with the United States Air Force to increase the efficiency of North American air defence. The emphasis of planning on air defence gave it a budgetary priority in both countries and came to characterise the arms race of the Cold War for North Americans. In the United States, the Navy and Army attempted to respond to the growth of the Air Force by carving out nuclear and/or air defence roles for themselves (nuclear-
powered nuclear attack submarines and surface-to-air missiles, respectively). The Royal Canadian Navy and Army had no such recourse; Canada was avowedly non-nuclear.314

Unlike the Navy and Army, the Defence Research Board had a role to play in North American air defence. There were four ways in which the DRB participated in the evolution of air defence in the early Cold War. First and foremost, the Board held nominal control of the research and development purse strings for the entire Department of National Defence. The Board’s estimates matched the Royal Canadian Air Force’s – air defence was of prime importance, especially in the 1949 Five Year Plan – so a conflict over expenditures was unlikely.

Second, the Defence Research Board devoted research heavily to fields with a bearing on air defence. The DRB’s largest project was guided missiles, to the point that one in four scientists at Canadian Armaments Research and Development Establishment in Québec, DRB’s largest establishment, were devoted to the project. The DRB was also devoted to projects in telecommunications and electronics, which were largely related to air defence needs. Two of the four university laboratories supported by the DRB were entirely devoted to problems of flight (Mordell and Patterson); the other two laboratories were devoted to broader questions in electronics (Woonton) and computing (Gotlieb) that had a primary application in command, control and computation for air defence.

Third, the operational researchers of the Defence Research Board were highly active in planning air defence in North America. In 1946 American General Harry “Hap” Arnold created Project RAND (Research and Development) with the Douglas Aircraft Company’s founder Donald Douglas, Sr. RAND was essentially an operational research and strategic analysis think-tank. In 1948 it was rechristened the RAND Corporation and split from Douglas Aircraft to become a non-profit entity. RAND, in particular Albert Wohlstetter, is often credited with being the originator of the distinction between first and second strikes in a nuclear war. A first strike, also called a counter-force strike or an attack on hard targets, attacks and destroys the opposition’s nuclear weapons before he has the opportunity to deploy them. A second strike, also referred to as a counter-value strike or an attack on soft targets, comes either in response to a

first strike by an enemy, an impending first strike, or as a follow-up to a successful first strike; a counter-value attack targets cities with civilians.  

Robert Sutherland’s biographers, James Lee and David Bellamy, have summarized an historical priority dispute originated by Sutherland in response to RAND receiving credit for the distinction between first and second strikes in the war games of strategic analysts. Sutherland claimed in a 1966 paper, “The Strategic Significance of the Canadian Arctic,” which he contributed to an edited collection entitled *The Arctic Frontier*, that RAND consultants and policy analysts gave credit to a Canadian for realising the distinction between first and second strikes in military planning. Lee and Bellamy claim that historians James Eayrs and Desmond Morton believe that Sutherland was modestly referring to himself.

Sutherland’s lifelong friend and colleague George Lindsey discredits this theory. Lindsey told Lee and Bellamy that both Sutherland and their mutual colleague Harold Larnder informed him that Larnder was the one who came up with the idea. Lee and Bellamy are inclined to believe the theory that it was Larnder and the evidence appears to support them. Larnder’s pedigree as an air defence operational researcher stretched back to the earliest operational research group in the Royal Air Force’s Fighter Command before the Second World War. When he was hired by the Defence Research Board in 1951 he worked on air defence problems for the Royal Canadian Air Force’s Air Defence Command in St. Hubert, Québec. Larnder also spent time liaising with American operational researchers, including Wohlstetter

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316 DHH, Col 87/253 III (Box 6) File 0, “Dr RJ Sutherland: a Retrospective by James Lee and David Bellamy,” 3-4; R.J. Sutherland, “The Strategic Significance of the Canadian Arctic,” 266 in Ronald St J. Macdonald, *The Arctic Frontier* (Toronto: Published in association with the Canadian Institute of International Affairs and the Arctic Institute of North America by University of Toronto Press, 1966); Desmond Morton, *A Military History of Canada* 5th ed. (Toronto: McClelland & Stewart, 2007), 244.
whom he met in Washington. Sutherland, on the other hand, started with the DRB in 1951 in Army Operational Research and went to Korea. It was several years later that Sutherland became the most innovative and insightful operational researcher in Canada to concern himself with nuclear policies.  

Working informally and formally with the RAND Corporation was not the only tie that Defence Research Board operational researchers had to American strategic planning. When the United States Air Force contracted the Massachusetts Institute of Technology (MIT) to address the air defence problem in 1951, the Defence Research Board was involved. Project Charles was a study that determined if MIT was the appropriate place to conduct further research into radar defences. Based on its work in the Second World War on radar at its Radiation Laboratory, it was unsurprising that MIT was chosen as the ideal location for Project Lincoln. 

The Defence Research Board sent various operational researchers to Project Lincoln to address the problem of continental air defence. Project Lincoln assessed the tactics that were likely to be used and the technologies that would be required to fulfill those tactics. The first member of the DRB to participate was George Lindsey in 1951 when Project Lincoln considered the location and tactics for the Pinetree line of warning radar stations; he was joined by Foster from McGill University. Lindsey’s impression of the proposed radar net was that it would preserve the retaliatory force by giving warning, but it would not, without better methods of destroying incoming bombers, provide anything close to heavy attrition on the enemy. In 1953 an entire team of operational researchers returned to collaborate with the Americans as part of Project Counterchange. Project Counterchange was an assessment of the Mid-Canada and Distant Early Warning lines of radar; it originated from Project Lincoln and more importantly from the Permanent Joint Board on Defence (PJBD). 

The Permanent Joint Board on Defence was created as a result of the 1940 Ogdensburg Declarations, when Prime Minister King and President Roosevelt committed to continental 

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317 DHH, Col 87/253 III (Box 6) File 0, “Dr RJ Sutherland: a Retrospective by James Lee and David Bellamy,” 4-7.  
319 LAC, RG 24 S F1 Vol 4212 File DRBS 69-181-267-2 “ORG, Operational Research – Air Defence Project on Early Warning Systems,” “Internal Memorandum No. 12 from Lindsey regarding The Summer Study on Air Defence at Project Lincoln, September 1952,” and “Memorandum from Lindsey to Joint Intelligence Bureau (attention Mr. Bowen) regarding Defence Against Atomic War, 31 March 1953;” Jockel, No Boundaries Upstairs, 64, 66, 79.
defence. Roosevelt pledged aid in the event of an invasion, and King promised not to let Canada be a quick route for an invader to reach the United States. In 1953 the PJBD created a Military Study Group (MSG) to look at the problem of continental air defence, and it in turn sought scientific and technical advice.\textsuperscript{320}

The Canadian team was led by Abrams and his counterpart was the Director of the Research and Development Board’s Planning Division, Charles Mottley, who was “born in Canada, naturalized American.”\textsuperscript{321} The rest of the Canadian team was composed entirely of members of the Operational Research Group, including: Harold Larnder, George Lindsey, Colin Barnes (a University of Toronto professor on contract to the Operational Research Group) and Margaret Montgomery. Although Montgomery was listed as the DRB’s secretary, she was normally a full scientific member of the ORG; she married Harold Larnder and left the DRB for family life and a second career elsewhere in the civil service.\textsuperscript{322}

A Year later the Military Study Group created the Canada-United States Scientific Advisory Team (CUSSAT) as a more permanent advisory structure. Harold Larnder assumed responsibility for leading the team in 1954. Larnder was replaced from 1955 to 1957, when the project was completed, by Ian Cole who was one of the early pioneers of OR with Larnder at Bawdsey and then throughout the Second World War.\textsuperscript{323}

The fourth and final way that the Defence Research Board was actively involved in aiding the Royal Canadian Air Force with North American air defence was the DRB’s contributions to improvements in radar. This work in radar was closely tied to the other three

\textsuperscript{320} Jockel, \textit{No Boundaries Upstairs}, 11, 70-71.
\textsuperscript{321} NACP, RG Entry 5298 Box 9 File 4-g.8 “Canada Project Counterchange Extension of Early Warning System (Formerly Project 572-Corrode) 1952-4,” “Memorandum for the Files regarding Scientific group to advise on distant early warning system – Project COUNTERCHANGE Participants: Gordon Arneson (S/AE), AF Peterson and WL Wight (BNA), 18 May 1953.”
\textsuperscript{322} NACP, RG Entry 341 Box 534 File 111.7 “Defence Research Board of Canada,” “Letter from Walt Whitman to Omond Solandt, 26 May 1953,” and “Letter from Solandt to Whitman, 30 May 1953.”
contributions (budgeting, research and operational research). Three lines of radar stations were built across Canada and the Northern United States. The first was the Pinetree line of pulse radar stations that could track flight paths and plan interceptions. Construction of the Pinetree stations began in 1951 and ended in 1954 with an operational line of radar. The second line of radar stations were Canadian designed and made based on the double Doppler principle; it was called the Mid-Canada Line or the McGill Fence, the former based on its location and the latter based on its point of origin as a research project. Construction of the McGill Fence started in 1955 and did not end until 1958 when it became fully operational. The third and final set of radar stations was the Distant Early Warning (DEW) system that was placed furthest north and had the best operational capacities for detection and tracking. As a joint project its construction was fast-tracked in comparison to the Mid-Canada Line; it was started in 1956 as well, but it became fully operational in 1957.  

The idea to use the double Doppler principle apparently came from Wilfred Bennett Lewis sometime before 1951. Lewis was John Cockcroft’s replacement within Canada’s atomic project, but previously he had worked at Telecommunications Research Establishment on radar. Lewis’ idea to use Doppler measurements was passed onto the National Research Council’s Radio and Electrical Engineering Division and Garnet Woonton’s laboratory at McGill as the primary Canadian research facility on radar. Woonton delegated the project to a British ex-patriot and recent recruit, J. Rennie Whitehead when he arrived at McGill in 1951. The Radio Physics Laboratory of the DRB participated as well, and the main contractor was RCA Victor. Coordination of the various aspects of the project was given by Guy Eon of the Defence Research Board, who reported to George Field.

As with the other two lines of radar stations, there were field trials of the McGill Fence. These trials, called “Operation Spider Web,” were conducted in 1953 and 1954. The double Doppler principle was to set up transmitters and receivers in a line. Anytime a plane passed

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324 Jockel, No Boundaries Upstairs, 2-3; Jockel, Canada in NORAD, 11.
through the line it would change the frequency of the transmitted signal, which would alert the stations that something had passed through the web. The plane was a moving object and the electromagnetic waves being deflected by it were bound to obey the Doppler Effect. The Mid-Canada Line acted as a tripwire or detector, but could not pinpoint the range and direction of incoming targets. Full scale construction did not start until 1955. Because of their expense, redundancy and obsolescence in the face of both the Distant Early Warning system and Intercontinental Ballistic Missiles, the stations were decommissioned in stages starting with the western leg in 1964 and ending with the eastern industrial defence in 1965; Major D.H. Thorne suggests the lag in decommissioning the eastern leg was a result of American reluctance to admit that the Mid-Canada Line provided no additional warning time or even a reliability check for the DEW line.326

3.9.2 Montebello

This Canadian participation in the early Cold War nuclear arms race, particularly the collaboration with the United States in air defence has been thoroughly documented and analysed by many Canadians and a few Americans. What has not yet been documented is the collaboration of the Defence Research Board with the Atomic Weapons Research Establishment (AWRE) of the Ministry of Supply in the United Kingdom. The AWRE was created 1 April 1950 under the leadership of William Penney who had started official, but secret, work on designing a bomb for the UK in June 1947. On 3 October 1952, the AWRE detonated their first atomic device, a plutonium implosion bomb, off the Montebello Islands on the north-western coast of Australia.327


Solandt and C.J. Mackenzie offered what help they could to Operation Hurricane – expertise, diplomatic capital and Canadian facilities. On 13 August 1951 Penney wrote Solandt to indicate that the test would be held in Australia, but that the Royal Navy would prefer a test in existing United States testing facilities so that they would not have assume responsibility for transportation and security. Penney, at the suggestion of C.J. Mackenzie, requested that the DRB second several personnel to fill vacancies at Atomic Weapons Research Establishment. Meanwhile, Mackenzie, at the insistence of Howe, was tasked with securing American permission to test the resulting bomb in the United States. Mackenzie was unsuccessful in his quest to secure American collaboration, but Solandt gladly loaned several scientists to the British and responded to a request from Cockcroft that test sites could easily be located in Canada and that the government might be amenable to allowing small nuclear tests. Solandt and Mackenzie never had to persuade Howe to put the matter of Canadian territory being used for atomic tests before Cabinet, as the British were happy enough with the Australian arrangements.328

Solandt’s motivation for such close collaboration with Penney and the Atomic Weapons Research Establishment was threefold. He rose to prominence while working in British Operational Research and knew Penney and many of the other major figures personally. Second, Solandt knew the British were short of experienced personnel, and that part of the reason was his recruitment of British scientists; seconding Defence Research Board personnel to the AWRE was a way to balance the manpower drain. Finally, Solandt saw the utility of having Canadians trained in the design and development of atomic weapons. Canadians were locked out of the American program, and defence against atomic weapons was clearly important in the early 1950s.

Penney and Solandt agreed that the Defence Research Board would send three electronics physicists and two radiochemists. The five scientists were to be paid by the DRB and seconded to the Atomic Weapons Research Establishment; they were to go for a period of two years, which would include some preparation work, the test, and some reporting after the test. The

three electronics specialists (J. Alexander Carruthers – the most senior, Richard A. Kendall and Geoffrey M. Kerrigan) were found in November and travelled to the United Kingdom late in November and early in December. The DRB had more difficulty finding the two radiochemists.  

By February of 1952 in a letter to John Cockcroft, Penney had given up hope that the Canadians would be able to supply the radiochemists. Penney was disappointed as he felt the project would be a benefit to the Canadians, but he requested that Cockcroft send a pair of radiochemists from Harwell (the location of the British nuclear energy program). By the time Solandt located two radiochemists at Chalk River, Alexander Cruikshank and a man who only appears in the records as Grummett, and secured appropriate permission to transfer them to the Defence Research Board and then to the United Kingdom it was too late for them to participate in the construction of the bomb. Grummett declined interest in travelling to Montebello for the test for personal reasons, but he was given the opportunity to travel to the UK to fill in for those travelling for the test. Cruikshank participated in Operation Hurricane, despite British fears that he would not arrive in time to get his Yellow Fever inoculation.

In addition to the four scientists on loan, Solandt insisted that one more member of the Defence Research Board be allowed to observe the test and participate in the survey team: himself. Solandt’s previous experience on the scientific survey team that studied the medical effects of the blasts at Hiroshima and Nagasaki made him a clear asset, but his commitments to administration of the DRB limited the time he had available. Solandt knew that he would be able to secure a two or three month sabbatical without too many objections from his Minister. Seeing
how determined he was to participate forced the British to acquiesce as a reward for all the assistance Solandt had offered Operation Hurricane.331

However, Solandt’s participation created several headaches in the coming year for the British and Solandt. An ill-advised press release from Solandt pre-empted the British announcement of the program and also named the Canadians who participated. Solandt’s concern was mainly the aggravation this would cause, rather than any sort of breach in security. The British might have been annoyed by the release of information by Solandt, but Solandt’s punishment was countless inquiries from Americans and Canadians trying to secure more information about the project. Previously some Americans had been shocked in 1948 when they learned the British were undertaking reactors capable of producing plutonium, but Vannevar Bush had chastised his colleagues. According to Bush it was inevitable that the British would work independently when they were locked out of American information and materials; it was a matter of national pride, regardless of the expense. Operation Hurricane could not have been a surprise to the Americans. Solandt wanted to respond to his inquisitors that the British had a balanced program (weapons and energy), and Penney supported an announcement along those lines, but Lord Cherwell was opposed to a foreign national making a statement about the United Kingdom’s atomic research. Solandt, not wanting to alienate himself from the British any further, accepted Lord Cherwell’s opinion.332

The original four Defence Research Board scientists were replaced at the end of their two year tours in 1954. Problems arose with the exchange in 1955, because it had become obvious that Howe’s statement in the House of Commons that Canada had no intention of building atomic or nuclear weapons had become official government policy. Solandt and Frederick Brundrett planned a gradual extraction process for the four scientists (three from the DRB and one Army officer) on loan from the DRB so that no Canadians would have knowledge of how to


Of course suitable scientists had not been found, and Canadian expertise in thermal measurements exceeded British capabilities. A Canadian team, led by Alexander Carruthers, returned for Operation Buffalo in 1956 and one led by Parr Tate was present for Operation Antler in 1957, both held at the Maralinga test site. The Maralinga tests were the end of the line for Canadian observers of British tests; neither country was interested in continuing the practice of having Canadians present for atomic blasts, and the British thermonuclear tests, which started in 1956, were even more secretive and nationalized than the atomic tests had been.\footnote{TNA, ES 1/522 “UKAEA, AWRE, Co-Operation with Canada, General, 1957,” “Memorandum from R. Pilgrim, SSTD to C.A. Adams, CR regarding Canadian Liaison Officer, 18 February 1957,” and “Letter from Penney to Zimmerman, 16 August 1957;” Tate, “Nuclear Defence Research at DREO – 1953 to 1982,” 29-32 in Norman and Crow, \textit{A History of the Defence Research Establishment Ottawa}; Board, \textit{A Brief History of the Defence Research Establishment Ottawa}, 12-13; Longair, \textit{Early Defence Atomic Research in Canada}, 12.}

3.9.3 DRB and the H-Bomb

It helped the Canadian case that atomic liaison was more free and open with the United States than it had been in the late 1940s. John Arnell reminisced about an amendment to the McMahon Act once McMahon realized how important international cooperation had been to the Manhattan Project. The Burns-Templar Agreement of 1950 was at least partially responsible. However, American documents from 1951 and onward reveal that the Americans were still wary of complete exchange of information with the United Kingdom and Canada, because the UK was
more vulnerable to attack and because the Americans felt they produced more reports and documents.335

The stakes in the Cold War escalated starting in 1952. Former General Dwight Eisenhower was elected President the same month that the United States tested their first thermonuclear device, nicknamed “Mike.” The following March Stalin died and in August the Russians tested a type of nuclear bomb that used a fusion reaction to accelerate a fission reaction, the Americans called the test “Joe 4.” The first true American thermonuclear weapon was tested in 1954 and the Russians tested theirs in 1955. Thermonuclear weapons, or hydrogen bombs (H-bombs), work in two stages – the primary is a small fission reaction (often boosted with the addition of hydrogen isotopes), which sparks a fusion reaction of hydrogen isotopes (the secondary), both the primary and secondary stages induce further fission reactions in the uranium tamper and casing through radiative implosion and the transfer of neutrons respectively. The destructive yield from atomic to nuclear bombs increased from city-levelling kilotons to civilization-threatening megatons.336

The United States, under Eisenhower and his Secretary of State John Foster Dulles, moved in a new direction in terms of defence in January 1954. Nuclear weapons were cheaper than conventional forces, so Eisenhower decided to get the maximum deterrence for the minimum cost by employing nuclear weapons and a new nuclear strategy. Dulles’ speech on 12 January asserted the American option of using massive retaliation for any attack on the United States or its allies. In other words, any Russian or Chinese aggression could escalate rapidly into a nuclear war. The Americans hoped the threat would dissuade aggressive behaviour.337


While the new Eisenhower administration reiterated the same desire for collaboration on defence research with Canada and the United Kingdom, there was no marked shift in American liaison. Instead, the new policy, coupled with Canada’s decision to remain non-nuclear (or at least non-weaponized), forced the Defence Research Board to readjust its research program.\textsuperscript{338}

In his annual report to the Board in 1952, Solandt showed how important atomic policy was for the Services, Canada’s Allies, and how important it should be for the Defence Research Board as a result. Solandt, because of his recent observation of Operation Hurricane, identified “knowledge of, and preparedness against, atomic attack” as the most important task ahead.\textsuperscript{339}

At its next meeting in April 1953, because of nuclear testing and air defence planning, the Board decided to strike a Committee on Defensive Aspects of Atomic Warfare. The chairman of the committee was D.C. Rose of the National Research Council. Members of the committee included A.J. Cipriani and L.G. Cook from Atomic Energy of Canada, Limited, W.R. Sawyer from Royal Military College, Gordon Shrum from the University of British Columbia, Harry Thode from McMaster University, and Otto Maass from McGill University and National Defence Headquarters. The secretary was the Defence Research Board’s most experienced atomic employee, Alexander Longair.\textsuperscript{340}

In his annual report for 1953, Solandt claimed that Canada’s priorities for atomic and nuclear research were threefold. First, it was to devise and implement defences for Canada and Canadian troops abroad. The second priority was to indoctrinate troops on the actual conduct of atomic warfare. Third and finally, it was a priority to develop atomic power for industry. No doubt this list assembled by Solandt was influenced by Mackenzie.\textsuperscript{341}

While Solandt was compiling his annual report the Russians tested what was thought to be their first thermonuclear device (the Americans quickly responded that it was merely a

\textsuperscript{338} NACP, RG 330 Entry 341 Box 598 File 120 “Exchange of Technical Information,” “Memorandum from Dwight Eisenhower regarding Release of Information to Foreign Nationals, 25 May 1953.”


boosted fission bomb, rather than a true hydrogen bomb). The discovery had set the Americans on edge and this percolated through defence circles to the Defence Research Board. Solandt was now firmly in favour of an atomic program for Canada that included at the very least defences and troop indoctrination. Solandt also floated ideas of having Defence Research Northern Laboratory hosting a British test of a thermonuclear weapon once it was inevitably completed. He reiterated his desire to have DRB experts present for American tests. 342

As part of a commitment to direct contact with the British, John Cockcroft visited a Board meeting in 1951 and William Penney attended the twenty-eighth Board meeting to discuss atomic matters. Cockcroft was joined by Walter Whitman, the Chairman of the United States Research and Development Board for an extensive discussion of what Canada could contribute to atomic, biological and chemical warfare in the foreseeable future. Penney was joined by Alexander Longair in a lively discussion of atomic matters. Penney and Longair travelled to Washington following this Board meeting for a discussion with the Americans on long-range detection of nuclear weapons tests. 343

The Board then had a pre-meeting prior to the twenty-ninth Board meeting on the topic of atomic weapons. They were joined by Donald Quarles, who was the Assistant Secretary of Defense (Research and Development) at the Pentagon, who informed the Board that the United States was devoting most of its effort to preparing for nuclear exchanges rather than limited wars. 344

The Chiefs of Staff were unanimous in their appeal to the Board to devote more time and energy to the atomic threat in light of this American information. The minutes demonstrate how rapidly the American strategic language dominated the defence discussions in Canada. The Board’s Secretary, Archie Pennie, writes that

the surest way to maintain peace was to ensure that this continent had a retaliatory potential which would act as a deterrent to a possible enemy. Top priority should be

given to establishing this situation even though we may enter into limited wars in
the interim period. Minor wars will only remain as minor conflicts, as long as we are
technically ahead of the enemy, but they can be considered as potential all out wars when
we lose the technical initiative and lead. 345

Canada’s role, as seen by the Chiefs of the Staff and the other members of the Board, was to help
defend the retaliatory capacity of the United States to deter the Russians from acting aggressively
by maintaining a technical advantage. Given the option by the government, the Board, and
especially the Chiefs of Staff, were keen to acquire Canadian atomic and nuclear weapons. 346

Although the Chiefs of Staff were still working out their own new strategies and planned
to report back at the next Board meeting, suggestions were made to the DRB to work on
countermeasures, civil defence measures for civilians and industry, and education and
indoctrination for all Canadians (an expansion from previous notions of only indoctrinating
Services personnel). Working with the Royal Canadian Air Force, the Defence Research Board
was to start investigating a replacement for the CF-105 (which was still in the design and
development stages). It was also recommended that the Operational Research Group begin
investigating ways to deter bombing by altering the layouts of cities in order to separate targets
of interest. 347

Even though atomic research accounted for a small fraction of the Defence Research
Board’s agenda, it was an immeasurable part of the Board’s, the Chiefs’, and their allies’ anxiety
in 1954. Atomic research was split into four sub-categories in the 1954 allocations: atomic
weapons, protective devices, radiation detection and radiological intelligence. Combined these
four fields accounted for 2.4% of the total budget, and 3.6% of the manpower. 348

Alexander Longair was tasked with reorganizing the DRB’s atomic, biological and
chemical warfare program to account for the importance and fear surrounding atomic weapons.

345 LAC, RG 24 S F1 Vol 11997 File DRBS 1-0-43-2 Vol 7, “Minutes of the 29th Meeting of the Defence Research
Board held at Ottawa, 11 June 1954,” 2.
346 LAC, RG 24 S F1 Vol 11997 File DRBS 1-0-43-2 Vol 7, “Minutes of the 29th Meeting of the Defence Research
Board held at Ottawa, 11 June 1954,” 2 and “Minutes of the 30th Meeting of the Defence Research Board held at
Esquimalt, 9 October 1954,” 3-4.
347 LAC, RG 24 S F1 Vol 11997 File DRBS 1-0-43-2 Vol 7, “Minutes of the 29th Meeting of the Defence Research
Board held at Ottawa, 11 June 1954,” 2.
348 LAC, RG 24 S F1 Vol 11995 File DRBS 1-0-43-1 Vol 5, “Agenda Item 3 for the 29th Meeting of the Defence
Research Board: Memorandum from F.H. Sanders to the Chairman regarding Assessment of Defence Research and
Development, Fiscal Year 1953-54,” Table 2 “Major Technical Fields (scientific and financial expenditure).”
This was done in 1953 in response to the threat posed by thermonuclear weapons. Longair was supposed to reassign half of the Suffield Experimental Station and the Defence Research Chemical Laboratories to work on atomic problems. Although defences and protective gear that can be used against chemical or bacteriological agents are similar to the ones needed for atomic and radiological threats, there are fundamental differences in expertise. The request went against Longair’s instincts, but he followed orders as best as he could.\textsuperscript{349}

Alexander Carruthers, who had been part of the team sent to Montebello, was put in charge of the atomic defence section at the Defence Research Chemical Laboratories when he returned. After Carruthers’ arrival his section became the largest one at DRCL. They were responsible for thermal measurements and after they acquired supplies of cobalt, cesium and an x-ray machine they were able to conduct research of a more diverse array of radiation physics and radiobiology. Radiochemistry remained at Chalk River, and Alexander Cruikshank was hired to work for the Defence Research Board and was seconded to his former employer, Atomic Energy of Canada, Limited.\textsuperscript{350}

Atomic Energy of Canada, Limited played a small but significant role in the development of thermonuclear weapons in the United States and the United Kingdom. The National Research Experimental reactor was an extremely efficient producer of irradiated materials. These textiles, as the British called them, were dutifully shipped off to the US or the UK to be used as fissile material for atomic bombs (plutonium), or triggers for hydrogen bombs (actinium). The Defence Research Board’s contribution to the process was arranging for the Royal Canadian Air Force to transport the materials to the UK, which allowed the British to detonate their own thermonuclear device in 1957 over Malden Island in the Pacific Ocean as part of Operation Grapple.\textsuperscript{351}

\textsuperscript{349} Longair, \textit{Early Defence Atomic Research in Canada}, 10.
\textsuperscript{351} TNA, ES 1/519 “UKAEA, AWRE, Co-Operation with Canada, General, 1954,” “Letter from Penney to Solandt, 9 November 1954,” “Letter from Solandt to Penney, 15 December 1954;” TNA, ES 1/522 “UKAEA, AWRE, Co-Operation with Canada, General, 1957,” “Letter from W.P. Grove of Radiochemical Centre to Admiral Brooking the Assistant Deputy Director of AWRE, 1 February 1957.”
3.10 Solandt’s Final Years, 1953 to 1956

3.10.1 Special Weapons in the DRB after Reed

The more drastic and permanent change to the Defence Research Board’s special weapons research program was not the result of international intrigue or national politics. When Guilford Reed died 21 February 1955 the permanence of the Defence Research Kingston Laboratory and the bacteriological research program were called into question.352

Less than two weeks later the Board, at its thirty-first meeting, approved the creation of a special biological warfare review committee. This ad hoc collection of Board members became known as the Harkness Committee because it was chaired by Dickson Harkness during his second tour on the Board. Other members of the committee included Andrew Gordon, Harold Smith and Hartley Zimmerman. Louis-Charles Simard was to have served, but was unavailable. The secretary of the Board, Richard Martineau, served as the secretary for this special committee.353

The Harkness Committee was given a specific reviewing task. They were to investigate “the relative importance of biological warfare in future wars and the place that BW research should occupy in the Board’s program.”354 This investigation of the future prospects of biological warfare included interviews with Canadian experts from the Defence Research Board and the Armed Services. The interviews were all conducted over two days at the end of April 1955. From the Joint Special Weapons Committee they spoke to its chairman Brigadier R.W. Moncel and its special adviser Otto Maass. From DRB headquarters they spoke to E.Ll. Davies, George Field, Milroy Carrie and John Arnell. From the establishments they spoke to J.C. Clunie who was acting as Superintendent at Defence Research Kingston Laboratory. From the DRB’s

Biological Warfare Research Panel they spoke to its chairman Charles Mitchell and members J.H. Orr and C.E. van Rooyen.\textsuperscript{355}

Zimmerman prepared the four page report, which was submitted at the thirty-second Board meeting in June 1955. Goodspeed transcribes some of the important elements of the report into his official history of the Defence Research Board. Goodspeed highlights the fact that the bacteriological threat still existed, but it was not a threat that could inflict as much damage as nuclear weapons. There were two scenarios where the effects of biological weapons were perceived to be highest: in the wake of a disaster that disorganized a community or in the hands of a saboteur against key individuals or small groups. Canada, as a country with basic medical and biological knowledge, and an organized medical infrastructure was not realistically threatened by a biological attack.\textsuperscript{356}

The Committee concluded that the prudent course of action was for the Defence Research Board to ensure that the defences against biological agents were current. To minimize duplication of effort, the Committee recommended that any protective clothing that was being designed should be able to resist the effects of all three types of special weapons: biological, chemical and nuclear. In addition to protective clothing, methods of detection, analysis, treatment and decontamination were recommended as useful areas of study. The Committee suggested that there were available, but unused, researchers in Canadian universities who could solve some of these problems through grants-in-aid.\textsuperscript{357}

The emphasis in Goodspeed, and the bulk of Zimmerman’s report, is on the defensive aspects of bacteriological warfare and finding a way to satisfy tri-service policies. However, reading between the lines of Goodspeed’s summary of the defensive emphasis, one can see a portion of the Zimmerman report that Goodspeed did not summarize. Many comments were apparently made about the future of the Kingston Laboratory, but most of them were only noted as being suggestions that exceeded the terms of reference of the Harkness Committee. A few

comments, however, were summarized as being relevant to the Harkness mandate. The first of these was to “de-emphasize projects in the offensive aspect.”

Taken out of the context of the overwhelming evidence of the defensive nature of the research, muckrakers like John Bryden take this as evidence of what he sees as a sinister effort by the Department of National Defence to prepare for a type of warfare banned by the Geneva Protocol and abhorred by many Canadians. The other two suggestions for revisions to the Kingston agenda were to work on a more select set of problems defined by the Armed Services and to maintain continual contact with the Americans and British.

The report also summarizes the relative effort across Defence Research Board establishments and a comparison with the British and American programs. The Suffield Experimental Station had 6 full-time researchers and 16 part-time for a cost of $494,000 annually; Suffield was the location of any trials of agents that could be used against humans and was run for the benefit of the tripartite nations. The Grosse Île Experimental Station was staffed entirely by the Department of Agriculture, but the DRB supplied over half of the funding; it was the location of any tests of agents that could be used against animals. Kingston was the home of 5 full-time scientists and cost $666,000 annually; while Reed was there it was a training school for bacteriologists, microbiologists and virologists. Most of his problems were fundamental research questions. It was, in other words, a normal university laboratory that just happened to be engaged in research that had limited applicability outside of defence. A total of 11 full-time and 16 part-time employees worked on biological warfare in Canada.

Compared to the British and Americans, the Canadian program, as usual, was dwarfed. The British had 50 scientists working at the Microbiological Research Establishment at Porton Down. In addition to the field trials at Suffield, the Royal Navy conducted trials in the Caribbean Sea. The program was described in the Zimmerman report as limited and entirely defensive. The British program was modest in comparison to the American within the US

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Chemical Corps, which employed 1000 scientists and $16,000,000 annually. In addition to threats against humans and animals the Americans were the only tripartite nation to investigate threats against crops. The American program satisfied the needs of the Army, Navy and Air Force and investigated problems of both offence and defence.\footnote{LAC, RG 24 S F1 A 1983-84/167 Vol 7407 File 173-2 part 1, “Harkness Committee – Summary of Facts and Conclusions, 2 June 1955,” 1–3.}

Given the importance of field trials at Suffield to the tripartite arrangement and Grosse Île for limited Canadian field trials, the Harkness Committee recommended that both be retained. Kingston, however, was in need of a new and experienced Superintendent to manage a small program that should not exceed five scientists.\footnote{LAC, RG 24 S F1 A 1983-84/167 Vol 7407 File 173-2 part 1, “Harkness Committee – Summary of Facts and Conclusions, 2 June 1955,” 1–4.}

The problem of what to do with Kingston in relation to the special weapons agenda of the Defence Research Board remained for several years. The first decision was to coordinate the research programs of Kingston and Ottawa. The establishments were combined in management structure and assigned a single superintendent, Harry Sheffer. Sheffer took over as the superintendent of the Defence Research Chemical Laboratories in 1954 when John Arnell moved to headquarters for a year-long stint as Senior Scientific Staff Officer (Special Weapons) before becoming the Director of Scientific Intelligence; Sheffer had been working at the Ottawa chemical facilities as a member of the Army since 1942 when he completed his doctorate at the University of Toronto. In 1955 he was named the superintendent of the joint DRCL/KL (Defence Research Chemical Laboratories / Kingston Laboratory) establishment, while Clunie stayed on as the local superintendent in Kingston.\footnote{LAC, RG 24 S F1 A 1983-84/167 Vol 7407 File 173-2 part 1 “Organization & Administration, Defence Chemical Biological and Radiation Laboratories, DCBRL,” “Memorandum from E.Ll. Davies to Chief Superintendents, Superintendents and Directors regarding DRCL – Organization and Administration, 25 August 1952,” “Memorandum from H.W. Jamieson for the Chairman of the Defence Research Board to Chief Superintendents, Superintendents and HQ Staff regarding Appointments, 30 June 1955;” DHH, Col 85/333, Finding Aid for Dr. J.C. Arnell Papers; Harry Sheffer, “Personal Reminiscences of Early Days,” 11 in Norman and Crow, A History of the Defence Research Establishment Ottawa; Board, A Brief History of the Defence Research Establishment Ottawa, 15.}

The plan was to move the Ottawa facilities to Kingston to coordinate the combined research and to make room for the growing electronics section at Shirley’s Bay. The plan
reached the point where Sheffer had purchased property in Kingston and had plans to build a house on it, before the move was cancelled in 1957.\textsuperscript{364}

The plan to move from Ottawa did not go over well with all of the employees of the Ottawa facilities. W.E. Cowie, who was Head of the Protective Equipment Group, sent a memorandum to the Chairman of the Defence Research Board and Hugh Barrett, the Chief of Establishments. Cowie explained in the December 1955 memorandum that the Kingston facilities were not capable of expanding and needed to be replaced even to continue as they were. Cowie was particularly troubled by the difficulties of conducting protective equipment research geographically separated from the production facilities, and of having to travel to Suffield for any field trials. Much like Harry Sheffer, Cowie had his own problem with housing; he had recently found the perfect house in Ottawa and he was not interested in having to repeat the search in Kingston. Cowie felt that the decision to move to Kingston had already cost the DRB one employee and would likely result in further resignations of irreplaceable technical personnel and even much of the scientific staff in spite of the responses to a survey the DRB gave to the scientific personnel.\textsuperscript{365}

The Defence Research Board reversed the decision in January 1957. Instead of moving the facilities from Ottawa to Kingston, they opted to close the Kingston Laboratory and expand the facilities in Ottawa over a five year period. Barrett issued a memorandum indicating that all employees had been notified of the decision orally. Barrett was opposed to any written notice being circulated to employees for fear that it would fall into the hands of the media, who could then turn it into a dangerous political question in what would prove to be an election year.\textsuperscript{366}


\textsuperscript{365} LAC, RG 24 S F1 A 1983-84/167 Vol 7327 File DRBC 100-21/0 Part 1 “Organization & Administration, Defence Chemical Biological and Radiation Laboratories, DCBRL,” “Memorandum from W.E. Cowie (Head, Protective Equipment Group) to the Chairman of the Defence Research Board (attention H.M. Barrett, Chief of Establishments) regarding Transfer of DRCL to Kingston, 2 December 1955,” 1-2.

3.10.2 Facilities of the DRB

The state of the Defence Research Board’s buildings was, as Cowie pointed out, inadequate during the period of the DRB’s massive growth in the first half of the 1950s. The oldest buildings were temporary wartime construction, hastily constructed to meet immediate demands. The DRB was given the opportunity from 1950 to 1955 to build more permanent and versatile facilities.

Building construction, as already noted above (Table 3.1), peaked in the 1952-53 fiscal year at $6,363,000. This was the peak of a three year construction initiative taken during the Defence Research Board’s overall growth in personnel. In 1951-52 the DRB spent $4,745,000 and in 1953-54 it spent $4,657,000 on construction of new buildings. The Board hoped to have finished replacing its temporary wartime construction by the 1954-55 fiscal year. The permanent buildings constructed from 1950 to 1960 were still in use 50 years later, although all of those buildings were transformed over the years.367

The Defence Research Board erected permanent buildings for all the laboratories it created and also the ones it absorbed. In Halifax Harbour on the Dartmouth side the DRB built a three-floor facility surrounding the old French Cable Company, a solid building that withstood the Halifax explosion in 1917; previously the Naval Research Establishment had used whatever space was available between Dalhousie and the Royal Canadian Navy’s dockyards. Aside from renovations, there has been no new major construction at NRE.368

At Valcartier many buildings, including a central laboratory and several explosives test facilities, were dispersed on the grounds. Construction continued here for several decades including the construction of a wind tunnel. The buildings, while physically separated in a

section of the proving grounds closest to the village of Valcartier, are all reinforced and the safety of researchers was taken into consideration.\footnote{Goodspeed, \textit{A History of the Defence Research Board of Canada}, 119-123; Tardif, \textit{Recollections of CARDE/DREV}, 136; Gelly and Tardif, \textit{Defence Research Establishment Valcartier}, 58-60.}

In Ottawa the chemical and telecommunications laboratories were mostly moved from downtown, where they were close to the National Research Council buildings, to the outskirts of the city at Shirley’s Bay. The Electronics Laboratory remained on Montreal Road for a few more years. The land at Shirley’s Bay was taken from a section of a firing range of the Army. In total, six buildings were constructed for the Defence Research Chemical Laboratories and the Defence Research Telecommunications Establishment.\footnote{LAC, RG 24 S F1 Vol 12003 File DRB 70-0-1-32 “DRTE Sites – Acquisition of Land,” “Memorandum from A.E. Cooney (Property Section) to DGS regarding Permanent RPL Site, 17 June 1949,” and “Memorandum from A.E. Cooney (for Chairman DRB) to Quartermaster General regarding Connaught Rifle Range, Shirley Bay Area, 20 November 1952;” LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 4, “Minutes of the Fifteenth Meeting of the Defence Research Board held at Trenton, 9-10 June 1950,” 5; Norman, “DREO,” 4, and Nelms and Hindson, “DRTE,” 9, both in Norman and Crow, \textit{A History of the Defence Research Establishment Ottawa}; Board, \textit{A Brief History of the Defence Research Establishment Ottawa}, 7-8; Goodspeed, \textit{A History of the Defence Research Board of Canada}, 140, 195-197.}

A single building was constructed on the military grounds east of Kingston for Reed’s laboratory. The three-story Barriefield facility was, as Cowie pointed out, not suitable for the kind of expansion that would have been required to incorporate the four buildings worth of equipment and personnel from Shirley’s Bay. The permanent facility allowed Reed to move his research from the campus of Queen’s University.\footnote{LAC, RG 24 S F1 A 1983-84/167 Vol 7327 File DRBC 100-21/0 Part 1 “Organization & Administration, Defence Chemical Biological and Radiation Laboratories, DCBRL,” “Memorandum from W.E. Cowie (Head, Protective Equipment Group) to the Chairman of the Defence Research Board (attention H.M. Barrett, Chief of Establishments) regarding Transfer of DRCL to Kingston, 2 December 1955,” 1-2; Goodspeed, \textit{A History of the Defence Research Board of Canada}, 156.}

On the Downsview airbase in northern Toronto the Defence Research Board erected a spacious single building for the Defence Research Medical Laboratories. In later years the building was renovated, expanded and a second building was added; DRML was also joined at Downsview by the Royal Canadian Air Forces’ Institute of Aviation Medicine, which moved from its wartime location at the Eglinton Hunt Club on Avenue Road.\footnote{LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 4, “Minutes of the 17\textsuperscript{th} Meeting of the Defence Research Board held at Ottawa and Fort Churchill, 6-9 December 1950,” 6, and “Minutes of the 18\textsuperscript{th} Meeting of the Defence Research Board held at Ottawa, 10 March 1951,” 1-2; Goodspeed, \textit{A History of the Defence Research Board of Canada}, 140, 195-197.}
In Fort Churchill the Defence Research Board started with no fixed facilities at a military port. Over the years several huts were constructed to house personnel, equipment and experimental facilities. Most of the data collected by the Defence Research Northern Laboratory was done outside, and staff was always minimal, so construction was not extensive in Churchill.  

The Suffield Experimental Station was located on land that the Government of Canada had acquired during the Second World War. The village of Ralston, as already mentioned, was built near the testing grounds. Most of SES is barren land suitable for testing any kind of weapon. The laboratory facilities were constructed on the southwest corner of the test range, the area closest to Ralston.  

Finally, in Esquimalt the Defence Research Board built a single structure. Because it was on the Royal Canadian Navy’s Pacific base the Pacific Naval Laboratory had access to the docks. The building, as with so many others, was a three-storey facility made of reinforced concrete with a sterile and austere interior. Function trumped form in the Defence Research Board’s building designs, and the versatility of the buildings has proved useful since their initial construction.  

3.10.3 Management Structures  

To commemorate the Defence Research Board’s tenth anniversary the first, and official, history of the DRB was published in 1958. Omond Solandt suggested in December 1955 that a ten year history be produced for 1 April 1957 and that work needed to start in 1956. After several months delay, Wallace Goforth, who had been instrumental in the creation of the DRB from 1944 to 1947, was asked to write the history in March 1956. Goforth was working in

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Canada, 234-235; Defence and Civil Institute of Environmental Medicine, DCIEM, the First Fifty Years, 1939-1989 (North York, Ont.: Defence and Civil Institute of Environmental Medicine, 1989), 4, 18-20.  
Toronto at the time and he was approached by DRB’s Chief Scientist, George Field. After certain concessions from both parties – Goforth gave the Chairman of the Board final authority over publication and he acquired a research assistant – Field passed liaison for the project over to Milroy Carrie, who was more likely to be in the country to consult with Goforth. After two months negotiating the details, and a month of researching for the project, Goforth died in July 1956. The Defence Research Board was determined to write an official history of Solandt’s tenure, so the history was entrusted to Goforth’s research assistant, Donald Goodspeed. Goodspeed completed the project in little over a year, including a significant revision period placating various stakeholders, particularly the Royal Canadian Air Force who felt they were being portrayed poorly. The record of their objections vilifies the RCAF far more than Goodspeed did in the official history.376

With the official history underway Solandt turned his attention to adjusting the management structure so that it could deal with the post-Korean War stabilization of the Defence Research Board. These administrative realignments were yet another attempt to find the best way to manage the DRB’s activities, and also a way to set the DRB up for a future after Solandt retired.

When he finally stepped aside in 1956 Omond Solandt reminisced about his intentions and why he was leaving the Defence Research Board. Solandt felt that he had only intended to stay in the position for five years, to get the DRB started, and then to move on to something else. With the drastic increase in international hostilities at the five year mark, and the resulting growth of the DRB, Solandt was compelled to stay on. He was able to convince E.L.I. Davies to remain through the growth stage, but in 1955 they were both yearning to be elsewhere. Davies had been in Canada entirely too long for his liking and was keen to return to the United

Kingdom. Solandt felt he was ready for a new challenge and that it was time for someone else to have a hand in guiding the DRB. The problem of a logical successor was acute, since both the Chair and the Vice-Chair wanted to leave.\(^377\)

The Board never seems to have considered the possibility of finding a successor from within the administration of the Defence Research Board. In 1955 the divisional alignment was scrapped because of the difficulties in performing the dual role of supervision and advising. The new alignment had three branches: staff functions (science), command functions (establishments) and administrative functions. George Field became the Chief Scientist, Hugh Barrett became the Chief of Establishments and Garnet Dunn remained Chief of Administration and also became the Secretary of Board (see Appendix E for tables of organization).\(^378\)

Reporting to George Field were the Directors of the seven scientific directorates (Weapons, Engineering, Physical, Atomic, and Personnel Research, Scientific Intelligence and Scientific Information) as well as the Superintendent of the Operational Research Group. The full-time scientific advisers (Sanders, Morton and Abrams) were also nominally responsible to Field.\(^379\)

Hugh Barrett, who was formerly the Chief Superintendent at the Canadian Armaments Research and Development Establishment, Suffield Experimental Station and Porton Down in the United Kingdom, was an intermediary between the Vice Chairman and the Superintendents or Chief Superintendents of the Defence Research Board’s establishments. As Chief of the Establishments, Barrett was to track the progress of projects, follow career trajectories of employees and the finances of the establishments for construction, procurement, alterations and research (see Appendix E for tables of organization).\(^380\)

Within the Administration Branch were the Directorate of General Services, the Directorate of Personnel, the Joint Intelligence Bureau (JIB), the Public Relations Officer and the

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Secretary of the Board. The two Directorates handled the administrative and bureaucratic details so that the scientists could focus on producing science and technology. The Public Relations Officer, C.A. Pope was hired in 1952 to publicize the DRB’s activities and field questions from the media and the public. The Joint Intelligence Bureau, much like the Operational Research Group, was administered by the Defence Research Board, but reported to the military; JIB was responsible for producing information for the Chiefs of Staff Committee.\(^{381}\)

Rather than promoting one of the senior administrators like George Field, Hugh Barrett or Garnet Dunn to become the next Chairman or Vice Chairman of the Board, the preference was to entice a Board member to take on the job. The Board, of course, had undergone annual changes in membership (see Appendix E for tables of organization).

In 1952 Board membership was affected by two changes at the Cabinet level of the Canadian government. First, C.J. Mackenzie stepped aside from the National Research Council to run Atomic Energy of Canada, Limited when it was severed from NRC control. He was replaced by Edgar William Richard Steacie, whom Mackenzie had been grooming for the position for several years. Steacie assumed Mackenzie’s *ex officio* position on the Board of the Defence Research Board.\(^{382}\)

A year previously C.D. Howe’s portfolio in Cabinet changed. Howe, who was already the Minister of Trade and Commerce, became the Minister of Defence Production and a new department was created to deal with the military industries and materiel required for the Korean War. The Department of Defence Production (DDP) was similar in scope and function to the Department of Munitions and Supply that Howe had run during the Second World War.

After a year of existence it was realized that the gap between defence development, which was the Defence Research Board’s fiscal responsibility, and defence production required coordination and collaboration to bridge. The problem was amplified by the nature of the threats Canada faced, the Army was occupied in Korea whereas the Royal Canadian Air Force was preoccupied with continental defence. Giving the powerful Minister of Everything authority

across the spectrum of production and development was a way of managing and mitigating the existing tensions for the benefit of the war effort. To facilitate Howe’s influence across departments Hartley Zimmerman was appointed as the Department of Defence Production’s representative on the Board of DRB for a three-year term to ensure coordination between DDP and the DRB.

Zimmerman did not complete his three year tour. In 1954 he was chosen as Solandt’s successor. Zimmerman spent a little over one year training for the position, including receiving a couple of months of instruction from E.II. Davies. Reginald Brophy, the Deputy Minister of the Department of Defence Production assumed Zimmerman’s position on the Board.  

3.11 Conclusion

Much has been written and said about Solandt’s tenure as Chairman of the Defence Research Board. Donald Goodspeed reflected on it in the official history in 1958 and broader retrospective was attempted by a series of speakers at the symposium held in Solandt’s honour in 1994. More recently, Jason Ridler has reached the same conclusion as his sources: that Solandt was adored and has since been forgotten. There is near universal agreement that Solandt was the right man for the job, in the right place at the right time. Solandt was Charles Best’s protégé and a rising star in medicine before his talents were pressed into operational research and then scientific advising and managing during the Second World War. His international connections and recognition certainly helped the DRB in its liaison and tripartite activities as well as recruiting scientists and engineers to join the DRB. Solandt was forceful enough to guide a Board that included the Chiefs of Staff and C.J. Mackenzie, not to mention the assorted other strong personalities who served as temporary members. It is clear that much of the direction of the Board was Solandt’s and that he had a powerful and astute presence.

384 Goodspeed, A History of the Defence Research Board of Canada, v, 91-93; Grenville, Law and Lindsey, Perspectives in Science and Technology; Ridler, State Scientist, 293.
Solandt guided the Board through its growth period. Analogies to the Golden Age of Canadian Foreign Relations are not remiss here. In both cases the Golden Age was the result of international circumstances and how a select group of Canadian men responded to the changing world around them. The smallness of the world, especially in the reaches of those with power and influence in Canada, is particularly poignant. Solandt’s football coach at the University of Toronto was the man most responsible for Canada’s admirable foreign affairs from 1945 to 1957, Lester Pearson.

Events turned in 1956. Following the Suez Crisis of 1956 Canadians elected a government led by John Diefenbaker. Scientists around the globe agreed to collaborate on the International Geophysical Year. The impact of the events of 1956 to 1958 on defence research was far more profound than the change of the chairmanship. Zimmerman brought many of the same characteristics as Solandt, but with better connections to industries for the logical extension of many Defence Research Board projects. Solandt had been the right man for the job in 1945, and Zimmerman was certainly the right man in 1956. However, with the exception of the International Geophysical Year, the main source of changes in the DRB came from federal politics rather than the international forces that were more influential to Solandt’s DRB.
Chapter 4
Satellites and Royal Commissions: From IGY to the Centennial

4 Hartley Zimmerman, 1956-1967

4.1 Introduction

4.1.1 Biography

Adam Hartley Zimmerman was born in Hamilton in 1902 where he lived until he went to university. He graduated from Royal Military College in 1922 where he was the silver medalist. While there he befriended Edward Steacie. Zimmerman took graduate studies at the University of Toronto in mining engineering and entered the profession. Eventually he was hired by the Moore Corporation, a family of companies that produced ledger books; he was the Assistant Director of Research in Niagara Falls, New York. In 1941 Zimmerman’s managerial talents were requested by C.D. Howe in the Department of Munitions and Supply. Zimmerman started as the Director of Small Arms Production and then became the Director General of Signals Production. In 1945 he resumed his work with the Moore Corporation, but he returned to Ottawa in 1951 to act as Director of the Electronics Division in the Department of Defence Production. In 1952 he was appointed as the Department of Defence Production’s representative on the Board of the DRB by an Order-In-Council.\footnote{Goodspeed, \textit{A History of the Defence Research Board of Canada}, 92; Defence Research Board, \textit{The Defence Research Board of Canada}, 4-5; King, \textit{E.W.R. Steacie}, 7; A.H. Zimmerman, \textit{Who's in Charge here Anyway?: Reflections from a Life in Business} (Don Mills, Ont.: Stoddart, 1997), 10, 12-13.}

That Zimmerman had the confidence of Howe and Steacie made him an appealing candidate to replace Omond Solandt as Chairman of the Defence Research Board. His experience in defence production during the Second World War and the Korean War made him an invaluable asset to the DRB as it attempted to push some of its more mature research projects to development and as other projects required specific contributions from industries in order to reach completion. Zimmerman appears to have proved his worth to the Board with his work on the Harkness Committee.
In 1954 before Zimmerman’s three-year term with the Board was set to expire, he was replaced by Reginald Brophy, who was the Deputy Minister of Defence Production. Zimmerman was named as E.Ll. Davies’ replacement and Davies remained in Canada for a few months as a Special Assistant to the Chairman in order to train Zimmerman. In 1956, when Solandt retired from the Board and moved on to his new career at Canadian National, Zimmerman assumed his position as Chairman of the Defence Research Board.

With Zimmerman taking over as Chairman of the Defence Research Board there was a vacancy in the Vice Chairman position and no clear replacement. Zimmerman obviously wanted to put his own stamp on the Board, which he was able to accomplish through the annual renewals of the term members and finding a suitable Vice Chairman. It took Zimmerman a full year to find the next Vice-Chairman. John Keyston was previously the Superintendent of the Naval Research Establishment in Halifax and he was promoted to the position over several men who had been serving in DRB headquarters for five or more years. Keyston was not without his own qualifications, having been recruited from the (British) Admiralty research establishments.386

4.1.2 Themes

Zimmerman brought many of the same skills as Solandt to the chairmanship. He was well connected to politicians (Howe), bureaucrats (Steacie, Brophy) and industries (Moore, defence production – especially electronics). He did, however, bring his own managerial methods to the job. Zimmerman continued the process of circulating meeting agendas and recording the minutes of Board meetings, but he seems to have insisted on the disposal of unnecessary paperwork (or it has been lost or destroyed since). If not for the meticulous filing system of Robert Uffen and the sequence of events that lead him to keep his copies of Board minutes when they should have been destroyed, then there would be very little evidence that Zimmerman even held Board meetings. Zimmerman seems to have been as forceful and determined to run the Board and Defence Research Board his own way, just like Solandt before him and Uffen after him, but he was much quieter and less commanding than his predecessor, which lead to concerns about his suitability to be Chairman.

However, Canada and the world changed during Zimmerman’s tenure, and he was forced to respond to a different set of problems than Solandt. Zimmerman’s time at the Defence Research Board can be characterized by how he responded to three events: the International Geophysical Year (IGY), the election of John Diefenbaker and the election of Lester Pearson. The events resulted in mixed signals and conflicting imperatives. The IGY brought increased funding and recognition for northern and aerospace studies, as well as international collaboration and tension arising from the space race. The elections of 1957 and 1963 altered the Canadian political landscape including increasing the scrutiny directed at national defence (and defence research) spending, priorities and management. It was a tumultuous time to be the Chairman of the DRB, and the consequences of the events in Zimmerman’s tenure continued to impact the DRB until its eventual demise in 1977. From 1956 onward, Canada turned inward and domestic politics and priorities overshadowed international events and concerns; defence research, an inherently international activity, was bound to decline from the Solandt golden age regardless of who was Chairman.

4.2 New Operating Procedures, 1956 to 1958

4.2.1 Canada in the World

Hartley Zimmerman’s tenure as the Chairman of the Defence Research Board began with an international situation that had profound and long-term effects on Canada. The international situation was the climax of Canada’s golden age of foreign relations, and consequently the harbinger of reductions in Canada’s national defence and defence research spending.

On 21 July 1956 Egypt nationalized control of the Suez Canal from the Suez Maritime Company (a multinational controlled primarily by British and French interests) that had run the canal since its construction. Egypt’s nationalization of the Suez Canal and its procurement of weapons from Czechoslovakia were troubling and drastic for the British, French and Israelis. The crisis heightened when the United Kingdom, France and Israel arranged in secret to reverse the nationalization of the Suez Canal. Israel would invade Egypt and the British and French would intervene to separate the Egyptians and Israelis (mostly by attacking the Suez Canal region) which would demonstrate that the nationalization had to be reversed. On 29 October Israel duly invaded and two days later the British and French began preparing to intervene by
bombing the Suez Canal region. The crisis became international, and the United States was unimpressed with the British and French action.\textsuperscript{387}

The Canadian government was left in an unenviable position of being privately frustrated with the British for their desperate attempt to retain empire and for alienating the United States. Publicly, the Canadian government had to remain calm and ambivalent. Lester Pearson made the most of the situation and his numerous international contacts by brokering a United Nations resolution that satisfied the United States and allowed the British to save face by participating in the United Nations Emergency Force (the peacekeepers) before being replaced by Canadian and other non-belligerent forces. As the face of the United Nations maneuvering Lester Pearson was awarded the Nobel Peace Prize in 1957.\textsuperscript{388}

Although not obvious at the time, the Suez Crisis of 1956 began two trends that affected national defence and defence research in Canada. First, it highlighted the need for the Canadian military to be able to respond to threats abroad that could eventually lead to a war that would embroil Canadians. It did not negate the need for North American defence (Canada’s contribution to deterrence), and events that followed the Suez Crisis ensured that continental defence remained a priority, but it showed that there was more to Canada’s national defence requirements than air defence.\textsuperscript{389}

Second, the Suez Crisis and the eventual shifting of emphasis from mostly continental defence to a combination of continental defence and mobile tactical forces caused the Defence Research Board to reorient its research program in support of the Department of National


Defence’s evolving mandate. The period from 1956 to 1977 is characterized by both the Department of National Defence and the Defence Research Board attempting to discover their role in the world and in Canada as the Canadian government determined and defined a new role in the world.390

4.2.2 The Elections of 1957 and 1958

However, the most important effect of the Suez Crisis for Canada, and eventually the Defence Research Board, was how the event was interpreted in the election of 1957. John Diefenbaker, a British loyalist, viewed Pearson’s actions as disloyal, verging on treasonous.

Aside from Suez, which John Diefenbaker spun as a foreign relations gaffe, the ruling Liberal party had fostered the creation of numerous domestic issues that came up in the 1957 and 1958 election campaigns. These included the Trans-Canada Pipeline and energy policy in general, economic and social regionalism (especially Québec and Western Canada), and the recession of 1957-1958. There are several excellent explanations why Diefenbaker won the elections in 1957 and 1958. Two of these explanations have a bearing on changes in the way the country was governed after 1957, and in particular how the importance of national defence declined.391

First, Diefenbaker represented a new type of politician, despite all his reverence for the past. His debating skills were remarkable, but they followed a decade-long American trend of dealing in absolutes. Senator Joseph McCarthy was the epitome of this type of political debate-master. Either you agreed with McCarthy or you were his enemy, and if you were his enemy, then you were an enemy of the United States and therefore a communist. There was no grey, no room for compromise, just black and white. Diefenbaker did not use the same anticommunist

rhetoric, but either you were with the Chief or you were against him, especially within the party and Cabinet.\textsuperscript{392}

Second, Canadians flocked to the leader in record numbers, especially in 1958, and Canadian politics became less about the party and more about the leader; a drastic change from King and St-Laurent who had done their best to be invisible. The Progressive Conservative Party also introduced Canadian politics to the benefits of professional public relations in election campaigns. Dalton Camp masterminded the Progressive Conservative Party machinery modeled after the Liberal party’s and also introduced calculated advertising and campaigning that closely resembled American electioneering.\textsuperscript{393}

The importance of civil servants in the formation of policy drastically changed starting in 1957. Most civil servants, certainly all of the employees of the Defence Research Board, were hired or appointed when the Liberal Party ran the country, which was a fact that John Diefenbaker never overlooked. The Liberals and civil servants had a common understanding of how they should sustain each other. Diefenbaker had a different understanding of how the civil servants, and his Cabinet and caucus, should support him. Diefenbaker wanted to make decisions and he wanted these decisions to be the basis of his popularity and election success.\textsuperscript{394}

4.2.3 Diefenbaker and Defence

The most common story about how the civil service changed under Diefenbaker and the impact this had on national defence is the Avro Arrow. In a country typically averse to spending on defence the Korean War was an exception. Unlike the end of the Second World War, when forces were demobilized immediately and funding to the Department of National Defence reduced drastically, the Korean War lacked a firm resolution. Following the flurry of activity there were two years of stalemate before an official cease fire. National defence spending peaked from 1951 to 1953, but following the Korean War it did not return to levels of the late 1940s because the government was spending money on continental air defence expenses (see Appendix B).

\textsuperscript{392} Smith, Rogue Tory, 220-223, 331.
\textsuperscript{393} Dalton Camp, Gentlemen, Players and Politicians (Ottawa: Deneau & Greenberg, 1979; 1970); Bothwell, The Penguin History of Canada, 391-392.
\textsuperscript{394} Newman, Renegade in Power, 252; Smith, Rogue Tory, 249-250, 261; Bothwell, The Penguin History of Canada, 391-392.
When Diefenbaker took office the country dipped into a recession, and national defence spending was reduced after a local high watermark in 1956-57. After three years of decreasing national defence budgets there was a moderate increase in 1960-61 and a slightly bigger increase in 1962-63. Throughout Diefenbaker’s term as Prime Minister the budget fluctuated between $1.53 and $1.72 billion (see Appendix B).\textsuperscript{395}

The lowest years for national defence funding under Diefenbaker were 1958-59 and 1959-60; the beginning of the decline of the importance of national defence in Canada came in February 1959. There had been hints for over a year, but the cancellation of the Avro Arrow (also known as the CF-105) project still came as a surprise to the executives at A.V. Roe of Canada. Cancelling the Arrow was the fiscally responsible move, since the escalating price-per-unit of the fighter-interceptor had skyrocketed. The decision had the support of many civil servants, even within the Department of National Defence including the Royal Canadian Air Force, but it had enough opponents within and outside the civil service to become problematic for Diefenbaker. Diefenbaker’s confidence to make decisions was linked to his popularity with the people, but the fallout from the cancellation of the Arrow made the Chief realize that his popularity was tenuous and not guaranteed. Diefenbaker’s confidence diminished and his fury at civil servants for leading him astray resulted in even further drastic changes to the relationship between the civil service and parliament.\textsuperscript{396}

The problems for the Arrow started on the same day as its public unveiling, which happened to be the same day that the Russians launched Sputnik, 4 October 1957. The satellites that followed Sputnik surpassed it in scientific function, rendering it the first piece of space junk, but the scientific and technical importance of getting an object into orbit was monumental. Of the many defence possibilities opened up by Sputnik the most threatening to the Arrow was the possibility of unmanned ballistic missiles reaching North America from Russia. The Arrow was designed to intercept manned bombers not intercontinental missiles, but guided missiles held some promise for defending against both bombers and intercontinental missiles. Canada needed the cheapest and most versatile defence options available, the cost over-runs of the Arrow made it the least cost-effective and the least versatile option. Canada was in a recession in 1958 and

\textsuperscript{395} See Appendix B; Bothwell, Drummond and English, \textit{Canada since 1945}, 213.  
there was very little appetite for expanded national defence spending. The Arrow followed its Velvet Glove missile onto the scrap heap.397

The Department of National Defence was unhappy with its budget restrictions. The Defence Research Board, in particular, had obtained the first increases in its overall budget since 1950 in 1957, and then it was faced with retrenchment. The only option open to a department when its funding is not what it expects, is to lobby for increases. This lobbying permeates the activities of ministers, deputy ministers and assistant deputy ministers who have to take into account the increasing cost to run their departments (salaries, capital expenditures, repair, maintenance, etc.). When the desired results are not forthcoming through the normal political channels, the only remaining recourse is an appeal to the voting public. This appeal to the public can be indirectly accomplished through leaks to sympathetic journalists or directly during speeches.398

The Department of National Defence exhausted all of these options from 1958 onwards with very little success. Peter Newman and journalists in Ottawa were aware of the ire elicited by Diefenbaker within the Department of National Defence and the entire civil service, but Diefenbaker, having already felt betrayed by civil servants, was not in a mood to be persuaded. Canadian voters were even less interested – they were weary of war and preferred to simply ignore the problem than take the need for war-readiness seriously.399

Jon McLin’s insightful work on national defence from 1957 to 1963 was written with the benefit of unimpeded access to national defence papers and working materials – materials that are, in some cases, still inaccessible and in other cases destroyed or lost. McLin, as an American, brought a unique and rare perspective to the study of Canadian national defence and foreign relations. Canada, McLin reminds us, has been a middle power in an alliance with a superpower since the Second World War. Projects and priorities are overwhelmingly determined by the superpower. The highest priority of Canadian defence research and defence industries following the Second World War was to create and maintain a capacity in order to contribute to the

397 McLin, Canada's Changing Defense Policy, 69.
399 Newman, Renegade in Power; Smith, Rogue Tory, 310-325.
alliance. A secondary priority was to manufacture tangible defence goods where Canadian industry had a unique expertise.400

4.3 The International Geophysical Year of 1957-1958

4.3.1 The DRB and the Upper Atmosphere

As part of the Defence Research Board’s mandate within the Atlantic Triangle they were intrigued by the problems of communications in Canada’s North. Because of the remoteness of settlements and armed forces units in the North, long distance radio communications are essential. In the 1920s amateur radio enthusiasts discovered the benefits of shortwave (high frequency) radio for propagation over long distances like the Atlantic or Pacific. These waves rely on the density and other properties of the ionosphere for reflection back towards the curved earth (otherwise they would continue in a straight line into outer space); the ionosphere and the surface of the earth act as a waveguide, which allows the shortwaves to propagate over long distances. This phenomenon is known as ‘skywave.’401

The ionosphere is relatively predictable in the tropics. During the day the D-layer of the ionosphere is most active because of radiation from the sun and this layer absorbs waves with low frequencies while permitting high frequencies to propagate. The D-layer diminishes at night and lower frequencies within the shortwave band propagate easier than higher frequencies. Unfortunately, closer to the earth’s magnetic poles the properties of the ionosphere are less predictable than the tropics or temperate regions. The Radio Physics Laboratory of the Defence Research Board began mapping and tracking the changes of the propagation properties of the ionosphere in order to improve long-distance communications in the North.402

400 McIn, Canada’s Changing Defense Policy, 3-8. For more recent takes on a similar topic, one could look at two books, the first is a textual analysis and comparison of strategic ideologies, and the second is a survey of Canada’s nuclear acquisitions throughout the Cold War Andrew Richter, Avoiding Armageddon (Vancouver: UBC, 2002); Sean M. Maloney, Learning to Love the Bomb: Canada’s Nuclear Weapons during the Cold War (Washington, D.C.: Potomac Books, 2007).
402 McNamara, The Ionosphere, 97-100; Schunk and Andrew Nagy, Ionospheres, 366-431; “Shortwave” and “Skywave,” Wikipedia.
Throughout the 1950s the Radio Physical Laboratory (formerly the Radio Propagation Laboratory) team meticulously sounded the ionosphere from the ground. They created thousands of ionograms, which contributed to the creation of what the Defence Research Board called “a high frequency radio prediction system especially designed for use in the high latitudes. It is considered the best available for the polar regions.”\(^{403}\) In other words, their meticulous observation of the ionosphere (and sunspots and magnetic data) from the ground over several years gave them the best predictive model available.\(^{404}\)

Unfortunately for the radio propagation experts, as historian Edward Jones-Imhotep points out, their ionograms were only of limited use. Any beams fired from the ground could penetrate the ionosphere to varying depths depending on the energy (and therefore frequency) of the beams. At some threshold energy, however, the beam would pass entirely through the ionosphere and reveal no further information about the upper portion of the ionosphere. The only way to find out if there was any ionosphere above the densest layer, and what its physical properties were, was to sound the ionosphere from above (the topside). The radio propagation experts of the Defence Research Board wanted to learn all of the properties of the ionosphere from the bottom to the top so that they could predict the communications properties and variations.\(^{405}\)


4.3.2 IGY

Not only did the DRB’s interest in the ionosphere satisfy a uniquely Canadian research need, but it coincided with American and international research initiatives in the 1950s and 1960s. In 1950 a group of international scientists decided to hold an International Geophysical Year from 1 July 1957 to 31 December 1958 to coincide with increased solar activity. The emphasis, of course, was on earth sciences and the 18 months of peak solar activity would merely allow for increased scientific exploration in rare circumstances. The group was led by ionospheric research pioneer Lloyd Berkner and space researcher James Van Allen. Their initial ad hoc discussion was confirmed two years later by the International Council of Scientific Unions.  

The properties of the ionosphere are susceptible to radiation from the sun, so ionospheric studies were an important part of the itinerary for the International Geophysical Year. There were ten other fields of study. The Defence Research Board had minimal interest in three of these fields (cosmic rays, gravity and solar activity), and a much higher interest in seven (the aurora, geomagnetism, precision mapping, meteorology, oceanography and seismology). Globally, the International Geophysical Year, which was a continuation of the previous International Polar Years (1882-3 and 1932-3), was focused in the Antarctic. Canada, through the Defence Research Board, concentrated its activities in the Arctic at existing research stations of the Defence Research Northern Laboratory and the ionospheric study northern field stations of the Defence Research Telecommunications Establishment (Radio Physics Laboratory), and additionally opened a temporary research station at Lake Hazen on Ellesmere Island.

Ellesmere Island is adjacent to the northern part of Greenland and is the largest and most northerly island of the Queen Elizabeth Islands. Lake Hazen is at the north-eastern end of the island and is large enough to have islands of its own; it is entirely within the Arctic Circle, but summer temperatures are generally as warm as the northern parts of mainland Canada, so it was an ideal situation for year-round research associated with the International Geophysical Year.

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The leader of the research expedition, as with all expeditions the Defence Research Board made to Ellesmere was Geoffrey Hattersley-Smith, a glaciologist from London, England who received a Ph.D. from Oxford for his DRB work on Ellesmere and the Canadian North from 1951 to 1956. Logistics for the International Geophysical Year expedition were coordinated by James Croal, the first employee of the Defence Research Northern Laboratory. 409

4.3.3 The Space Race and the Alouette

The International Geophysical Years is perhaps best remembered for the Russian and American space race. The Russians launched Sputnik I in October 1957 and Sputnik II in November. The American Navy already had plans to launch a satellite named Vanguard during the International Geophysical Year, but Sputnik accelerated and expanded American missile and satellite development. The American Army now got into the race to launch its own satellite named Explorer. The first Explorer was launched in January and was the result of the work by Wernher von Braun. The Explorer observed the belt of radiation that James Van Allen had predicted. 410

In addition to the American military efforts a civilian agency was created to take over the American space race, the National Aeronautics and Space Administration, more commonly known by its acronym, NASA. After its creation in October 1958 NASA solicited proposals for research payloads that it could deliver into space. The Defence Research Telecommunications Establishment seized the opportunity to further its ionospheric research by proposing a topside sounder. The proposal involved all aspects of the Defence Research Telecommunications Establishment in Ottawa, which was split into an Electronics Laboratory (EL) and the Radio

Physics Laboratory (RPL). RPL needed a topside ionogram, and EL needed a large-scale project.\textsuperscript{411}

Chief Superintendent James Scott, and former Chief Superintendent Frank Davies, who was now at headquarters assisting George Field, the Chief Scientist, supported the project. The proposal was put together by John Chapman, Eldon Warren, Colin Franklin and several other scientists, engineers and technicians at DRTE. It was submitted to NASA at the end of 1958 and accepted a few months later. In close collaboration with the Americans, whose Thor-Agena B rocket was set to be the delivery vehicle, DRTE began to design the satellite from the ground up.\textsuperscript{412}

The satellite required a series of innovations and inventions. Internally the project was known as S-27, but at launch it was rechristened by Chairman Hartley Zimmerman as the Alouette. It required batteries, and a means of charging them, to power the topside sounding equipment (a transmitter and receiver capable of a variety of frequencies) and a means of transmitting the data back to the Defence Research Telecommunications Establishment for collection and analysis. It could not exceed 145 kilograms, as this was the maximum payload of the Thor-Agena B. Work began in earnest in 1959 and the first Alouette was launched 29 September 1962.\textsuperscript{413}

4.3.4 The Black Brant Research Rocket

While working on the S-27 the Defence Research Telecommunications was also collaborating with the Canadian Armaments Research and Development Establishment on a project to continue ionospheric research in the interim. After the cancellation of the Velvet Glove program in 1956 CARDE was in need of a major project that would be a clear

continuation of its established expertise in missiles. The decision was made to transfer some of their skilled staff to Canadair for work on the Sparrow missile and the remaining scientists and engineers were given the task of creating a research, or sounding, rocket.

A sounding rocket is one where both the delivery vehicle and the payload follow an elliptical path that returns them to the ground. In other words, it does not deliver a satellite into orbit, but it can launch research equipment to heights that are unattainable by balloons. This includes the layers of the atmosphere like the aurora and the ionosphere that were of particular interest to the Radio Physics Laboratory.\(^{414}\)

The various wings of the Canadian Armaments Research and Development Establishment set to work on their components of the problem. The Chemistry Wing investigated fuels, including high yield solid fuels. As this was an innovative fuel, the Chemistry Wing had to build and operate a pilot plant. The Mechanics and Systems Wings set to work on a motor to burn the fuel and the work on the airframe was contracted out, based on CARDE’s design specifications to Bristol Aircraft Company of the United Kingdom, which had a branch in Winnipeg, Manitoba.\(^{415}\)

The resulting rocket was called the Black Brant. As with the Alouette, the name was taken from a bird, in this case a goose, and with the Alouette, a lark. The first Black Brants were flight tested at the Defence Research Northern Laboratory in September 1959. The success of these tests allowed the rockets to be fitted with equipment to study the upper atmosphere. In addition to the previously mentioned interest in the ionosphere for communication, the Canadian Armaments Research and Development Establishment had their own reasons for creating and testing the rockets.

The first reason that CARDE was keen to build the rockets was as a replacement for the Velvet Glove project. CARDE needed a large project to make use of its facilities and expertise, and this project had to include close collaboration with industry.


The second reason that CARDE wanted a sounding rocket was to fulfill their research obligations related to ballistic and anti-ballistic missiles. In the early 1950s the reality of Intercontinental Ballistic Missiles became a design project, rather than a hypothetical futuristic weapon. Thermonuclear weapons were increasing the yield of the nuclear weapons while at the same time reducing their size. The remaining problem was designing a rocket capable of carrying the warhead payload to its appropriate destination. This was no small feat as it required advances in design, fuel, and navigation and guidance. As the likelihood of intercontinental missiles increased throughout the 1950s the Defence Research Board began preliminary investigations into the topic.  

Researchers at the Canadian Armaments Research and Development Establishment were primarily interested in defence, rather than exploratory research into building intercontinental missiles. In order to learn about defence, CARDE had to understand the physics and chemistry of re-entry through the upper atmosphere. How would defenders be able to detect and track incoming warheads? Until they had a better understanding of flight in the upper atmosphere, the trajectory and signature of incoming warheads were mysteries. Black Brant research rockets followed on the initial work done by high altitude balloons.

4.3.5 The Churchill Rocket Range

The creation of a rocket range at Churchill as part of the Defence Research Northern Laboratory and the Fort Churchill military base started in 1954 when the United States was looking for a northern launch facility for auroral research during the International Geophysical Year. Churchill was accessible by sea and rail and it had existing research facilities, so it was an ideal location for further research. The project became a joint American-Canadian rocket range, with the Defence Research Board representing Canada and the United States Air Force representing America. In 1955 and 1956 the Canadian Army launched Nike-Ajax missiles supplied by the United States to test the operation of missiles in the cold.  

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416 For a detailed discussion of the quest to improve accuracy see: MacKenzie, Inventing Accuracy.
In 1956 the United States Air Force began construction in preparation for the International Geophysical Year. Over the course of the 18-month year the Canadian-American team launched research rockets (Aerobee and Nike-Cajun) on behalf of several agencies including the United States Air Force and Army as well as NASA, and for the Canadian military, the Canadian Armaments Research and Development Establishment and the Defence Research Telecommunications Establishment. DRTE was interested in auroral and ionospheric sounding data, whereas CARDE was interested in ballistic properties. At the conclusion of the International Geophysical Year the rocket range was closed, but only temporarily until CARDE began flight testing Black Brant rockets in 1959.419

The Churchill Rocket Range was illustrative of the collaborative nature of Canadian and American defence research and the global collaboration of the International Geophysical Year. It was also an indication of the size and scope of American defence interests. If the Americans felt a need to research a topic, they researched it regardless of what Canada was doing, and upper atmospheric research in the North was pivotal to the operation of their Intercontinental Ballistic Missiles. The most the Defence Research Board could hope to do was work alongside the United States and benefit from the funding and research.

4.3.6 Diefenbaker and Radar

The desire for a working collaboration with the United States drove the creation of the Prince Albert Radar Laboratory. The United States Air Force and its researchers at the Lincoln Laboratory of the Massachusetts Institute of Technology were interested in the question of tracking warheads in 1956 and 1957. Within the Defence Research Board the Defence Research Telecommunications Establishment and Canadian Armaments Research and Development Establishment were also interested in this topic of investigation. When looking back at the creation of the Prince Albert Radar Laboratory in 1971 Léon L’Heureux, then the Chairman of the Defence Research Board, claimed that it was one of many projects that the Americans were so determined to carry out that they would have ignored Canadian sovereignty to undertake it.420

The political climate of 1971 was different from the political atmosphere of 1958, especially as it pertained to sovereignty, so L’Heureux’s comments have an air of appealing to 1971 political sensibilities rather than thoroughly honest reflection of the situation. Relations were cordial in 1958, and there were several projects, even within the Defence Research Board, that were bipartite. The DRB was determined to participate, and have a stake in the research direction, since the American project aligned with Canadian research interests. L’Heureux is correct that the United States was keen for any research on re-entry of warheads from missiles and they were willing to supply a radar dish to study the upper atmosphere.

In fact, the Americans wanted two: one in the auroral zone at Churchill, or some other appropriate location, and one further south to study the auroral zone at a suitable angle. In 1957 Jack Hogarth and Peter Forsyth of the Defence Research Telecommunications Establishment searched for a location near Saskatoon, where there was a high calibre upper atmospheric research program at the University of Saskatchewan centred on Balfour Currie, the head of the physics department. Hogarth and Forsyth submitted a list of possible locations; this list went up the administrative ladder until it reached Cabinet. Prime Minister Diefenbaker suggested that instead of siting the radar near Saskatoon it should be placed within his constituency of Prince Albert. A new location was scouts and the Prince Albert Radar Laboratory (PARL) commenced operations in 1958. Administrative authority for PARL was given to John Chapman of DRTE, who would also oversee the Alouette research satellites.421

4.4 The DRB under Zimmerman

4.4.1 The Board

Zimmerman was keen to put his own stamp on the membership of the Board, while continuing many of Solandt’s prescient practices of diversifying membership geographically, professionally and on the basis of expertise. In 1957, shortly after adding John Keyston as the Vice Chairman, Zimmerman increased George Field’s authority by naming him to the Board for a three year term as the Chief Scientist. Of course, Field had been in the administration levels of DRB headquarters longer than either Zimmerman or Keyston, so his expertise and experience were invaluable (see Appendix E for tables of organization).

Zimmerman did not retain all things Solandt, however. One obscure rule that Solandt had insisted upon – that term members take a year off before being reappointed to the Board – was removed by Zimmerman. At first it was a one-off exception for C.J. Mackenzie in 1957 who had been a member of the Board since its inception, but it soon became standard practice when Harry Thode was reappointed in 1958.

Zimmerman decided to expand the Board in 1960 from six rolling term representatives from university and industry to seven. Three new members were appointed to replace Mackenzie and Thomas Ingledow of the British Columbia Electric and Power Corporation. It was not easy for Zimmerman to remove Mackenzie from the Board; he spent a week entertaining the possibility of renewing Mackenzie, returning Gordon Shrum and finding two new members. Instead, Zimmerman found three new members and neither renewed Mackenzie nor returned Shrum from his six-years of retirement from the Board. J. Tuzo Wilson, the University of Toronto geophysicist responsible for plate tectonics, John F. McCreary, the Head of the Department of Paediatrics at the University of British Columbia (but a University of Toronto, Toronto General Hospital and Hospital for Sick Children alumnus), and Cyril A. Peachey, an executive at Northern Electric, all joined the Board.422

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In 1963 the Board experienced its first interference from Cabinet in the appointment of term members. Normally Cabinet simply approved the recommendations that were made by the Board through the Minister of National Defence, and then had the Privy Council Office record these as Orders-In-Council. In 1963 Wilson wanted to resign, and the Board wanted to replace him with Robert Uffen, a geophysicist and rising administrator at the University of Western Ontario. Cabinet felt that Wilson was a distinguished scientist and should be retained, so they sent the recommendation back to the Board for further consideration. Given that Wilson was as much a leader in his field as any of the Board members, this request from Cabinet indicates how much non-scientific recognition Wilson’s work achieved. It was also one of the last acts that Diefenbaker and his Cabinet undertook, since the request to reconsider Wilson’s membership came in March 1963, in the midst of a federal election campaign.423

Wilson was persuaded to continue for an additional term, but his attendance was sporadic over his second term. Uffen also joined the Board, which expanded the number of term members sitting on the Board from seven to eight. However, David L. Thomson, the Dean of Graduate Studies at McGill University who had been appointed in 1961, was injured in an accident and was a member in name only, and Wilson’s inactivity meant that there were only six participating term members (seven when Wilson showed up).424

Despite Zimmerman’s personal preferences for Board members, it was still a similar collection of well-connected and highly respected men. Aside from the geographic or regional representation, there was a repetition in the specialisations. Throughout its history the Board’s members were predominantly engineers (the degree of choice for Chiefs of Staff), physicists, chemists and medical doctors. Other fields like biology and the social sciences were not represented on the Board directly, and they were a relatively minor part of the Defence Research Board’s program.

423 LAC, RG 2 S A-5-a Vol 6253, “Meeting Date 1963/03/04,” 7 (available online: http://www.collectionscanada.gc.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=23485&page_sequence_nbr=1&interval=20&&PHPSESSID=chq6t5uchllvhrdqj1gl0tp322) and “Meeting date 1963/03/25,” 6 (available online: http://www.collectionscanada.gc.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=23528&page_sequence_nbr=1&interval=20&&PHPSESSID=chq6t5uchllvhrdqj1gl0tp322).

After some initial fluctuation in the balance between university and industry representatives under Solandt the balance settled at two industrialists, and Zimmerman maintained this number even while expanding the representation. The inclusion of the Department of Defence Production via Zimmerman, followed by Deputy Ministers Reginald Brophy and then David Golden, also allowed for greater coordination within the government and with industry for development and production work. Given the shifting emphasis to projects like Black Brant and the Alouette, which included close collaboration with industry, the bonds formed at the Board level played to Zimmerman’s strengths and helped guide the Defence Research Board in the direction he wanted.

4.4.2 DRB’s Extramural Research Program

The biggest change to the Defence Research Board’s extramural research program came as a result of Zimmerman’s drive to push projects to industry in collaboration with the Department of Defence Production. The old contract method of working with industry received an overhaul given the increased level of collaboration between the Defence Research Board and industries on projects like the Black Brant and Alouette. A new initiative, the Defence Industrial Research (DIR) Program was introduced in 1961 for two reasons. The first reason was to acquire as much equipment as possible without having to create, develop and produce it internally. Second, the DRB wanted to continue supporting the long-term growth of Canadian industries, especially with defence applications, and to encourage the capacity for spin-offs. The DIR was, in other words, both a military and economic advantage for Canada.425

Working with industry had two benefits. It shifted some of the cost for defence research and development expenditures out of the government and into industry. With the increasing difficulty of budgetary constraints, this was an important factor. Contracting out to industry also had the more abstract and tangential advantage of creating a broader base of talent and knowledge that could be applied to defence research. This included the practical benefit, for the

Defence Research Board and Department of National Defence, of having a sector of industry capable of filling production and development contract work. It also had the, at least hypothetical, advantage of contributing to the national economy by expanding an industry that could compete for global, or at least North Atlantic, contracts.426

Another change to the Defence Research Board’s extramural research program began in 1960. To recognize the importance of medical research separate from the rest of the science and technology research funded by the DRB and the National Research Council, the government asked University of Toronto’s Ray Farquharson to write a report on the situation. Farquharson, as a former member of the Council of the NRC and the Board of the DRB as well as the relevant granting committees, was intimately informed. He recommended the creation of the Medical Research Council (MRC), of which he was made the first President in 1960. The MRC immediately challenged the Department of National Health and Welfare as a major funder of medical research, and reduced the DRB’s scope of funding to a more narrowly defined range of projects with defence interest. The DRB continued funding medical research as long as it had an extramural budget.427

4.4.3 Intramural Research

The slight reorientation of the research programs at Canadian Armaments Research and Development Establishment and the Defence Research Telecommunications Establishment in the late 1950s to problems of the upper atmosphere through projects of rockets and satellites were just two of several realignments of the Defence Research Board in the period. Both Black Brant and Alouette were driven by the same three factors: the Canadian budget, the changing military threat, and scientific and technical progress.


The budget factored into most decisions made by the Board and the Defence Research Board. The Velvet Glove was scrapped in favour of a cheaper American alternative; the available expertise was then recycled on the Black Brant project. The Alouette satellite was a joint project with the United States, which meant that funding and, more importantly, a delivery vehicle were available to the DRB; both were essential for the existence of the Alouette project. The possibility of ramping up the Black Brant project from a sounding rocket to something capable of putting a satellite (designed within the DRB) into orbit was never considered; the cost and the expected research hurdles were too prohibitive for Canada to act independently.428

The second factor that affected the creation of the Black Brant and Alouette projects was the changing nature of the threat to Canada’s defences. After Sputnik the imminent threat of intercontinental ballistic missiles accelerated the existing research interests into the upper atmosphere.

Coupled to the evolving military threats were changes in the science and technology used in defence research. The decision to hold an International Geophysical Year meant that there was an interest in advancing scientific knowledge generally, but especially scientific knowledge that was applicable to defence problems. Researching the upper atmosphere was going to solve problems surrounding the understanding of how projectiles and electromagnetic radiation travel, which would aid in communications as well as tracking incoming warheads.

To increase the budget for these new topics of interest, Zimmerman had to realise savings elsewhere. Where Solandt was personally enthusiastic about Arctic research and willing to divert funds to it, Zimmerman was not. Zimmerman’s ambivalence alone would not have been enough to drastically alter the Arctic research program. Changes to international science, technology and the military threat also forced Defence Research Northern Laboratory to adapt.

The early agenda of the Defence Research Northern Laboratory was a combination of increasing the basic understanding of the Arctic and applying this to survivability of soldiers stationed there. The agenda for the International Geophysical Year called for more research into

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428 Budget considerations and lack of broad political support will most likely combine to thwart the most recent proposal to build a Canadian rocket to launch Canadian microsatellites; see Jonathan Turner, “Countdown to Re-entry,” The Bubble Chamber, 20 January 2011, http://thebubblechamber.org/2011/01/countdown-to-re-entry/.
the basic understanding of the earth, especially near the poles (since the IGY was a continuation of the previous International Polar Years), so Churchill was an ideal location for continued research. It was in the Arctic, but still reasonably accessible by plane, train and boat. The IGY also expanded the scope of desired knowledge of the North, which brought the new research endeavours of radios and rocketry to Churchill, at the expense of continuing survival and adaptability studies. The United States Air Force, and later NASA, increased their presence at Churchill as both a cause and effect of the creation of a rocket-launching facility.

The Churchill Rocket Range closed, reopened and changed administrative hands numerous times over its history. In 1954 it was used by the Services and the Defence Research Board. Leading up to, and then during the International Geophysical Year, there was collaboration between the United States Air Force and the DRB. Following the IGY, the United States withdrew its funding and personnel, but the DRB found the Churchill Rocket Range useful for Black Brant trials.429

In 1959 Canadian defence researchers were rejoined by the United States Air Force and NASA after a year away. In 1960 a NASA liquid-fuelled rocket sparked a fire that destroyed the facilities. The United States budgeted for a massive rebuild of the facilities at a new location near Churchill in 1961 and 1962, but withdrew the promise when they had to allocate funds to the troop increases and resumption of underground thermonuclear testing mandated by President Kennedy as a response to the Berlin Crisis. Once the Berlin Wall was erected, and a new stalemate in Europe achieved, the United States was willing to devote money to a rocket range in Churchill, but this time it was only for refurbishing of the existing facilities undertaken by the United States Corps of Engineers and Canada’s Defence Industries Limited. From 1962 to 1965 the Defence Research Board retained responsibility on the Canadian side for the Churchill Rocket Range, but in 1965 the DRB had other priorities, the Black Brant project was almost entirely in the hands of the Bristol Aerospace Company and research rocketry was increasingly showing promise for civilian, rather than military, needs. The National Research Council

assumed control of Churchill from 1965 to 1984. From 1965 to 1970 the NRC ran Churchill in conjunction with NASA until NASA withdrew its support.430

The International Geophysical Year came at the same time that the military threat of Russian land-forces invasion across the Arctic was downgraded in possibility from unlikely to improbable, especially as the menace of Russian missiles increased. The necessity of training Canadian troops to survive and fight in the Arctic became less urgent as a result, and the emphasis was shifted to studying and training troops for environmental adaptability in general. After the Suez Crisis it was obvious that Canadian troops were just as likely to need acclimatization to fighting in the desert as the Arctic. Churchill was no longer an ideal location for such studies, since its environmental factors were frigid temperatures and ice and snow in the winter, and humidity and mosquitoes in the summer, and it was remote. Toronto was a better, more centralized location, and it already had climate chambers for acclimatization studies and training.431

When the Defence Research Board was created it listed the available assets across the country, and this included a tropical room and cold low-pressure chamber at the Royal Canadian Air Force’s Institute of Aviation Medicine (IAM) in Toronto. When the Defence Research Medical Laboratory was created in 1950 it absorbed much of the research facilities of the IAM. With the Northern Laboratory’s switch to rocketry this left DRML with nearly all of the cold-weather research. DRML was responsible for clothing and food research as part of the larger

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human factors engineering program. Nylon pile winter coats and dehydrated ration packets were among the projects that scientists worked on in Downsview.\textsuperscript{432}

Much like the Defence Research Medical Laboratory, the two naval establishments continued with business as usual during the Diefenbaker interlude. The Naval Research Establishment in Halifax was still primarily devoted to antisubmarine warfare, including testing of prototype hydrofoils in collaboration with the British Royal Navy, the Royal Canadian Navy and participating industries. From 1957 to 1963 NRE tested the Bras d’Or, known as the R-103 when it was under construction from 1953 to 1957 at Saunders Roe Ltd on the Isle of Wight. In 1963 this hydrofoil was rechristened Baddeck and a new larger hydrofoil craft was given the name Bras d’Or. The NRE also continued their projects on acoustics and variable depth sonar, which were all part of a program to track submarines and negate their stealth advantage.\textsuperscript{433}

The Pacific Naval Laboratory also continued along a similar trajectory. Its permanent buildings were constructed by the time Zimmerman became Chairman. The PNL was still primarily concerned with the peculiarities of Pacific oceanography and acoustics as an extension of Atlantic oceanography and acoustics. From 1956 to 1958 the PNL began to acquire its own research vessels, so that it could operate somewhat independently from the Royal Canadian Navy. These research vessels (Oshawa and Whitethroat) had to be shared with two civilian research agencies: Pacific Oceanographic Group of the Department of Fisheries and the Institute of Oceanography at the University of British Columbia.\textsuperscript{434}

The new task that arose as part of the increased emphasis on Arctic research in the late 1950s was under-ice acoustics in the Arctic. The United States submarine USS Nautilus began operations in 1955; it was the first nuclear-powered submarine and it challenged existing antisubmarine defences. First, it could stay submerged much longer than diesel-powered submarines, meaning that aerial tracking for a surfaced submarine would no longer suffice. Both naval research establishments of the Defence Research Board were already working on alternative tracking methods. Second, because it could stay submerged much longer it was able

\textsuperscript{432} LAC, RG 24 S F1 Vol 11995 File DRBS 1-0-43-1 Vol 1, “Research Facilities Available within the DND to the DRO, December 1946,” 6.
\textsuperscript{433} Longard, Knots, Volts and Decibels, 64-65, 73-75, 87-89.
\textsuperscript{434} Chapman, Alpha and Omega, 20.
to navigate under the ice of the Arctic Ocean. The latter necessitated the Pacific Naval Laboratory to investigate oceanography and acoustics in the Arctic.\textsuperscript{435}

Special weapons research continued under Zimmerman. The Defence Research Kingston Laboratory was closed in 1957 in the wake of Zimmerman’s 1955 report. The proximity of the pilot plants for protective gear made the Ottawa establishment more cost effective. Harry Sheffer was the new Chief Superintendent of the Defence Research Chemical Laboratory in Ottawa; his Deputy was N.J.B. Wiggin. The Defence Research Kingston Laboratory was operated as a satellite of the DRCL until 1964 when construction of facilities at Shirley Bay was completed and all of the Kingston capacities moved to Ottawa. The facility was descriptively renamed the Defence Chemical, Biological and Radiation Laboratories (DCBRL). The Grosse Île Experimental Station was transferred administratively to the Department of Agriculture – who had long provided the majority of scientists and projects – in 1958 but remained Department of National Defence property.\textsuperscript{436}

This left Ottawa and Suffield as the two locations of special weapons research (chemical, biological/bacteriological and atomic/nuclear/radiological). Suffield expanded its capacity for field trials from chemical and biological to simulated atomic/nuclear in 1958. That year the Suffield Experimental Station detonated a single ton charge of explosives, and the following year SES exploded 5 tons. The test, and ensuing ones of up to 500 tons, was intended to simulate a nuclear explosion, but without the radioactive or thermal effects. This meant that scientists, engineers and technicians could test the resiliency of blast meters and sensors, building materials, humans and animals, equipment and vehicles to blast waves.\textsuperscript{437}

As with the previous field trials at Suffield, the scaled explosions testing generated tripartite interest. Representatives from the United Kingdom visited the Suffield Experimental Station in 1957 and found the scientists at SES overly keen for a suggestion of research work they could undertake as a way to replace Canadian participation in the British nuclear weapons

\textsuperscript{435} A.R. Milne, “Arctic Under-Ice Acoustics,” 141-208 in Chapman, Alpha and Omega, 22; Francis Duncan, Rickover: The Struggle for Excellence (Annapolis, MD: Naval Institute Press, 2001), 156-158.
\textsuperscript{436} LAC, RG 24 S F1 Vol 12003 File DRBS 58-0-240 “Grosse Isle – Organization and Administration Generally,” Note to File from Director General Services, 9 May 1961,” and “Note to File from Chairman, DRB, 4 June 1968.”
\textsuperscript{437} TNA, DEFE 15/1105 “The War Office, ARDE: Materials Explosives Division, Memorandum (MX) 22/60, Note on a visit to Suffield Experimental Station, HJ James, May 1960,” 1; Longair, Early Defence Atomic Research in Canada, 13-14.
program; one suggestion was using the wind shed to test fallout, but SES researchers opted for scaled blast trials. The team at SES invited British scientists to return in 1959 for the first blast trial as a means of gauging mutual interest in further blast trials. The British expressed an interest in trials of scaled explosions over 25 tons and starting in 1960 this is what SES did. The United States began participating in 1960 – although they had been contributing high explosives previously.438

The British and American interest in the blast trials was relatively short-lived. The United States, of course, was not willing to rely on the Suffield trials alone and conducted their own research in New Mexico, and the British eventually found their participation more cost-effective than productive – they spent very little, but they also did not learn as much as they would have liked. The 500 ton explosion in 1964 was the point at which both American and British researchers began to consider ending their participation. The British Atomic Weapons Research Establishment, which had been the primary research agency involved in the Suffield blast trials was invited to return for the 500-ton trial in 1968; they had developed simulators at Foulness which were cheaper and more reliable. To replace British funding and participation, the Home Office suggested that the Defence Research Board should seek participation from other North Atlantic Treaty Organization allies, which the DRB was already doing.439

The blast trials continued until 1970, but their demise was the result of advances in simulations, modeling and computing. The Suffield blast trials were also a mixed lesson in tripartite cooperation. Both the British and Americans were determined to maintain their own research facilities, and their promotion of their own national research interests came at the expense of tripartite cooperation (and expenditures on research in Suffield).

438 TNA, DEFE 15/1105 “The War Office, ARDE: Materials Explosives Division, Memorandum (MX) 22/60, Note on a visit to Suffield Experimental Station, HJ James, May 1960,” 1; TNA, ES 1/523 “UKAEA, AWRE, Cooperation with Canada, General, 1958,” “Letter from C.A. Adams to Director, 6 November 1957;” Longair, Early Defence Atomic Research in Canada, 13-14.
4.5 The DRB in the World

4.5.1 TTCP and NATO

However, the work at Suffield was one of several areas where the three allies had overlapping priorities and interests, and on which they could (temporarily) agree. The close collaboration between the three led to the creation of the Tripartite Technical Cooperation Program (TTCP) in 1957. A year later, as a result of the British thermonuclear tests, the Americans agreed to more open sharing of atomic secrets by signing the US-UK Mutual Defence Agreement. In 1965 Australia joined the TTCP and the meaning of the acronym changed to The Technical Cooperation Program; New Zealand joined in 1969, and those have remained the five nations involved ever since. Although the original exchange was formalized by the President of the United States and the British Prime Minister, followed shortly thereafter by the Canadian Prime Minister, TTCP was intended as a working level exchange of ideas and information, something that had long been a problem between the United States and the United Kingdom (and Canada). This meant that there were committees, sub-committees, working groups and panels on all topics of interest in defence research. Canada declined to participate in nuclear research, but was active in most of the rest of the research, including the first working group, antisubmarine warfare.\(^{440}\)

Although national interests still presented a significant problem for full cooperation and collaboration, The Technical Cooperation Program smoothed the long-standing difficulty of transferring knowledge from the United States defence research programs to Canada and the United Kingdom. TTCP continued the moderately successful tradition initiated by the Tripartite Standardization Agreement.

The three founding members of The (Tripartite) Technical Cooperation Program were also part of NATO, and collaborated within that framework as well. Before Zimmerman became Chairman of the Board the Defence Research Board’s participation in NATO cooperation was mostly scientific liaison and operational research. This participation increased under

Zimmerman. In 1958 John Abrams was loaned, upon request, to General Lauris Norstad the Supreme Allied Commander in Europe (SACEUR), at the Supreme Headquarters of the Allied Powers in Europe (SHAPE) to scientifically analyze and plan Europe’s air defences. Norstad wanted Abrams because of his excellent reputation in the field; Abrams had participated in the early studies of North American air defence and was a scientific adviser to the Chief of the Air Staff.⁴⁴¹

The reputation and experience of the Defence Research Board’s establishments meant that exchange with NATO allies expanded beyond operational research. The DRB formed bilateral exchange agreements with several NATO allies (France, Greece, Norway, the Netherlands, West Germany and even Turkey). This exchange included information, but more importantly it also included accepting scientists and engineers from these allies for tours of duty at establishments through the Canadian Defence Research Fellowship program. The fellowships were jointly funded with the exchanging country, and it allowed allied scientists to gain experience working with Canadian equipment and laboratories. By 1965 the Defence Research Board had stationed a scientist (former Secretary of the Board, Richard Martineau) at the Canadian Embassy in Paris, France, since the French were starting to diverge from NATO planning and to create their own defence and nuclear programs. Canadian eyes may have been firmly fixed on their senior allies for information, but that did not preclude this opportunity to extend a sympathetic and experienced hand to junior allies or to keep a close watch on any allies who had the resources and desire to take scientific initiatives, like France.⁴⁴²

Even with their increased activity, the French, largely because of their independent streak under President Charles De Gaulle, limited exchange and liaison with the Defence Research Board. The United States was still the leader in defence research, the United Kingdom,
motivated largely by self-preservation, was the other significant ally. No policy created by the Diefenbaker government was going to reverse this reality. The Defence Research Board had to remain focused on close bonds with the United States through the Tripartite Technical Cooperation Program and direct bilateral exchange.

4.5.2 Reorganization of Defence Research in the United States

The organization of research for defence in the United States had undergone changes since the end of the Research and Development Board in 1953. The most significant reorganizations came at the beginning and again near the end of Eisenhower’s presidency when he was most concerned with creating a streamlined and efficient Department of Defense. From 1953 to 1957 there were two Assistant Secretaries of Defense, one was responsible for Research and Development and the other for Applications Engineering. In 1957 the two positions were merged into a single Assistant Secretary of Defense (Research and Engineering), which was renamed Director, Defense Research and Engineering in 1958. The succession of positions had more authority over the direction of research and development than had the Research and Development Board, which was primarily concerned with mediating difficulties with joint service projects. The Assistant Secretary and Director positions had the authority and oversight over projects in the Department of Defense, and the responsibility to integrate these with the Secretary of Defense’s (and by extension Cabinet’s) plans.

The 1958 reorganization of the Department of Defense also included the creation of the Advanced Research Projects Agency (ARPA). Where the Services were individually responsible for meeting their own immediate and medium-range needs in science and technology, ARPA was responsible for the long-range horizon and with a broader applicability. Although it has never had its own laboratories, ARPA started researching space, nuclear-blast detection and

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ballistic missile defence. The Defence Research Board collaborated with ARPA on Project Vela, which was a project to improve detection of nuclear blasts.444

In many ways the Advanced Research Projects Agency had similar functions and responsibilities to the Defence Research Board. Both ARPA and DRB were concerned with long-term projects that had national (defence) utility. However, the DRB strove to satisfy the immediate research and development needs of the military as well, something the American Services refused to relinquish to a centralized agency, and the DRB bore responsibility for oversight and planning like the Assistant Secretary of Defense (Research and Engineering) or later the Director, Defense Research and Engineering. Given that both Canada and the United States had given one man centralized authority for defence research during the Second World War, Vannevar Bush in the United States and C.J. Mackenzie in Canada, the divergent paths reveal the uniqueness of the two situations and the different priorities each country had moving forward.

The divergence of priorities was exemplified by the policies for nuclear weapons research and acquisition. The Defence Research Board, as Canada’s representative on the Tripartite Technical Cooperation Program did not participate in the exchange of information pertinent to nuclear materials, warheads and propulsion; nuclear research was the domain of Atomic Energy of Canada, Limited and the DRB was only interested in the defensive aspects of atomic and nuclear weapons. This might have been insignificant had it not been for the Diefenbaker interlude. Canadian policy was already against national development of nuclear weapons, and expensive foray into nuclear-propelled submarines was inconceivable. However, under Diefenbaker the opportunity presented itself for Canada to jointly possess American warheads.

4.6 Diefenbaker and Nuclear Weapons

4.6.1 Nuclear Strategy – Massive Retaliation

Under President Dwight Eisenhower the United States shifted to a policy for defence weighted in favour of massive retaliation. Any attack on the United States or its allies would

result in a complete nuclear response. The American arsenal had grown since the bombs dropped on Hiroshima and Nagasaki, so the potential devastation was more ominous, and the actuality of the deterrent was believable. The concern then became about defending the deterrent forces of Strategic Air Command from a first strike and developing new delivery systems (missiles and nuclear-armed / nuclear-propelled submarines) that were immune to first strikes. Canada’s only potential role in the United States defence planning was giving the retaliatory threat credibility, and defending civilian and military targets as best as possible from incoming Russian bombers.

In the nuclear games played out in the minds of RAND’s deep thinkers, military strategic analysts in the United States and the Operational Research Group in Canada the next war would have a logical sequence. The Russians would invade Western Europe, the American-led West could not stand up to the Russian infantry for any prolonged length of time, so NATO forces would cede land and respond with a nuclear attack on Russia, which would lead to one of two results. Either the Russians would launch their own arsenal, or their retaliatory force would be destroyed on the ground before they could retaliate. Presumably the Russian army that was now occupying Western Europe in this game would surrender en masse once they realized they had no homeland and therefore no leadership, reinforcements or supplies to continue a war. Even if the retaliatory strike hit the United States, the Russians would still lose, because they would have no homeland. Presumably this option was so horrific that the new Russian leadership (eventually Nikita Khrushchev after several years of maneuvering following Stalin’s death) would avoid starting war at all costs, unless they were able to eliminate the American retaliatory capacity as the first act of war.445

Assuming that the Russians were territorially aggressive, and that this analysis was in fact accurate, then the main vulnerability of the entire NATO alliance was an attack that removed the American retaliatory capacity, which would leave Western Europe and North America defenceless. Defending this capacity was one of two jobs that Canada undertook in the 1950s and 1960s. The other task was a combination of land forces and tactical strike forces in Europe. The land forces were supposed to delay the Russian ground forces long enough for the tactical

445 One would suspect that the Russians had similar war plans with the roles of aggressor and world-saving liberator reversed. Neither side would act first if they knew the other side had a guaranteed retaliatory capacity. What sane man would start a war, knowing that he and his country would not survive?
strike force to scramble and attack the supply chains (with nuclear weapons). The massive retaliation coming from Strategic Air Command would take care of the rest of the Russian supply chain. The bulk of Canada’s defensive effort was dedicated to continental air defence.

4.6.2 Cooking Bombs and Buying Missiles

In the event that Russian bombers came to attack North America, either as a response for an American massive retaliation, or as a precursor for an invasion of Western Europe, Canada needed radar to detect and track the incoming bombers and fighter-interceptors to shoot them down. There was a question about whether or not shooting down an intercontinental bomber would trigger the bombs it carried to detonate at a certain altitude or on impact with the ground. This was a highly pressing problem for Canadians, since the bombers were likely to be shot down over Canada. The theory that guided American defence planning in the years of transition from the bomber threat to the missile threat was that an incoming warhead could be disabled, or “cooked,” if the delivery vehicle was destroyed by a small yield nuclear weapon. However, different defensive missiles had varying effectiveness, as the Defence Research Board’s nuclear expert, Alexander Longair, had to explain to the Minister when the question arose in Parliament in 1962 – the Royal Canadian Air Force gave the Minister inaccurate information when he first answered the question, and Thomas Berger attempted to catch the government on the point. “Cooking” remained an important topic of discussion for much of the next year.446

After the cancellation of the Avro Arrow project the Department of National Defence needed some weapon to continue the North American air defence against bombers. Just because missiles were likely to be superior to bombers for many reasons did not mean that Canada and the United States could remove the defences against the bomber. If there were no defences, then bombers were the cheaper and more versatile weapon. To supplement fighter-interceptors the Diefenbaker government agreed to the acquisition of the BOMARC (for Boeing Michigan

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Aeronautical Research Center) in 1958. The BOMARC was part of an integrated weapon system with the Semi-Automated Ground Environment (with the wise acronym SAGE), which was a new system of command and control that relied on computing and automation that was developed at the Massachusetts Institute of Technology. At the time there were two types of BOMARC being tested, one with a nuclear payload, and one without; neither was fast enough to be effective against incoming Intercontinental Ballistic Missiles, only bombers. Canada agreed to purchase the nuclear-tipped variant, but Diefenbaker advertised the purchase in public as an acquisition consistent with Canada’s non-nuclear status and that would fill Canada’s defence needs against bombers and missiles.\(^\text{447}\)

To replace the old CF-100 fighter-interceptors for North American use the Diefenbaker government purchased CF-101 Voodoo planes from the United States Air Force in 1961. The maintenance contract for these went to Winnipeg-based Bristol, who also had the contract for the Black Brant rockets. Toronto-based aerospace companies received nothing in the wake of the cancellation of the Arrow, but Montréal-based Canadair received contracts in 1959 for both the CF-104 Starfighter (the replacement for CF-86 Sabre used by the Royal Canadian Air Force’s NATO squadrons as a fighter-bomber-reconnaissance plane) and the CL-44 transport plane. Domestic politics and Diefenbaker’s unique brand of vengeance no doubt played a role in these decisions.\(^\text{448}\)

The CF-101 came armed with Genie air-to-air missiles and the CF-104 came with air-to-ground missiles; both of these new missiles were, like the BOMARC, nuclear-tipped. The Genie missiles were designed to “cook” the nuclear payloads of bombers. These nuclear-armed intercepting missiles also negated the need for direct hits on incoming bombers. On the other hand, the CF-104 was supposed to attack supply lines in Eastern Europe and Russia with its small nuclear payload, and to supplement the Starfighters Diefenbaker agreed to acquire Honest John surface-to-surface missiles for a similar nuclear role. Again, Diefenbaker advertised the

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Weapons as potentially non-nuclear. He was not lying; the Honest John could also be loaded with Sarin, a potent nerve agent.\footnote{Mclin, \textit{Canada's Changing Defense Policy}, 132-133; Jockel, \textit{No Boundaries Upstairs}, 127; Smith, \textit{Rogue Tory}, 384, 387; Jockel, \textit{Canada in NORAD}, 53, 61-62.}

\subsection{Joint Keys}

Whether Diefenbaker was confused or being disingenuous about the nuclear intention of the weapons he acquired is still not clear. If he was confused, it was likely because he did not trust the advice of the Department of National Defence after the fallout from the cancellation of the Avro Arrow. If he was disingenuous, it was because he held a grudge. For the Department of National Defence it did not make much difference, because nuclear weapons were the entire basis of Western strategy and Diefenbaker was publicly obfuscating this reality. The Canadian military could only justify itself, at the budgetary levels the government was willing to extend, as part of the Western nuclear alliance. By questioning nuclear weapons – the entire basis of Western defence policy – Diefenbaker was undermining the DND’s role and credibility in public.

Part of the problem for the Diefenbaker government was that negotiations with the United States were stalled. The transcripts of these negotiations read like the script of the “Who’s on first?” sketch made famous by American comedians Abbott and Costello. Bud Abbott and Lou Costello had retired by the time Diefenbaker became Prime Minister, and given the deadly serious matter being negotiated, no one in the State Department or External Affairs seems to have seen the dark humour in their frustrations. The United States was offering a joint-key arrangement where the use of nuclear weapons would have to be authorized by both the President of the United States (or, in the event of an emergency, an appropriate delegate) and the Prime Minister of Canada before they could be removed from storage, deployed on the Voooods and used in action over Northern Canada.\footnote{LAC, MG 32 B 13 Vol 7 File 14003-U4-3 Number 74, “Canada-US Committee on Joint Defence, Meetings of 12-13 July 1960;” Mclin, \textit{Canada's Changing Defense Policy}, 126; Smith, \textit{Rogue Tory}, 466-468; Jockel, \textit{Canada in NORAD}, 49-54, 60-61.}

Diefenbaker had three problems with the joint key arrangement. First and foremost, it diminished Canadian sovereignty by relying on the United States. Second, while the joint key discussions were ongoing Diefenbaker was hesitant to aid President Kennedy during the Cuban
Missile Crisis of October 1962, perhaps because of a lingering distrust. To say that Canadian-American, or rather Diefenbaker-Kennedy, relations were strained would be an understatement. Third and finally, given his personal unease with the American strategy of massive retaliation and the uneasy balance of nuclear deterrence, Diefenbaker, and his Secretary of State for External Affairs Howard Green, felt there was a storm brewing among Canadian voters in opposition to nuclear war.\textsuperscript{451}

The Kennedy and Robert McNamara revision of American strategy from massive retaliation to flexible response in 1961 did little to quell fears of nuclear strategy. The new strategy, exemplified by the use of a naval blockade during the Cuban Missile Crisis, was an improvement, at least marginally in the games at RAND, over complete annihilation in the first round of a nuclear exchange. Addressing the humanitarian concern, flexible response opened the remote possibility of survival, unless a nuclear exchange went through several rounds and exhausted the arsenals of both sides. In military circles this was a significant improvement of the sanity of the situation; to outsiders the entire endeavour of nuclear war was madness, a fear that was fed by a policy that became popular under McNamara, Mutual Assured Destruction (MAD).\textsuperscript{452}

4.6.4 Visions of Indecision – Sutherland and the Chief

Diefenbaker, it turned out, was not entirely wrong about the growing unease of voters about the sanity of nuclear strategy. However, the immediate problem was how divisive the issue was within his Cabinet and among civil servants. The Department of National Defence, including the Defence Research Board, was nearly universally in favour of upholding its promise to acquire and deploy nuclear weapons as part of the Western defence against communist aggression. Robert Sutherland, who was already putting in long hours in operational research, was given the additional task of creating DND’s case in favour of acquiring nuclear weapons.

Most memoranda that were used by the Ministers for National Defence in the quest to accept the joint-key nuclear weapons crossed Sutherland’s desk at some point. He was either the

\textsuperscript{451} Smith, Rogue Tory, 462-480; Bothwell, The Penguin History of Canada, 398; Bothwell, Alliance and Illusion, 169-173; Jockel, Canada in NORAD, 49-54, 60-63.
primary author or a significant reviser. Sutherland was in demand as a public speaker on the
topic. John Holmes, a civil servant with External Affairs until the Royal Canadian Mounted
Police targeted him as susceptible to subversion in 1960, invited Sutherland to address the non-
partisan Canadian Institute of International Affairs of which he was the President and/or Director
General from 1960 to 1973. Sutherland accepted and the two began discussions afterwards
about publishing the talk in the Institute’s *International Journal*. At first Sutherland entertained
the possibility of printing the article, “Canada’s Long-term Strategic Situation,” under a
pseudonym, much as George Kennan had in the United States regarding the Russian menace, but
eventually he settled for publishing it under his own name. The article might not have spread
beyond civil servants and connected outsiders like Holmes had it not been serialized and
published by *The Globe and Mail* from October 1st to 5th of 1962.\(^\text{453}\)

In the article Sutherland laid out the reasons why Canada had to remain a strong ally of
the United States and participate in NATO. He also explained that nuclear-tipped intercepting
missiles were more effective than conventional warheads and so they had to be implemented.
The article was compelling, although it likely would not have persuaded anyone who was
opposed to nuclear weapons on humanitarian grounds. Another benefit of Sutherland’s article
was that it did not rely on classified information, which was something that Holmes claimed was
a significant problem for those trying to foster open and informed discussion of the issue.\(^\text{454}\)

Sutherland’s speeches put the point more bluntly. Canada had three options with regards
to nuclear weapons. One, which was already soundly rejected for economic infeasibility, futility,
and continental tension, was for Canada to become a full member of the nuclear club by building
its own weapons. At the other extreme, and equally implausible, Canada could become a nuclear
virgin by reversing its acquisitions of nuclear weapons and rewriting the history of its
participation in the Manhattan Project, Tube Alloys and Montebello. Ignoring the problems with

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\(^{453}\) Norman Hillmer, “Holmes, John Wendell,” *The Canadian Encyclopedia*, accessed 26 September 2011,
http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003819; DHH, Col 87/253
III (Box 6) File 11 “Canadian Institute of International Affairs,” “Letter from Holmes to Sutherland, 5 April 1962;”
Princeton University Press, 1992), 31; Adam Chapnick, *Canada’s Voice: The Public Life of John Wendell Holmes*
(Vancouver: UBC Press, 2009), 113.

\(^{454}\) DHH, Col 87/253 III (Box 6) File 11 “Canadian Institute of International Affairs,” “Letter from Holmes to
Sutherland, 5 April 1962;” Sutherland, “Canada’s Long Term Strategic Situation,” 214 (which was serialized in the
*Globe and Mail* from 1 to 5 October 1962).
historical facts, this option would have meant the abandonment of the Western alliance, international destabilization, and counter-intuitively it would have necessitated Canada acquiring its own nuclear weapons to survive on its own as a non-aligned power. This, according to Sutherland, left one real option: accepting the joint-key arrangement, and full commitment to the Western alliance and international stability. No one in the Department of National Defence thought it even remotely possible that the United States would intentionally start a nuclear exchange with the Russians; the weapons were only to be a deterrent and, fortunately, Sutherland and the Chiefs of Staff were right.\footnote{DHH, Col 87/253 III (Box 6) File 2 “Arms Control (lecture drafts) February 1967,” “The Minor Leagues;” DHH, Col 87/253 III (Box 8) File 45 “Nuclear Weapons: miscellaneous lecture drafts and reports,” “The Nuclear Weapon Issue, 22 January 1962;” DHH, Col 87/253 III (Box 9) File 64 “Some Problems of Canadian Defence Policy: Lecture delivered to the Ottawa Branch of the Canadian Institute of International Affairs, 9 January 1963.”}

Moreover, Diefenbaker learned lessons in politics from Mackenzie King and John A. MacDonald. He rejected Sutherland’s formulation of the options and simply stalled. Diefenbaker hoped the options might improve the longer he avoided the problem. The Department of National Defence from Sutherland up through Minister of National Defence Douglas Harkness seethed.

4.6.5 Keyston Sounds Off


Keyston was ashamed of the government and frustrated by its lack of support for the Department of National Defence; he claimed that he had not noticed any increase in animosity from his counterparts in the United States (who were, at the working levels, sympathetic to the
problem the Canadians faced). The most pressing problem that Keyston faced was that the DRB had recently been excluded from a scientific meeting in the United States, because the current political situation meant the DRB had no “need to know.” In the past, claimed Keyston, he would have asserted the right of the DRB to be represented, but he was too ashamed by the government’s undermining behaviour to act in this case. Keyston suggested that the situation might have been resolved sooner if the United States had linked the acceptance of nuclear weapons to defence production sharing, which would have forced Diefenbaker to act rather than stalling interminably.\footnote{NACP, RG 59 Entry 5298 Vol 2 File “Canada US & Canadian Policy Acquisition & Control of Nuclear Weapons 1962,” “Memorandum of Conversation by Rufus Z. Smith regarding US-Canadian Defense Relationship, Conversation with Dr J.E. Keyston (VC of DRB), AVM J.B. Millward (Commanding Officer, Air Materiel Command, RCAF), Ivan B. White (Charge d’Affaires ad interim, US Embassy) on 29 August 1962, 30 August 1962.”}

Also present for the conversation was Air Vice-Marshal J.B. Millward of the Royal Canadian Air Force’s Materiel Command. Millward disagreed with Keyston’s point about suggesting the United States put political pressure on Diefenbaker through defence production sharing; he felt that it would undermine political relations (further). He also suggested that Keyston had not suitably acclimatized to Canada or Canadians in the twelve years he had been in Canada. Millward did agree with Keyston that nuclear weapons had to be accepted.\footnote{NACP, RG 59 Entry 5298 Vol 2 File “Canada US & Canadian Policy Acquisition & Control of Nuclear Weapons 1962,” “Memorandum of Conversation by Rufus Z. Smith regarding US-Canadian Defense Relationship, Conversation with Dr J.E. Keyston (VC of DRB), AVM J.B. Millward (Commanding Officer, Air Materiel Command, RCAF), Ivan B. White (Charge d’Affaires ad interim, US Embassy) on 29 August 1962, 30 August 1962.”}

Keyston was not the only one to speak out of turn, according to the Americans. Air Marshal Roy Slemon, then the head of the Canadian delegation at North American Air Defence (NORAD) headquarters, made flippant and disparaging comments about the Canadian government during a meeting at NORAD in September 1962.\footnote{NACP, RG 59 Entry 5298 Vol 2 File “Canada US & Canadian Policy Acquisition & Control of Nuclear Weapons 1962,” “Memorandum of Conversation by Rufus Z. Smith (Counselor of Embassy for Political Affairs) regarding Nuclear Weapons for Canada, Conversation with H.H. Carter (Chief, USA Division of External) on 27 September 1962, 28 September 1962.”}

### 4.6.6 Dief Loses the Nuclear Debate

Kennedy and the Americans eventually had enough in February 1963. They blamed the Diefenbaker government for a failure to come to terms on the joint-key arrangement.

The nuclear debate was the most public example of a feud between Diefenbaker and civil servants. It was partly Diefenbaker’s insecurity and paranoia about the Pearsonalities, as he called them, and their loyalty to the Liberal party rather than to the country (and more importantly to him). The problem was also partly the fault of civil servants who simply did not adapt to the new style of management. The only conceivable solution for Diefenbaker was to strike a Royal Commission to investigate the problem.

4.7 The Glassco Commission

The Royal Commission on Government Organization was formed in 1960. Its chairman was J. Grant Glassco, a chartered accountant from Toronto who was frequently pressed into service by the Canadian government due to his prominence in the business community. In the Second World War he oversaw De Havilland, and in 1945 he was called upon to investigate the business practices of Eldorado. Glassco brought a businessman’s mind for efficiency to investigate the organization of the federal government in 1960. The Royal Commission on Government Organization is more commonly known as the Glassco Commission as a result.\footnote{“Canada: The Dominion: Suspicions,” \textit{Time Magazine}, 5 November 1945, available online at http://www.time.com/time/magazine/article/0,9171,852411,00.html; S.L. Sutherland, “Government Organization, Royal Commission on,” \textit{The Canadian Encyclopedia}, accessed 27 September 2011, http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003349; Bothwell, \textit{Eldorado}, 152.}

The mandate of the Glassco Commission was sweeping. “It investigated 23 departments, the armed forces, 21 statutory boards and 42 corporations.”\footnote{Sutherland, “Government Organization, Royal Commission on.”} This included the Defence Research Board, as well as the Treasury Board, the National Research Council and everything else that had a direct impact on the operation of the Defence Research Board. One of the goals was to investigate the efficiency of management throughout the government, and to see if the best practices of business could be brought to the government; a recurring campaign theme in
democracies. The civil service was, of course, less than efficient, but the idealized business against which it was being compared did not exist and real businesses were probably comparable in terms of their efficiency with the government. Thanks to visits to the United Kingdom and the United States, where they interviewed former President Herbert Hoover, the Commission earned the temporary nickname ‘The Canadian Hoover Commission.’ This nickname was outlived by the effects of the publication of the results, which continue to be felt over 45 years later.463

The report was released in five volumes, starting in 1962 and continuing into 1963. The Defence Research Board (or the Department of National Defence or science policy) was discussed in volumes one, two and four. In the first volume, the DRB was raised as an example of an institution that had special status under the Civil Service Act – i.e. that it was exempt from the Act like the National Research Council – where other similar research organizations in Agriculture and Mines and Technical Surveys had no such special status. The DND’s byzantine regulations and policies were also mentioned.464

In the second volume the Defence Research Board was noted as a participant in the multi-pronged procurement of the Canadian government. The critique, in this case, was pointed at the Department of Defence Production and its inadequacy and overlapping responsibilities. The DRB escaped comment in the section on ‘Make or Buy,’ which would be a policy that was revisited under Pierre Trudeau in the 1970s, but the Department of National Defence did not. The Glassco commissioners believed that the DND should focus on military acquisitions and leave other acquisitions to civilian departments.465

The bulk of the discussion relevant to the Defence Research Board was in the fourth volume. In the section devoted to the Department of National Defence, the DRB received very little mention. This section was largely devoted to the possibility of integration and/or

463 Sutherland, “Government Organization, Royal Commission on.”
unification, with the emphasis being that the integration of headquarters functions to a single service was the most plausible and effective.\textsuperscript{466}

In the section of the fourth volume devoted to Scientific Research and Development the Defence Research Board received far more discussion. The commissioners claimed that when the DRB was founded it received about half of the government’s spending on science and technology, but that it had dropped off to about one third in the following ten years. They also claimed the DRB’s budget had levelled off at around $77 million, but their budget table in the section on the Department of National Defence told a different story.

Table 4.1 – Defence Research Board Budget for Fiscal Years 1951 to 1962 (in Millions of Dollars, Fiscal Year ending in March of year indicated)

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<td>Budget</td>
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<td>35.4</td>
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<td>49.9</td>
<td>64.6</td>
<td>69.3</td>
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<td>74.4</td>
<td>39.2</td>
<td>44.2</td>
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Source: Royal Commission on Government Organization, \textit{Special Areas of Administration}, 89.

While the numbers for 1960 to 1962 did not coincide with what the Glassco Commission claimed later in the same report, their accounting of the percentage as compared to the United States and the United Kingdom was accurate – Canada spent far less on defence research and development than either of its allies.\textsuperscript{467}

The Board’s role as policy adviser to the Minister was discussed next, and the Board was faulted for not assuming this responsibility and allowing the Services too much autonomy to act in their acquisition of development – something the military had made a condition of approving the Defence Research Board’s creation – and in the formation of policy. The Board’s failure to fulfill its responsibilities for development and advising was noted repeatedly by the Glassco Commission. The DRB was praised for its results in spite of the limits placed upon its intramural research program; the role of the DRB in basic research was dismissed entirely as


\textsuperscript{467} Canada, Royal Commission on Government Organization, and J. G. Glassco. \textit{Special Areas of Administration - Vol.4}, 204-205.
“not important.” The apparently overlapping responsibilities of senior personnel in DRB headquarters was noted by the Commission, and specific areas that appeared redundant in the intramural program (either because of other establishments or allied countries) were documented.

The conclusion of the section on the Defence Research Board was a set of recommendations that haunted the final fourteen years of the Board. The first three recommendations dealt with the creation of a new Defence Research and Development Board that would have all the same authorities, members and responsibilities as the Board – it might have been easier for the commissioners to suggest renaming the Board so as to make it clearer that the Board was responsible for research and development. The fourth and fifth suggestions involved severing the Board from its research arm, which would be more closely related to the Services so as to meet their needs better. It took eleven years, but the Glassco Commission’s suggestion was attempted in 1974 when further business experts came to the same conclusions.

The full report was released too late for the Diefenbaker government to take directed action and make sweeping changes. The reprieve was only temporary, especially for the Department of National Defence, which faced integration and unification almost immediately. The Defence Research Board was impacted by integration and unification, but the recommendations for reorganization of defence research had a much larger impact on the DRB. Members of the Board, former chairmen, and employees of the DRB, justifiably, felt that their organisation had been misrepresented by the Glassco Commission, and they exhausted themselves to no avail attempting to explain the misunderstanding that would eventually lead to the demise of the DRB from 1974 to 1977.

The Defence Research Board began dealing with the absurd questions and the ramifications of the Glassco Commission’s interpretation of the DRB’s answers in 1961 at the Senior Officers’ Conference. This became an annual tradition. Once the full report was released in 1963, the call for responses extended beyond the senior officers to the mid-level managers (bench scientists with administrative responsibility for a project or group). The responses demonstrate a sense of foreboding, fear and displeasure, because it was quite obvious that the DRB’s role had been misunderstood by the commissioners and as a consequence that things were going to have to change.472

The only exception to the gloomy outlook came from operational research. John Abrams, at the time the Superintendent of Operational Research, wrote to George Lindsey who was in La Spezia at the NATO Antisubmarine Warfare Research Centre. Abrams confided that he hoped the Glassco reports would give operational research a renewed justification for their


existence. The prolonged, and successful, interaction of operational researchers and the Royal Canadian Air Force in the creation of North American air defence was several years past, and the integration of operational researchers in the Korean War were even older news. The Services were under scrutiny, and their closest working partners, the operational researchers, had to bear the brunt of the soul-searching trickle down.473

4.7.1 Management Changes from Within – Retirements

Abrams got his wish for a renewal of operational research, but he left the Defence Research Board for academia at the beginning of 1963 before any realignment was commenced. Abrams never seems to have laid out his reasons for leaving. He may have been pulled by the allure of restarting his academic career, or he may have been among those who were pushed out by Diefenbaker’s style and substance.474

Additionally, the Defence Research Board had a peculiar problem in terms of personnel retention and recruitment. Abrams had essentially hit his ceiling. He had been shuffled around a variety of management positions for his entire career at the DRB, but he was unlikely to advance any further. Field, Keyston and Zimmerman were all at least five years away from retirement (see Table 4.2), and Abrams was not the only senior officer waiting for a promotion.475

474 LAC, MG 31 J 16 Vol 12 File “Correspondence, 1962,” “Letter from J.J. Macdonell (Price Waterhouse & Co., Montreal) to Abrams, 18 December 1962;” LAC, MG 31 J 16 Vol 12 File “Correspondence, 1963,” “Letter from Claude Bissell (President, University of Toronto) to Abrams, 29 January 1963;” statistics regarding the exodus inspired by Diefenbaker are hard to come by, which leaves anecdotal evidence such as the following memorandum that indicates that 21 group leaders or more senior left CARDE between 1961 and 1963 because of the government’s indecision and morale-sapping behaviour: LAC, RG 24 A 1983-84/167 S F1 Vol 7327 File DRBS 100-15/0 Part 5, “Memorandum from G.D. MacAulay (Instrumentation Section Leader, Technical Services Wing) to Mr E.S. Guy, Superintendent Technical Services regarding M. Belak’s Resignation, 30 May 1963.”
Table 4.2 – Expected Retirements by Half-Decade

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<tr>
<td>Guilford Reed</td>
<td>Garnet Dunn</td>
<td>George Field</td>
<td>Omond Solandt</td>
<td>John Abrams</td>
<td>Archie Pennie</td>
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<td>G.P. Morrison</td>
<td>Harold Taber</td>
<td>Alec Fordyce</td>
<td>H.H. Watson</td>
<td>George Lindsey</td>
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<td>R.O. King</td>
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<td>E.F. Schmidlin</td>
<td>J.S. Johnson</td>
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<td>James Scott</td>
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Sources: Three pages of tables in LAC, RG 24 S F1 Vol 11997 File DRBC 1082 Vol 2, expanded using biographical information for individuals who were not tabulated in 1952 surveys.

The Personnel Division made the original tabulation of projected retirements sometime around 1952, but it only relied on responses from Suffield, Esquimalt and Operational Research. Table 4.2 is an expansion of that original work. The expectation was of retirement between the ages of 60 and 65. While Table 4.2 is not meant to be an exhaustive listing of predicted retirements, it is indicative of the generational divide in the senior levels of the Defence Research Board. Half of the senior officers of the DRB were mid-career scientists when the Second World War broke out, and they chose to complete the final years of their careers with the new challenge presented by the DRB rather than returning to their former careers. The other senior officers were early-career scientists when they joined the war effort and as they hit their own personal ceilings within the organization they had to decide whether to remain (accepting annual increments and new research projects) or leave for other employment.

John Keyston was seconded to the Supreme Headquarters Allied Powers Europe (SHAPE) Technical Centre, located in The Hague, for a three year tour in 1964. Keyston’s move to SHAPE came at the same time as SHAPE began to consider the operational research problems facing the ground forces in Europe, which was not Keyston’s expertise. Presumably he desired a new managerial challenge, which was closer to the United Kingdom where he probably intended to retire. It is also possible that the accumulated frustration of the now settled nuclear debate had weighed on him and worn out his welcome.476

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Keyston’s replacement was Chief Scientist George Field; Field seemed the logical successor for E.Ll. Davies in 1956, but he had to wait until 1964 for his final promotion. However, Field was also approaching retirement age, so he was not an ideal replacement for Zimmerman as Chairman of the Board. Instead, Field retired in 1966 and Zimmerman asked Robert Uffen to transition from his three-year term membership on the Board to the Vice Chairman position. Uffen was chosen because Zimmerman wanted someone “who had established an international scientific reputation and who was known throughout the Canadian academic community.” Shortly after his appointment as Vice Chairman Uffen met with the Liberal Minister of National Defence, Paul Hellyer, and C.J. Mackenzie who both assured him that he was going to be the next Chairman of the DRB (see Appendix E for tables of organization).

The Chief Scientist position was relegated to headquarters staff after Field’s promotion, and a new *ex officio*, but term-limited, position was created on the Board and within the headquarters of the Defence Research Board. Archie Pennie was named the Deputy Chairman in 1965. Pennie was a former Secretary of the Board, as well as Superintendent of both the Defence Research Northern Laboratory and the Suffield Experimental Station. He was an experienced manager of operations, and the perfect complement to Field’s management of science. Pennie, who was held in high regard by Hellyer, retained this position for the duration of the Board.

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478 LAC, RG 2 S A-5-a Vol 6321, “Meeting Date: 1966/01/17,” 5 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=27276&page_sequence_nbr=1&interval=20&&PHPSESSID=ia5blcvv54g96s5k21h86k4va2); LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Part 2, “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman) to the Chairman, DRB regarding Agenda 60th Meeting of the DRB, 22 September 1964,” 2 and “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman, DRB) to the Chairman regarding Notes for 63rd Meeting, 8 October 1965,” 1; LAC, RG 24 A 1983-84/167 S F1 Vol 7324 File 100-1/0 Part 4, “Letter from Robert Uffen (Vice Chairman) to Air Marshal F.R. Sharp (Vice Chief of Defence Staff), cc all members Defence Research Board, all members Defence Research Council, Canadian Defence Research Staff (London and Washington) and Defence Research Attache Paris, Chief of Defence Staff, Dr. Keyston and Dr. Chapman;” “SHAPE’s Technical Direction,” 495; QUA, A 1993-Q097 Vol 11 File 4, “‘Advice from C.J.,’ 30 November 1966” and “‘Meeting with the Minister,’ 30 November 1966.”
479 LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Part 2, “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman) to the Chairman, DRB regarding Agenda 60th Meeting of the DRB, 22 September 1964,” 2 and “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman, DRB) to the Chairman regarding Notes for 63rd Meeting, 8 October 1965,” 1; LAC, RG 2 S A-5-a Vol 6271, “Meeting Date 1965/06/15,” 12 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=27276&page_sequence_nbr=1&interval=20&&PHPSESSID=ia5blcvv54g96s5k21h86k4va2); LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Part 2, “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman) to the Chairman, DRB regarding Agenda 60th Meeting of the DRB, 22 September 1964,” 2 and “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman, DRB) to the Chairman regarding Notes for 63rd Meeting, 8 October 1965,” 1; LAC, RG 2 S A-5-a Vol 6271, “Meeting Date 1965/06/15,” 12 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=27276&page_sequence_nbr=1&interval=20&&PHPSESSID=ia5blcvv54g96s5k21h86k4va2); LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Part 2, “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman) to the Chairman, DRB regarding Agenda 60th Meeting of the DRB, 22 September 1964,” 2 and “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman, DRB) to the Chairman regarding Notes for 63rd Meeting, 8 October 1965,” 1; LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Part 2, “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman, DRB) to the Chairman regarding Notes for 63rd Meeting, 8 October 1965,” 1; LAC, RG 2 S A-5-a Vol 6271, “Meeting Date 1965/06/15,” 12 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-
Field was replaced by two men as Chief Scientist. William Petrie, formerly of operational research and most recently Field’s Deputy, became the new Chief Scientist (Physics and Engineering) and Hugh Barrett became the Chief Scientist (Chemistry and Biology). Barrett’s former position of Chief of Establishments was abolished, and many of its functions were now assumed by Pennie as Deputy Chairman (see Appendix E for tables of organization).

The final managerial shuffle came as the result of Garnet Dunn retiring October 1961. He was both the Chief of Administration and the Secretary of the Board. The position of Chief of Administration was abolished by Zimmerman, and the functions were transferred to two new positions: Comptroller of the Defence Research Management Committee and Chief of Personnel. Dunn’s assistant, Alec Fordyce, became the Comptroller, and Whitman Morton assumed responsibility for the new Personnel branch (formerly a directorate). E. Francis Schmidlin was promoted from administrative officer of the Suffield Experimental Station to Secretary of the Board and Personal Assistant to the Chairman.

4.7.2 The 1963 Election: From Glassco to Integration

The most drastic change did not come as the result of projected retirements and movement of senior personnel. It came as the result of changes in the Department of National Defence as a direct result of the Glassco Reports. The Chiefs of Staff Committee was replaced in 1964 by a single Chief of the Defence Staff (CDS). The first CDS was the last Chairman of the Chiefs of Staff Committee, Air Chief Marshal Frank Miller.

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480 LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Part 2, “Memorandum from E.F. Schmidlin (Personal Assistant to the Chairman) to the Chairman, DRB regarding Agenda 60th Meeting of the DRB, 22 September 1964,” 2; William Petrie’s brother was the noted astronomer Robert Methven Petrie, the Director of the Dominion Astrophysical Observatory.

The Vice Chief of Defence Staff (VCDS) and the Chief of Technical Services (CTS) were added as *ex officio* members of the Board in 1964. The CTS was responsible for all development projects within the Department of National Defence, so close collaboration with the Defence Research Board was essential. Three years later, Robert Uffen, the Chairman-in-waiting of the DRB requested that the Minister add the Chief of the Defence Staff as an *ex officio* member to the Board to allow for better coordination between the DRB and the military, and to return the military representation on the Board to three.\(^{482}\)

The reason for the realignment was contained in the reports of the Glassco Commission. Having three sets of staff officers serving the three Chiefs of Staff was redundant. The Glassco Commission called for integration of these staff services in the name of cost-effectiveness, and the recommendations found receptive and enthusiastic endorsement in the new governing party.\(^{483}\)

Lester Pearson won the 1963 federal election. Pearson’s Cabinet included a veteran of the Liberal Party (and Canadian Army), Paul Hellyer, as Minister of National Defence from 1963 to 1967, and, as Associate Minister of National Defence from 1963 to 1965, Lucien Cardin, who was a veteran of the Royal Canadian Navy. Léo Cadieux succeeded Cardin from 1965 to 1967, and then he succeeded Paul Hellyer as Minister of National Defence until 1970. The Hellyer years were some of the most transformative (and traumatic) for the Department of National Defence. After leaving the position of Minister of National Defence, Hellyer has periodically reappeared in the public’s eye through a variety of outlandish ideas and political positions from housing to Unidentified Flying Objects.\(^{484}\)


Pearson requested that Hellyer and Cardin study the recommendations of the Glassco Commission and come up with a White Paper on Defence. Hellyer, in turn, delegated the study and authorship to members of the Department of National Defence. One of the writers and editors of the White Paper was Robert Sutherland, who was Abrams’ replacement as head of the Operational Research Establishment. Sutherland was widely regarded for his ability to “quickly absorb details and view them in a broader context,” and because of this he was called upon frequently by Hellyer to head panels and teams over the next four years. The 15-hour days took a heavy toll on Sutherland, and he died in his office in 1967. In his obituary, the Ottawa Citizen described Sutherland as “Canada’s one man equivalent to the RAND Corporation.”

The Department of National Defence had already begun anticipating, perhaps even craving, Liberal victory in an election as early as 1962. An unsigned memorandum to the Chairman of the Chiefs of Staff Committee laid out the Department’s fears and hopes. They expected Charles Drury, the former Deputy Minister to be named the Minister of National Defence in the event of a Liberal victory, and they worried that he would not have enough political capital to support them. They also worried, given the Parliamentary positions of Pearson and the participation of Maryon Pearson in the anti-nuclear Voice of Women, that the new Liberal government would be non-nuclear. The course of action was obvious to them, they would have to draft memoranda immediately to inform and persuade the new government of the truth of matters. The key to accomplishing this goal was to link national defence needs (nuclear weapons) to the priorities of External Affairs (international stability and influence), and to find a way to make Norman Robertson sympathetic, since he was likely to become the most influential civil servant by displacing R.B. Bryce. They felt that waiting to learn what Diefenbaker wanted had been a mistake, and they should correct this by being proactive, persuasive and persistent to secure influence going forward.

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485 DHH, Col 87/253 III (Box 6) File 0, “Dr RJ Sutherland: a Retrospective by James Lee and David Bellamy,” 2.
486 Ottawa Citizen quotation found in: DHH, Col 87/253 III (Box 6) File 0, “Dr RJ Sutherland: a Retrospective by James Lee and David Bellamy,” 9. DHH, Col 87/253 III (Box 6) File 0, “Dr RJ Sutherland: a Retrospective by James Lee and David Bellamy,” 1-14; George Lindsey, interviewed at his home in Ottawa by the author, 28 August 2008; Hellyer, Damn the Torpedoes, 32, 34-37.
It does not appear that the Department of National Defence acted on these impulses, which was just as well given that the election that brought the Liberals to power occurred a full year later. The results of the election were a Liberal minority government, but none of the other premonitions came to fruition. The government accepted the joint stockpile of nuclear weapons, and Hellyer was named Minister of National Defence instead of Drury. The final fear expressed in the memorandum was the unknown interpretation and application of the Glassco Commission recommendations, and the Department of National Defence had to wait a year for the results of the White Paper on Defence.  

4.7.3 Mackenzie, Pearson and Science Policy

The Glassco reports had a second impact on the Defence Research Board aside from the recommendations having to do with the Department of National Defence. After the Second World War three men were primarily responsible for science policy in the government: C.D. Howe, C.J. Mackenzie and Omond Solandt. The membership of this unofficial committee evolved over the years. It expanded to include Steacie when he became President of the National Research Council, and included Mackenzie even after he retired from Atomic Energy of Canada, Limited in 1954. Zimmerman supplanted Solandt as the defence research representative in 1956. In 1957, the unofficial science policy committee lost its head in the election. With no one in the new government possessing the same abilities or interests as C.D. Howe, Mackenzie, Steacie and Zimmerman had a more difficult time obtaining political support.  

The lack of a true scientific advising function was noticed by the Glassco Commission and they passed a series of four recommendations, all of which were attempted in the next
decade, with only slight modifications. First, they recommended that a single minister, the President of the Treasury Board in particular, should be responsible for scientific policy and activity (an attempt to replicate C.D. Howe’s role in Cabinet) – this was not attempted as worded, although a Minister of State for Science and Technology position was created in 1971. Second, they recommended that a science secretariat, called the Central Scientific Bureau, and a Science Secretary should be created to serve the new science minister – this was done almost immediately. Third, an independent National Scientific Advisory Council should be created to provide independent review and analysis – this was created and called the Science Council. Fourth and finally, the Science Secretary and the science secretariat should serve the National Scientific Advisory Council – this too came true in due course.\(^{490}\)

When Pearson was elected in 1963 he took the Glassco Commission’s reports and sought out the advice of Canada’s science policy expert, C.J. Mackenzie. Mackenzie issued his own report in 1964. Mackenzie made one change to the recommendations offered by the Glassco Commission; he demanded that the government’s new science policy body should have the same status as the previous advisory panel, which reported to the Privy Council instead of the Treasury Board.\(^{491}\)

Lester Pearson took the two sets of advice and created two new scientific advising and science policy forming bodies. These were the Science Secretariat and the Science Council. The Science Secretariat was created first in 1965 as part of the Privy Council Office. For two years it existed in a state of limbo. It was supposed to replace the National Research Council as the point of contact between the Privy Council Office, the Science Council and all of the science-based departments of the government. The first year of limbo for the Science Secretariat was spent waiting for the Science Council to be created and the National Research Council to be formally stripped of its advising responsibilities.\(^{492}\)


The Science Council was created in 1966. It was supposed to be an arm’s length body that provided the government with pointed, timely and independent opinions on science policy. The roles of both the Science Council and Science Secretariat were previously performed by the National Research Council. When it was created in 1916 the National Research Council was an honorary council of scientific experts from universities and industries; by the end of the Second World War the NRC was a vast network of laboratories controlled by civil servants with advice and oversight from a council of experts from universities and industries. In his opening address to the Science Council Pearson suggested that by 1962 it had become obvious that the scope of NRC’s activities meant that NRC was no longer in a position to be objective. The Glassco Commission brought this to the public’s attention. The Science Council was created to provide independent advice when needed, and Solandt was made the first Chairman. The Vice Chairman was also a recently appointed member of the Board, Roger Gaudry. In 1966 and 1967 the Science Council, with the support of the Science Secretariat, conducted influential surveys of Canada’s scientific capacities. The impact of these surveys was not felt until after Zimmerman had left the DRB.493

4.7.4 The White Paper on Defence and the DRB

The 1964 White Paper on Defence made one recommendation for the organization of the Department of National Defence. In the White Paper, Sutherland reviewed the current system of alliances and geopolitical realities that faced Canada. He explained why the nuclear question was answered by Canada’s participation in NATO and North American defence. He agreed with the recommendation of the Glassco Commission that there should be an integration of the staff level of the military under the single Chief of the Defence Staff. There was little the Services could say against this recommendation (Sutherland effectively countered the two main arguments regarding diminished morale and lack of competition), and they were begrudgingly amenable to the cost-effectiveness of it. The military retained a staff large enough that they could expand the size of the three Services in an emergency war. However, this was not the only

cost-cutting and efficiency-improving measure that Hellyer would impose on the Services, and the second realignment was the more painful and the more controversial.\textsuperscript{494}

It was this second half of Hellyer’s reform that met with resistance and resignations from the Services. The unification of the Royal Canadian Navy, Canadian Army and Royal Canadian Air Forces into a singular entity known as the Canadian Forces with a single style of uniform was, and continues to be, unpopular with soldiers, sailors and airmen/women. The main criticism has always been that the decimation of \textit{esprit de corp}, troop morale, outweighs any savings in cost-effectiveness. The perceived political benefit was a reduction in the fighting between the Services for what each perceived to be its fair share of the national defence budget – the Services believed their budget battles were beneficial to, and emotionally consistent with, their overall mission of defending Canadians and Canadian interests.\textsuperscript{495}

The calls for integration in Canada did not spring forth entirely independently. The Glassco Commission visited the United Kingdom, and Pearson’s extensive international network included his Oxbridge connections. The UK had a similar problem with the efficiency and top-heavy nature of its defence structure. The calls for better coordination stretched back to the First World War, but drastic action beyond creating a Chiefs of Staff Committee, and reducing the number of participants in Cabinet, was not undertaken until 1964. The organization for defence was different in the UK in 1963, with single Departments/Ministries for each of the Services (War Office, Admiralty, Air, Air Transport and Defence) but the call for integration and better coordination at the top-levels was identical to the Canadian situation, and the solution was a scaled-up version of the Canadian solution. The UK opted for a single Department of Defence to replace the five separate departments – they reduced the number of bureaucrats, where Canada opted for fewer generals. Neither country was wealthy enough to continue funding expensive defence organizations, at least not in times with no real war(s); the Cold War was diminishing in relevance for Canada and the UK. Understandably, both nations were looking for ways to fund


\textsuperscript{495} DHH, Col 87/253 III (Box 8) File 46, “The Defence Organization: Lecture to the Defence Medical Research Advisory Committee, Ottawa, Ontario, 5 March 1965, Sutherland,” 1-2; Granatstein, \textit{Who Killed the Canadian Military?}, 75-76; Bothwell, \textit{Alliance and Illusion}, 260-263.
more important domestic priorities, while maintaining the essential defence elements to contribute to the Western Alliance.\textsuperscript{496}

Unlike the Glassco Commission reports, the Defence Research Board escaped direct recommendations for reorganization in the White Paper. The Department’s overall research and development program was praised for its ongoing efforts, which were called ‘dynamic;’ increased support was promised. However, this did not mean that they could continue with business as usual. The DRB had to adapt to the new command and control structure of the Chief of the Defence Staff (CDS). Over the next decade internal reorganization of the headquarters of the DRB was constant. In the immediate wake of the White Paper the DRB modified itself in three ways to accomplish better coordination with the new CDS. In addition to the changes of the membership of the Board, the DRB had to change the elements that most closely interacted with the Services: operational research and scientific advising.\textsuperscript{497}

Abrams had worried about the increasing scrutiny that operational research was being subjected to when he left the Defence Research Board in 1963. The two problems that operational researchers of the DRB were most preoccupied with were antisubmarine warfare and air defences; while neither problem could be claimed to have been solved in 1963, there was a certain exhaustion of the possible answers. Sutherland kept himself busy with the nuclear debate, writing the White Paper of 1964 and participating in the committees that enacted the reorganization of the Department of National Defence.\textsuperscript{498}

There were two important developments that led to changes in the way the DRB’s operational researchers approached problems. First, the construction and implementation of computers gave operational researchers a new tool for solving their problems. They could model, simulate and conduct games and come up with solutions that were previously too lengthy

\textsuperscript{496} DHH, Col 87/253 III (Box 8) File 46, “The Defence Organization: Lecture to the Defence Medical Research Advisory Committee, Ottawa, Ontario, 5 March 1965, Sutherland,” 3-5.
to calculate by hand. This had an effect on operational research, but also on the more technical and scientific calculations done across the Defence Research Board.499

Second, Robert McNamara, the Secretary of Defense in the United States brought a new, and related, type of operational research to the organization and operation of the Department of Defense. McNamara was one of the Whiz Kids who had revolutionized business in the United States, particularly the Ford Motor Company, which had branches in Canada. McNamara’s methodology involved elements of operational research as it developed in the Second World War, but also older business efficiency theories derived from Taylorism. This new study was called ‘systems analysis,’ and it looked at the operation of the whole as well as the parts in order to come to the best possible solution. Sutherland, who was inclined to think broadly, embraced systems analysis and interpreted it for use in operational research in the DRB, especially in his own work regarding reorganization, which was one of McNamara’s applications in the United States. The other was nuclear strategy.500

Given this renewed importance of operational research it was given more independence from both the military and the Defence Research Board. Formerly operational researchers were hired by the DRB, and administrative authority for them was retained by DRB headquarters and the Board, but their projects were supposed to be integrated with the Services. This basic pattern continued after the 1964 White Paper, but a new structure was attempted that placed Sutherland


in the position of Director General, Operational Research. Sutherland reported to the Board for administrative authority for hiring, funding and some projects, but to the Vice Chief of the Defence Staff for the majority of his project management. This was the first step towards operational research’s eventual fate of being severed from defence research in 1974. Sutherland’s deputy was his lifelong friend George Lindsey, who assumed Sutherland’s position in 1967.501

The other element of the Defence Research Board that had to change in order to serve the new organization of the military was the scientific advising faculties. The Chairman was still the main scientific adviser to the Minister, and one of the three most senior members of the Department of National Defence along with the Deputy Minister and the Chief of the Defence Staff (all of whom sat on the Defence Council to advise the Minister and any Associate Ministers that may be appointed by the Prime Minister from time to time). A senior scientist, in the position of Director of Scientific Coordination, assumed scientific advising responsibilities to the Vice Chief of the Defence Staff (see Appendix E for tables of organization).502

It was, however, the Chief of Technical Services who assumed the most direct coordination with the Defence Research Board. John Arnell was the Scientific Adviser to the Chief of the Naval Staff from 1963 to 1964 after spending six years as the Scientific Adviser to the Chief of the Air Staff. He continued as a scientific adviser from 1964 to 1966 as the Scientific Deputy to the Chief of Technical Services, and from here he became the Assistant Deputy Minister (Finance).503

Before integration each of the three Services decided its own development needs and each was represented on a committee chaired by the Vice Chairman of the Defence Research Board. The Vice Chairman oversaw the entire development of the Department of National Defence, but had little real authority or influence except to mediate conflicts between the


502 LAC, MG 31 J 43 Vol 3 File 3-25 “DRB Sr. Officers Conference 1965,” “The Defence Research Board: Trends and Changes by the Secretary, DRB, 7 October 1965,” 2 (can also be found in LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-1 Part 3); Zimmerman, “Defence Research Program.”

503 DHH, Col 85/333, Finding Aid, 1.
Services. Coordination and tracking progress were somewhere between nonexistent and less than ideal, and the White Paper recommended that development be removed from the DRB’s mandate and be placed directly in the control of the Deputy Minister. A new committee was formed to report to the Deputy Minister, which was chaired by the Chief of Technical Services, and included the Vice Chairman of the DRB (Field), the Chief Scientists (Petrie and Barrett) and the Director General of Operational Research (Sutherland). Preparing reports and monitoring progress was a new Development and Associated Research Policy Group (DARPG), which was staffed largely by former employees of the DRB.504

The new management structure for development, as well as the other administrative changes in the wake of the White Paper, had a single unifying purpose as far as the Defence Research Board was concerned. One of the DRB’s main functions was to meet the scientific needs of the military, and these had always been problematic. The new structure and connections were yet another in a long line of attempts to reach an ideal working relationship. The problem for the DRB over the rest of Zimmerman’s tenure as Chairman was that the military was in a state of constant change, making it difficult to assess if the new approaches to serving the military were any more effective than previous attempts.

The unification of the three Services into the singular Canadian Forces did not involve the Defence Research Board, at least not directly. However, it cannot have been easy for defence researchers to serve clients who were unhappy with budgeting, strategy and impositions on command structures. From 1957 to 1963 the entire Department of National Defence shared a common displeasure with politicians (nuclear strategy, acquisitions, budgeting), but from 1963 to 1967 defence researchers were exempted from the more drastic and traumatizing recommendations of the Glassco Commission and the White Paper on Defence to reform the organization of the military in Canada. The DRB instead had to adapt to the new management structure, the new Canadian Forces model, the new definition of the military’s role in Canadian

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504 LAC, MG 31 J 43 Vol 3 File 3-25 “DRB Sr. Officers Conference 1965,” “The Defence Research Board: Trends and Changes by the Secretary, DRB, 7 October 1965,” 1-2, 4 (can also be found in LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-1 Part 3); DHH, Col 87/253 (Box 1) File 260 S III “Text of Speeches, Volume 2, 11 January 1962 – 8 May 1967,” “The Integration of the Canadian Defence Forces with Special Emphasis on the Technical Services Branch and its Relationship with the Defence Research Board’ Prepared by Dr JC Arnell, Scientific Deputy Chief of Technical Services, for the DRB Senior Officers’ Conference held in Kingston 27-29 October 1965,” 8-14; Zimmerman, “Defence Research Program.”
policy and strategy, and a military that was unhappy about the changes. The tension with politicians for the DRB was delayed until the early 1970s when further reviews recommended drastic changes to the organization and administration of research for national defence.

4.7.5 The Intramural Program during Integration/Unification

Aside from the reinvigoration of operational research and its closer alignment with the military, the establishments were largely unaffected by the changes brought about by the White Paper and the Glassco Commission. Or at least, the programs of the establishments were unaffected for the duration of Zimmerman’s tenure.

The Pacific Naval Laboratory (PNL) continued its work on Arctic and Pacific problems relating to antisubmarine warfare and general naval problems, while the Naval Research Establishment (NRE) continued the comparable problems of the Atlantic. The Suffield Experimental Station (SES) continued its diminished tripartite explosions as well as some special weapons work. The Defence Chemical, Biological and Radiation Laboratories (DCBRL) shared the special weapons work with SES; DCBRL was collocated with the Defence Research Telecommunications Establishment (DRTE) that was responsible for electronics and communications research (including managing the Prince Albert Radar Laboratory), although DRTE would outgrow its defence research application shortly after Zimmerman retired. DRTE’s main project was the series of four research satellites, which required the effort of designing and building (along with industry) as well as monitoring and using the incoming data. Alouette 1 was launched in 1962; Alouette 2 was launched in 1965; ISIS 1 (International Satellites for Ionospheric Studies) was launched in 1969 and ISIS 2 was launched in 1971. The Defence Research Northern Laboratory (DRNL) continued as a rocket and northern research facility until 1965 when it was transferred to the National Research Council. The Defence Research Medical Laboratory (DRML) also maintained its projects in studying the effects of stress (war and environment) on military personnel.

The only establishment to experience any drastic changes was the Canadian Armaments Research and Development Establishment (CARDE). However, the changes were the result of its main project, the Black Brant sounding rocket, being transferred almost entirely to industry and leaving CARDE with no major research project. CARDE was the largest establishment, and usually had the project that consumed the most personnel and funding. It remained the largest
establishment, but the big project of the Defence Research Board became the satellites (Alouette and ISIS). CARDE expanded the variety of work it was doing in ballistics and armaments, and joined the new field of lasers. Lasers (light amplification by stimulated emission of radiation) were a variation of the previous masers (microwave amplification by stimulated emission of radiation), both of which were developed, from the perspective of CARDE in the 1960s, by Charles Townes at Bell Laboratories in the United States. Lasers seemed to hold promise as concentrated energy weapons, but also in communications, targeting and imagery. CARDE chose to devote its energies towards a laser rangefinder as its first project.  

For the most part the stability of the research program of the Defence Research Board led to stable employment. Scientists and engineers generally either worked for the DRB for a few years (at most) or they stayed for an entire career. One prominent non-careerist was Gerald Bull, the aerodynamicist. Bull had a clear vision of the types of research he wanted to do, and these did not always coincide with the desired research endeavours of the Board. He alienated his superiors on numerous occasions, and earned a level of notoriety at Canadian Armaments Research and Development Establishment for instances of reckless experimentation that damaged his prized wind tunnel on more than one occasion. Bull and the DRB parted ways in 1961, and Bull went to McGill University to work with Donald Mordell. From McGill he moved onto projects for the United States and a series of other nations culminating with Iraq in 1990 when he was assassinated.
4.8 Canada in the 1960s

4.8.1 Demographics and Values: Defence Research in a Hostile Environment

The limited annual turnover did little to change the core values of the Defence Research Board. Board members and senior administrators were all veterans or men who had contributed to the effort to win the Second World War, the so-called ‘GI Generation’ or ‘Greatest Generation.’ New employees in the late 1950s and most of the 1960s represented an in-between generation, what is sometimes called the ‘Silent Generation.’ They were, for the most part, old enough to remember the Second World War, but not old enough to have participated. Their willingness to work as defence researchers demonstrated an acceptance of some, or all, of the core values of the senior members of the DRB. Generationally, at least, the DRB was a microcosm of Canadian society. The influx of Baby Boomers in the late 1960s, as men like Zimmerman and Field retired, would change the generational make-up of the DRB.507

However, the core values of members of the Defence Research Board increasingly became at odds with the popular will of many Canadians. The nuclear debate released a pent-up anti-war sentiment in the country, and for some a desire to think of the Cold War in new terms. Canada was not at war, but continental television brought the Vietnam War to Canadian homes. The anti-war sentiment was largely associated with Baby Boomers, but the older generations were as attuned to pacifism as teenagers and young adults. Lester Pearson and two of his Cabinet Ministers, Paul Martin, Sr. and Walter Gordon, spoke out in opposition to the American bombing campaign against North Vietnam starting in 1965. The episode demonstrated a streak of anti-Americanism. Pearson’s defiance was calculated and limited, and played no part in the close economic collaboration between the two nations, exemplified by the Auto Pact (properly, Automotive Products Trade Agreement) signed by the two nations earlier in 1965. Pearson, like Diefenbaker before and Trudeau after, was keen to show that Canada was not merely an obedient satellite of the United States, but had its own global and domestic interests, which included wanting to see a prosperous North American economy.508

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Defence researchers by and large shared a similar vision as most other Canadians about the desirability of a world without war(s). However, the devil was in the details when it came to figuring out how to achieve peace. Those defence researchers, like the rest of the military, who reflected on the consequences of their work preferred to believe that a minimum level of military preparation could deter war. Sutherland’s calm analysis that a Canada with a strong foreign policy presence and minimum national defence preparation was more stabilizing than any of the options was never going to persuade the war protestors whose absolutist logic equated the presence of weapons as a necessary and sufficient cause for war.509

The growth of an anti-war sentiment in Canada was not the only political change in the country. Pearson never achieved a majority government, so his political agenda had to be one of compromise. He chose to move left, politically, and court the support of the New Democratic Party. The new Liberal Party agenda was a mixture of liberal ideas from the United States and Europe, and a few uniquely Canadian ideas. The Canadian government under Pearson introduced universal health care, the idea of Tommy Douglas, who was leader of the New Democratic Party, and other elements of a social safety net (the Canada Pension Plan, student loans and the 40-hour work week).

Many of these new initiatives brought in by Pearson extended benefits that were already enjoyed by civil servants. Federal employees, like those in the Defence Research Board had a contribution-based pension plan. In 1967 civil servants were unionized and given the right to collective bargaining. Employees of the Defence Research Board were split into two unions, continuing the traditional hierarchy of the DRB. Professional (scientific and technical) staff was included in the Professional Institute of Public Servants of Canada along with other scientists and engineers employed by the government at the National Research Council and elsewhere. Other

employees were included in the Union of National Defence Employees (a subset of the Public Service Alliance of Canada).510

Bench scientists of the Defence Research Board described the unionisation as the first step in the loss of the paternalist management style. Previously, salaries were set by the Board, and while employees were relatively powerless in the process, they felt that their managers were behaving benevolently. After unionisation employees had the ability to bargain collectively, but the latitude of managers to set salaries with more than just the budget in mind was gone. The resulting conflict between management (on behalf of the Treasury Board) and scientists and engineers was good for employment equality, but bad for excellence.511

The social safety net was possible largely because the Canadian economy was performing admirably. The standard of living continued to increase throughout the 1960s. The unionisation of the civil service gave defence researchers the confidence that their employment within the government would be as profitable as opportunities in industry and academia.512


511 Harold Merklinger, interviewed at Defence Research and Development Canada – Atlantic by the author, 29 August 2007; Gilles Berube and Henri P. Tardif, interviewed at Defence Research and Development Canada – Valcartier by the author, 4 December 2007; Robert Chapman, interviewed at his home by the author, 12 December 2007; Harold L. Grant, Blyth Hughes, Allen R. Milne, and B. Frank Peters, interviewed at Grant’s home by the author, 13 December 2007; Terry Foster, interviewed at Defence Research and Development Canada – Atlantic, Dockyard Pacific Laboratory by the author, 13 December 2007; John Ross, interviewed at his home by the author, 15 August 2008; Gordon Marwood, Joseph Lackner, David Selwyn and Frank Szabo, interviewed at Defence Research and Development – Ottawa by the author, 20 August 2008; Robert Walker, interviewed at Defence Research and Development Canada – Corporate, Ottawa by the author, 22 August 2008; George Lindsey, interviewed at his home by the author, 28 August 2008; Anne Robison, interviewed at her home by the author, 28 August 2008; Randall Oscevski, Jan Pope, and M. Martin Taylor, interviewed at Defence Research and Development Canada – Toronto by the author, 6 October 2008; David Beevis, interviewed at his home by the author, 27 November 2008; 6 confidential sources.

4.8.2 Nationalism and Patriotism

Pearson also sought to increase patriotism in the country for the centennial in 1967. He commissioned the creation of the new Canadian flag and, in anticipation of the centenary celebrations school teachers across the country asked their students to write reports on something uniquely Canadian. The Alouette satellites were a highly popular topic, but information was hard to come by aside from a few newspaper clippings. Enterprising students wrote to the Prime Minister, the Minister of National Defence and the Chairman of the Defence Research Board asking for help with their projects. The requests all filtered to DRB headquarters and the desk of the Public Relations Officers, C.A. Pope. The Alouette, and the DRB, had captured Canadian attention and been embedded in the sense of national identity.  

Despite one of the most popular and famous events of the centenary being in Montréal, Québec (Expo '67), not everyone in the province was entirely enamoured with the wave of patriotism. There was a growing sentiment for nationalism and sovereignty within the francophone population of Québec. It was a combination of the Maurice Duplessis conservative nationalism and the interventionist independence of Jean Lesage’s Quiet Revolution.

This drive for power and independence was fed when French President, Charles De Gaulle visited Canada for Exposition '67. De Gaulle spurned official offers from Ottawa to be present for the celebration and instead accepted an offer from Québec Premier Daniel Johnson and Montréal Mayor Jean Drapeau. After landing in Québec City, De Gaulle made his way by car to Montréal, where he ended an impromptu broadcast address to an exuberant crowd with the expression “Vive le Québec libre!” (Long live a free Québec!) Reaction from Pearson and his new Minister of Justice Pierre Trudeau was swift and condemnatory, and De Gaulle hastily retreated from Canada before his scheduled visit was supposed to end. Franco-Canadian relations, frosty since the Suez Crisis, did not improve after this visit from De Gaulle. The cause of separatism in Québec continued to grow.

One of the indigenous driving forces for separatism was a chemist employed by the Defence Research Board. Marcel Chaput was variously stationed at the Defence Research Chemical Laboratory, the Defence Research Medical Laboratory and the Operational Research Group. In 1960, while working from Shirley Bay, he began giving interviews to the press in Hull, Québec. Chaput addressed increasingly politicized topics like the treatment of francophone employees of the government and soldiers in the military. At the very least he wanted to see more interactions in French as a means of redressing past and present injustices.516

However, Chaput quickly escalated his demands. In 1961 he published a long essay entitled "Pourquoi je suis séparatiste" ("Why I am a separatist"). Chaput was already under pressure from politicians within government and his superiors within the Defence Research Board, and this increased the tension. He was suspended because of regulations put in place to prevent civil servants from being active politically, and he was in the midst of organization meetings to found a new party. He resigned from the DRB in 1961 to lead the Rassemblement pour l'Indépendance Nationale (RIN - National Independence Movement) and in 1964 he ran unsuccessfully for Québec’s Legislative Assembly. The rest of his political career unfolded similarly. Chaput’s writing was at the centre of the separatist movement, but he never was.517

Chaput was not alone among members of the Defence Research Board calling for changes to be made within the DRB to improve the situation for francophones. Board members Louis-Philippe Bonneau and Roger Gaudry wrote a letter to Zimmerman in March 1964 suggesting improvements to the committee structure. They wanted to see more grants going to smaller universities, especially francophone institutions, and they felt that the way to achieve this was including more francophone representatives on committees. More francophone members would increase the number of applicants and the likelihood of those applicants receiving grants, so Bonneau and Gaudry argued. They also suggested that a wider variety of locations for


laboratories would make it more difficult for an enemy attack to disable the majority of the scientific capacity (laboratories and people) of the country.\footnote{LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-1 Part 2, “Letter from Louis-Philippe Bonneau and Roger Gaudry to Dr. Hartley Zimmerman, Chairman, DRB, 27 March 1964,” 1-2.}

Zimmerman’s response in April 1964 was placating and diplomatic. He asked Bonneau and Gaudry to offer suggestions of potential committee members to improve the situation, and apologized for the continuation of tradition within the Defence Research Board without critical reassessment.\footnote{LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-1 Part 2, “Letter from Zimmerman to Dean Bonneau and Dr. Gaudry, 8 April 1964,” 1-2.}

Moreover, the internal discussions of how to respond to Bonneau and Gaudry were far less diplomatic. Ronald Lowe, the Executive Secretary, Grants and Contracts, provided a table and interpretation to George Field and Hartley Zimmerman. Aside from the criticism of the language divide, Bonneau and Gaudry were also criticizing the level of funding that was going to the University of Toronto and McGill University. The statistics inevitably demonstrated that this allegation was groundless; the two institutions received the most funding, but they also had more graduate students than all the other universities in Canada combined. McGill and Toronto, along with McMaster, Saskatchewan and British Columbia, received large grants every year for the continuation of institutes, laboratories and a reactor that were created, at least in part, by Defence Research Board money for defence research purposes. Francophone universities (Laval, Ottawa and Montréal) received funding on par with comparable anglophone institutions (Manitoba, Alberta, Queen’s, Waterloo, and Dalhousie). On the point of committee membership, however, Lowe agreed. He suggested that committees had a tendency to be self-perpetuating and nepotistic, and that an expansion of membership to newer and smaller universities would be beneficial.\footnote{LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File DRBS 173-1 Part 2, “Memorandum from R.H. Lowe (Executive Secretary, Grants and Contracts) to Chairman, DRB through the Chief Scientist regarding Letter from Bonneau and Gaudry, 6 April 1964,” 1-3, and “Memorandum from Chief Scientist to Chairman regarding Letter from Bonneau and Gaudry, 7 April 1964,” and “Minute from Lowe to Chairman, 7 April 1964.”}

Pearson’s response to the Quiet Revolution and Marcel Chaput was the creation of a Royal Commission on Bilingualism and Biculturalism in 1963. It was chaired by André Laurendeau, an editor for the nationalist newspaper, Le Devoir, and A. Davidson Dunton who
had been the President of Carleton University since 1958 and had spent the 13 years before that as the Chairman of the Canadian Broadcasting Corporation (CBC). When Laurendeau died in 1968 he was replaced by Jean-Louis Gagnon, a commissioner and editor with La Presse. The so-called Laurendeau-Dunton Commission was tasked with investigating the extent of encouragement for bilingualism and biculturalism both within the federal government and outside of it. It released a preliminary report in 1965, but the full reports were not released until 1969.521

The Commission was viewed sceptically by a great many Canadians. Many francophones were suspicious that it was merely an attempt to stall and obfuscate. While more than a few anglophones feared that it would be yet another attempt to give a powerful minority even more leverage. Unsurprisingly, given the string of complaints within the Defence Research Board, the Laurendeau-Dunton Commission found that the federal government did not give adequate opportunities to francophones to advance their careers, nor did the federal government do enough to serve Canadians in the language of their choice. Legislation to correct the situation had to wait until the Commission was finished its reports in 1969. Given its history with the problem, the DRB started acting in 1967 when Zimmerman retired.522

4.9 Conclusion

Hartley Zimmerman turned 65 and retired from the Defence Research Board. He was a steady hand through a period of political and demographic uncertainty: the Suez Crisis, the Diefenbaker interlude, the nuclear debate, the Quiet Revolution, the Glassco Commission and the Laurendeau-Dunton Commission. His appointment was initially made because he was one of C.D. Howe’s boys and a close friend of Edward Steacie; shortly after his appointment Howe was

out of government and the Department of National Defence was under the intense scrutiny of a new government. Zimmerman’s strengths made him valuable to the new government, regardless of previous patronage.

As Sean Maloney and Jason Ridler have documented, Zimmerman was not universally admired by his staff. While George Lindsey apparently spoke to David Grenville about Zimmerman’s superior administration skills in 1985, more recently he simply refused to talk about any other Chairmen than Solandt. Lindsey was keen to advance his belief that his personal friend Solandt, who had hired him to the Defence Research Board, was fantastic and everyone else paled in comparison. Alec Fordyce, whom Ridler mistakenly calls ‘Arthur,’ claimed that Steacie came to dominate Board meetings and that the two men shut Solandt out; given the long history between Steacie and Zimmerman, it is perfectly understandable the degree of trust the two men had for each other; it is also reasonable for a Chairman to want to forge his own path and to distance himself from his predecessor. Aside from Solandt’s friends and supporters (and these were the clear majority of employees of the DRB when Zimmerman took over), the lynchpin of Maloney’s and Ridler’s argument is a single anonymous letter to Prime Minister Diefenbaker in 1960. The letter expresses disdain for Zimmerman’s qualifications (his doctorate was honorary) and his soft-spoken nature, and claims that he was only made Chairman because of his connection with C.D. Howe – the latter claim was probably most likely to resonate with Diefenbaker, whether the writer knew it or not. The letter-writer underrepresents the depth of the link between Zimmerman and Howe and undervalues (mining) engineers, which, while unsurprising, would probably not have made this scientist the most popular employee in his establishment. Diefenbaker probably took the letter with the grain of salt it deserved – it was likely written by an employee, like Gerald Bull, who was disgruntled because his project was cancelled. Zimmerman likely would have considered this amount of dissent a success – cordial relations with Solandt loyalists, trouble from Chaput, Bull and one anonymous employee.523

Robert Uffen was determined to do things differently when he took over from Zimmerman. However, four years later when he retired from government Uffen came to respect what Zimmerman had accomplished and the wisdom Zimmerman had shared with him. Uffen

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523 Maloney, Learning to Love the Bomb, 110; Ridler, State Scientist, 285-287.
wrote that "Few people knew the wisdom of his decisions." Uffen passed along the NASA Group Achievement Award to Zimmerman's wife, telling her that Zimmerman had done more than anyone else to make the satellite program happen, and indicated how grateful he was for Zimmerman's advice now that he was retiring from government.

Zimmerman’s true strengths appear to have been his contacts with industries, which were valuable in the hydrofoil, rocketry and satellite projects. Few of his thoughts on the period have survived, which gives the impression of a humble man who knew how to operate in political and personal channels. To deal with the increased responsibilities of the Board Zimmerman expanded membership and called upon new men for participation. He adapted to the new administration of the military within the Department of National Defence by changing his own organizational and managerial structure, and he pushed through a successful research program in spite of the turmoil surrounding the Defence Research Board, a static budget, and only minimal annual turnover of employees.

Sadly, Zimmerman did not enjoy retirement for very long, because he died later in the year. Shortly after Zimmerman’s death, Omond Solandt was invited back to address the Defence Research Board in his new role as Chairman of the Science Council of Canada. Solandt took the opportunity to reflect on the first 20 years of the DRB from both an insider’s and concerned outsider’s perspective. Solandt suggested that his time with the DRB was the period of growth and Zimmerman’s was one of stability. He said “Dr. Zimmerman will be remembered for the quiet and effective way in which he presided over the affairs of the Board throughout this very successful period.” Solandt went on to foreshadow impending problems for the DRB; he argued that there were three poorly coordinated agencies in charge of defence research (DRB, the Canadian Forces and the Department of Defence Production), that some unification of the three would be necessary in the future, and that collaboration with the Department of Industry

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would become necessary. Solandt’s new position as Chairman of the Science Council meant that his suggestions carried some, but not a lot, of weight.\textsuperscript{527}

Solandt was accurate that the next few years would be marked by more upheaval within the Defence Research Board, but the details escaped Solandt’s foresight. The next ten years of the Defence Research Board continued to be plagued by the interpretations of the Glassco Commission, the Laurendeau-Dunton Commission, the Bird Commission as well as the advice coming from Solandt’s Science Council. The research program remained unaffected, more or less, but management continued to evolve with each new theory on how the organization of the Department of National Defence could be improved.

Chapter 5
Dealing with Science and Defence Policy: The Demise of the DRB


5.1 Introduction

5.1.1 Biographies

Robert Uffen was born in 1923 in Toronto. He finished high school in 1941 and joined the Canadian Army, serving in the infantry and then artillery. After the war, Uffen took advantage of available resources and returned to pursue a university education. He obtained a Bachelor of Applied Science in engineering physics in 1949 and a Master of Arts in geophysics a year later, both degrees were taken at the University of Toronto, and for the graduate work he studied with J. Tuzo Wilson. Uffen left Toronto in 1951 to pursue a Ph.D. in physics, and to lecture, at the University of Western Ontario. He completed this degree in 1953 and won a post-doctoral fellowship at the University of California in Los Angeles where he studied with J. Robert Oppenheimer. Uffen returned to Western to the new geophysics department, and quickly gained a reputation as an excellent researcher, teacher and administrator - he was the head of the Department of Geophysics, followed by Principal of the Faculty of Arts and Science, and then the first Dean of the Faculty of Science. Uffen only held this final position for a year before leaving to become Vice Chairman of the Defence Research Board. He spent a year as Chairman-in-waiting and took over from Zimmerman on 3 March 1967.  

One of the first orders of business for Robert Uffen when he took over the Defence Research Board in March 1967 was to shuffle headquarters staff and the ex officio members of the Board. When he was appointed Chairman this left the Vice Chairman position vacant, a fact he anticipated beforehand and took action to rectify. Archie Pennie was the Deputy Chairman, and men like George Field and John Keyston had left the DRB. Uffen had a choice of finding external candidates to help with administration, or to promote from within. Of all the Chairmen and Vice Chairmen the Board had appointed over the years only E.Ll. Davies, Keyston and Field were promoted from the establishments. Both Davies and Keyston were loaned to Canada to run establishments in the first place and both returned to Europe after their tenures as Vice Chairmen (see Appendix E for tables of organization).

Given the glut of talented scientific administrators who were rising through the Defence Research Board, Uffen opted to promote from within. Archie Pennie was relatively happy in his position as Deputy Chairman; he had over 20 years of experience as Secretary, Superintendent, Chief Superintendent and Deputy Chairman, so he was an ideal candidate to continue in this position although his name was put forward as a candidate for the Vice Chairman position. To fill the role of Vice Chairman, Uffen appointed a special search committee because he had little experience with any of the candidates and because he was used to the academic practice of search committees. The special search committee considered all of the senior officers from liaison, headquarters and the establishments, but because the committee was well acquainted with all the candidates no interviews were conducted. The committee also considered and promptly dismissed Pennie and Keyston, both of whom were discussed by Uffen in his meetings with Hellyer and Mackenzie. In the end, the special committee opted to promote the Chief Superintendent of the largest establishment, Canadian Armaments Research and Development Establishment (CARDE).
Léon Joseph Jean L’Heureux started working for the Defence Research Board in 1947. L’Heureux, who was born in Ottawa in 1919, was a graduate of the University of Ottawa in 1940 with a Bachelor of Arts and the University of Saskatoon with a Bachelor of Engineering in Engineering Physics in 1944. From 1944 to 1947 he served in the Royal Canadian Corps of Signals, part of the Canadian Army. He, along with Edward Bobyn, was given tuition and travelling expenses to go to Johns Hopkins University to pursue graduate studies (Master’s and Doctoral) in guided missiles from 1947 to 1951. When Gordon D. Watson was promoted within Canadian Armaments Research and Development Establishment to Project Officer for guided missile program in 1952 – a position that involved coordinating work within the various Wings of CARDE with outside contractors – L’Heureux was suggested as his replacement, and Bobyn as the new deputy. Following his Superintendentship of G-Wing from 1952 to 1954 L’Heureux was promoted to Deputy Chief Superintendent of CARDE from 1955 to 1960. L’Heureux succeeded John Green as Chief Superintendent from 1963 to 1967. From 1961 to 1963 L’Heureux was the Scientific Adviser to the Chief of the General Staff. He was an ideal candidate for the Vice Chairman, and eventually the Chairman, position.

5.1.2 Themes

Robert Uffen and especially Léon L’Heureux marked a departure from the previous chairmen of the Board. Neither was well-connected politically before they arrived. Both were well-respected in their fields and professions, but neither had accumulated the kind of influential networks that Solandt and Zimmerman had when they arrived at the post. Uffen made his connections while acting as Chairman, which allowed him to move on from the Defence Research Board to a series of influential positions and committees. L’Heureux was a career...
defence researcher, and it was hard work and talent that earned him the Chairmanship, but it was also the culmination of his career.

Both men were effective administrators, and the research program continued to thrive under their leadership. The problem for both was the string of external reviews that had started in 1960 with the Glassco Commission, which emphasized bringing business management practices to the public service, even if the latest theories about management practices were less proven than the scientific management forged in the fires of the Second World War and continued within the Defence Research Board. Zimmerman had attempted to adapt through the process of integration and unification, but the management changes accelerated under Uffen and L’Heureux, until, eventually, the Board was disbanded by Pierre Trudeau’s government.

Aside from management reviews directed specifically at the Department of National Defence and the Defence Research Board, Canada was also attempting to modernize its apparatus for science policy. Previously, the government’s policy for scientific research had been formulated by men like C.J. Mackenzie and Omond Solandt with the patronage of a powerful minister (C.D. Howe). With Howe out of government, and no one possessing his natural organizational talents or grasp of science and engineering, the creation of science policy fell behind other national or regional priorities in the government agenda. When the Glassco Commission pointed out the vacuum where Howe and Mackenzie used to exist, Pearson turned to Mackenzie to suggest an apparatus to replace the personalities who had retired. The result was two new bodies that were supposed to fill roles previously occupied by Mackenzie’s National Research Council; they even persuaded Solandt to return, since he was the only one of the three available. With Charles Drury, the only politician with Howe’s scientific and technical insight, lacking Howe’s political capital, the results were easily predictable – no apparatus can replace competent people and influential relationships.

The Defence Research Board conducted introspective reviews of its intramural and granting programs under Uffen and L’Heureux. The DRB also responded to pressures from the government in favour of bilingualism and improving the employment of women. These two government initiatives were unquestionably noble, but also hopelessly naive and served as a distraction from the normal activities of defence researchers when defence research could hardly afford to be anything but productive, timely and relevant.
5.2 The Uffen Years

5.2.1 Management Changes

Uffen, based on the recommendations of a committee chaired by Léon L’Heureux, decided to supplement Archie Pennie as the Deputy Chairman and L’Heureux as Vice Chairman by adding William Petrie as a second Deputy Chairman. The change was motivated by an attempt to find efficiencies and economies within the Department of National Defence; Hellyer informed Uffen that the budget ceiling was likely to stay for the foreseeable future, so Uffen set out to reduce headquarters by 30% - L’Heureux only managed to cut it by 20%. The first step in reducing headquarters staff from 13 senior officers reporting to the Chairman to five was the forced departure of Hugh Barrett who was, until 1967, the Chief Scientist (Chemistry and Biology). This left Petrie as the only Chief Scientist (Physics and Engineering), but the committee, of which Petrie and Pennie were both members, felt that a second Deputy Chairman was more efficient than finding a second Chief Scientist. Petrie was put in charge of Science, and Pennie was responsible for Operations (see Appendix E for tables of organization).\(^{531}\)

The National Research Council also had a new President in 1967 when William George Schneider replaced Guy Ballard. When he was awarded an honorary degree at the University of Saskatoon in 1969, Balfour Currie described Schneider’s first two years as President as “a time when scientific policy in Canada is under critical examination by government, universities and professional societies.” Schneider attempted to modernize the NRC to meet expectations in the same way that Uffen and L’Heureux adapted the Defence Research Board to the changing demands made of science by the government and military.\(^{533}\)


Petrie stayed less than a year as the Deputy Chairman (Scientific) before asking for a transfer to the Liaison position in London. Pennie expressed an interest in being moved back to an establishment as a Chief Superintendent, with his first choice being to replace Frank Davies at the Defence Research Telecommunications Establishment when Davies retired. However, moving Pennie to DRTE would have limited the options open to John Chapman, although Uffen knew that other government priorities were going to take Chapman away from him soon anyway. The Chief Superintendent position at Suffield could be opened up, as Edward Bobyn felt that work done there was outside of his expertise.\(^\text{534}\)

Ultimately, Uffen decided that he wanted to keep things as steady as possible. Pennie was persuaded to stay as Deputy Chairman (Operations) and Chapman was named as Petrie’s replacement as Deputy Chairman (Scientific) in 1968. Chapman was destined for another promotion, and getting him some experience in senior management was essential. It was also only a matter of time before naming a successor for Davies at Defence Research Telecommunications Establishment ceased to be under the authority of the Defence Research Board.\(^\text{535}\)

In addition to responding to the upheaval in government organization, the changing political and cultural environment of Canada, North America and the world, Uffen and the Board had their own ideas about changes that needed to be made. One of these changes was to the names of the establishments in 1967. The names of each of the establishments represented links to the past, and gave employees a sense of inclusion and belonging at their own establishment. Establishments formed after the war had names that started with ‘Defence Research’ as a demonstration of their inclusion in the Defence Research Board. The Pacific Naval Laboratory was, of course, a post-war exception that followed the unique naming trend of establishments that were formed during the war (Naval Research Establishment, Suffield Experimental Station.

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\(^{534}\) LAC RG 24 A 1983-84/167 S F1 Vol 7417 File DRBC 212-2, “Memorandum from Secretary DR to Chairman, Vice Chairman and Chief of Personnel regarding Candidate for Language and Cultural Training in Quebec, 16 October 1967,” 1-2.

and Canadian Armaments Research and Development Establishment). Uffen wanted consistent names to give all the establishments a sense of solidarity and inclusion in the DRB as a whole. Every establishment was renamed to start with Defence Research Establishment and end with the location name, or Centre de Recherche pour la Défense in French. The first to change were NRE, PNL and SES, which became the Defence Research Establishment Atlantic (DREA), Defence Research Establishment Pacific (DREP), and Defence Research Establishment Suffield (DRES) respectively. The Toronto and Ottawa Establishments were renamed in this system shortly after the first three – Defence Research Establishment Toronto (DRET) and Defence Research Establishment Ottawa (DREO), and operational research, which was located wherever the military needed it (mostly Ottawa) was renamed Defence Research Analysis Establishment (DRAE). CARDE was the final establishment to be renamed – Defence Research Establishment Valcartier (DREV) – although its name change was delayed until 1969. Individuality, and the sometimes confusing alphabet soup, was sacrificed in favour of inclusion within the entire DRB rather than by establishment.536

The names of the establishments changed, and so did the names of the men running them. The classification Chief Superintendent (and in some cases Superintendent) was replaced by Director General (DG) at the same time that the establishments were renamed; another means of unifying the Defence Research Board and coordinating with naming procedures in the military and the entire civil service.537

5.2.2 Renewing the Intramural Research Program

Throughout 1967 and 1968 the Defence Research Board scrutinized its research program. The new Canadian Forces (CF) was to be more efficient, and the DRB was to serve its needs.

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537 DHH, Col 87/253 II (Box 5) File 27.2 “Miscellaneous memoranda, reports, papers, etc pertaining to the history, organization, programs and functions of the Defence Research Board and the Operational Research Establishment, 1966-1967,” “‘Titles and Organizational Structure at DRB Establishments’ by E.J. Bobyn (Chief Superintendent, SES), 22 March 1967,” 1-2.
For the Forces, this seemed to imply that the DRB should overhaul its program in order to focus on projects that would produce immediate results. However, the Board had long believed that the research program should focus on long-term research projects that would pay off in ten or more years, with a smaller portion of the DRB’s resources devoted to immediate problems. This was the justification behind the Velvet Glove and many other projects.  

Uffen took a new look at the research program and the entire organization of the Defence Research Board to attempt to find efficiencies. The same committee that recommended creating a second Deputy Chairman position was tasked with attempting to economize within the DRB by decentralizing. Each establishment had specific areas of expertise, but for two decades much of the coordination for liaison, grants and contracts had been centralized. The Ad Hoc Group expected that allowing direct coordination of establishments with the appropriate sub-groups of The Technical Cooperation Program (TTCP) would save time and money, and could still be monitored from headquarters by an Executive Secretary. The unique expertise of each establishment also meant that they were in a better position for coordinating grants and contracts than headquarters.

When called before the Senate’s Special Committee on Science Policy Uffen claimed that research and development, both within the Defence Research Board and in other research units, within the Department of National Defence accounted for five percent of the national defence budget. He considered this “the bare minimum threshold of a reasonable investment in R&D from the point of view of national defence.” The call for cuts, however, kept coming from Cabinet.

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The problem, from Uffen’s perspective, was that to account for inflation and sophistication (the increasing cost of electronics), the budget actually needed to increase by about 10% a year. He estimated that it cost $50,000 per scientist per year for work in physical sciences and engineering, and $30,000 per scientist per year for work in operational research, mathematics, social science and passive scientific intelligence; the Defence Research Board in 1968 had about 600 professionals, which was 200 less than both the National Research Council and the Department of Energy, Mines and Resources, and 315 less than Atomic Energy of Canada, Limited. The DRB’s number of professionals was roughly 200 more than Northern Electric and nearly 400 more than RCA Victor, two of the DRB’s main industry contractors.\(^5\)

As Uffen noted when he left the Defence Research Board in 1969, he had received competing priorities from Cabinet, and these were likely to continue for L’Heureux. On the one hand the Trudeau government despised spending on national defence, but on the other hand it was keen to fund science and technology as part of a national economy. Uffen himself was loath to destroy any individual establishment in order to realize demands for 5% cuts, and suggested that L’Heureux may face further decisions to sever defence research establishments in order for them to thrive in civilian situations (such as telecommunications research).\(^6\)

Uffen and L’Heureux were determined that business as usual at the establishment-level was the best way to meet the short- and long-term needs of the military. Headquarters, especially the Deputy Chairman (Scientific) via the two Scientific Advisers (one each for the Chief of Technical Service and Vice Chief of Defence Staff), was to bear the coordinating responsibility for all of the establishments meeting the needs of the Canadian Forces, and for persuading the Canadian Forces that the work being done was valuable through high-quality scientific and technical advising.\(^7\)

Three establishments were working on long-term projects that yielded useful ongoing results. The Defence Research Establishment Atlantic and the Defence Research Establishment

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\(^7\) DHH, Col 87/253 II (Box 5) File 27.2 “Miscellaneous memoranda, reports, papers, etc pertaining to the history, organization, programs and functions of the Defence Research Board and the Operational Research Establishment, 1966-1967,” “Preliminary Report of the Ad Hoc Planning Study Group,” 3-5.
Pacific had always been closely aligned with the primary naval problems. The two naval facilities were continuously investigating physical properties of the Pacific, Arctic and Atlantic Oceans in order to fulfill the mission of antisubmarine warfare. This duty required ongoing work on acoustics, electronics, ship corrosion, hydrofoil testing, and weapons. Combined the two establishments had 14.5% of the manpower and 21% of the projects. Likewise the Defence Research Establishment Toronto was investigating the human aspects of war: clothing and kit, acclimatization and human factors (i.e. vehicle design from an operator’s perspective). DRET had 5.8% of the manpower and accounted for 4% of the projects. These long-term projects provided short-term results, and were exemplary of what the Canadian Forces wanted, but could not express.\textsuperscript{544}

The laser project at Defence Research Establishment Valcartier was the least obviously applicable in the short-term, but it was part of both the communications objectives of the Canadian Forces and potentially the anti-ballistic missile defence. DREV’s continued work with conventional armaments from bullets to shells and rockets was rather obviously in the short and long-term interests of the Canadian Forces. DREV had 20% of the manpower and accounted for 22% of the projects. The Defence Research Telecommunications Establishment was still in the midst of its satellite projects in 1967 and 1968, an obvious communications need of the Canadian Forces, but also for civilian purposes; restructuring within the government to reflect this dual application of communications technology, as suggested by the Glassco Commission (and advocated by Uffen), was imminent. In its final years in the Defence Research Board DRTE had 19% of the manpower and made up 22% of the projects.\textsuperscript{545}

The Defence Research Analysis Establishment had been reinvigorated by the new Canadian Forces. The Canadian Forces were realigned to be more mission oriented, and this allowed for a smooth integration of operational researchers in the various headquarters. The

\textsuperscript{544} QU, A 1993-Q097 Vol 10 File 29, “A Briefing Given by Dr. Robert J. Uffen, Chairman, Defence Research Board to Treasury Board Officials, 2:30pm – Wednesday 24 April 1968,” Figures 3a and 3b; Defence Research Board, Defence Research Board: The First Twenty-Five Years, 20, 30, 34; Chapman, Alpha and Omega, 31-47; Gaede and Merklinger, Seas, Ships and Sensors, 27-.

Canadian Forces were quite receptive to operational research, resulting in Chief of Defence Staff General Jean Allard requesting that more operational research be done. The nature of operational research had evolved into something more like systems analysis. Operational researchers had new tools like computers and game theory, and they were beginning to approach problems with a specific methodology with entrenched holistic analysis. The days of the ideal operational researcher being a jack of all trades with basic statistical skills and an ability to cut through the nonessential details to see the bigger picture were gone. The new emphasis was decidedly American from Robert McNamara and the RAND Corporation. DRAE accounted for 4% of the total projects and 10% of the manpower.  

Special weapons research, split between Defence Research Establishment Ottawa and Defence Research Establishment Suffield, continued, but Uffen, L’Heureux, Harry Sheffer and Longair sought ways to reduce the size and expense of the research. DREO had stopped its pilot respirator assembly plant earlier in the 1960s, and it was concerned with specific Canadian Forces needs relating to chemical, biological and radiological protective equipment. DREO continued its close collaboration with the nuclear reactors of Atomic Energy of Canada, Limited at Chalk River. Combined, DREO and DRES held 15.7% of the manpower and 11% of the projects. Field trials continued at DRES, and the defence researchers at DRES were in the midst of wrapping up the scaled explosives testing that were central to their research program in the 1960s. Without the explosions, DRES was in search of a new justification; it was a massive

piece of real estate, and its history of testing and storing chemical weapons meant that the
government would have to do something with it. 547

5.3 Canada in 1967 and 1968

5.3.1 Public Outcry – Vietnam and *Silent Spring*

The Canadian government was also experiencing a dose of criticism regarding the past
activities of Suffield (and Kingston, Grosse Île, and Ottawa). Rachel Carson published *Silent
Spring* in 1962, which was a critical look at the widespread use of chemicals (especially DDT) in
the environment. Carson argued that the chemicals were having quite obvious deleterious effects
on the environment, which were in turn harming humans, even though the chemicals were
intended to aid humans by combating pests and diseases. *Silent Spring* was the most public and
accessible cause of the environmental movement; a condemnation of the uncritical application of
chemicals and pollution of the environment in general. 548

The application of herbicides and defoliants (like Agent Orange) and incendiaries (like
Napalm) by the United States in Vietnam was widely publicized. The military effectiveness of
these weapons was relatively obvious, but their destructive power was also clear. The
unpopularity of the Vietnam War was extended to war in general; the use of what appeared to be
chemical weapons, which were banned by the Geneva Protocol of 1928 (signed by Canada in
1930), was particularly vexing for both anti-war protestors and environmentalists. 549

The reminder of what was once fairly widespread knowledge that the United States,
Canada and the United Kingdom had produced and stockpiled mustard gas during the Second
World War was worrisome for the anti-war and environmental movements. The context no

547 LAC, RG 24 A 1983-84/167 S F1 Vol 7329 File 100-31/0 Part 3, “Paper by H Sheffer regarding NBC Program,
June 1968,” 1, 3-4, “Reduction and Consolidation of NBC Programs by H Sheffer, 27 December 1968,” 1-2,
“Reduction and Consolidation of Nuclear, Biological and Chemical Research Programs of the Defence Research
Board by H Sheffer, 17 February 1969,” and “Notes of a Meeting Held in the DRB Board Room on Monday, 10
Robert J. Uffen, Chairman, Defence Research Board to Treasury Board Officials, 2:30pm – Wednesday 24 April
1968,” 8, Figures 3a and 3b; Pennie, *Suffield Experimental Station, 1941-1961*; Defence Research Board, *Defence
Research Board: The First Twenty-Five Years, 22, 26; BATUS, *Dinosaurs to Defence, 113-115; Harry Nash and
Research Establishment Ottawa; Board, A Brief History of the Defence Research Establishment Ottawa, 16-18.


longer mattered; exigencies of war and the fear of German use of chemical and biological warfare were irrelevant by 1967. Chemical and biological weapons should be banned completely, so the line of reasoning went, and the loophole in the Geneva Protocol that allowed for production and storage should be closed. It was, by United Nations action in 1972, but in the meantime protestors and critics looked to the past. The Canadian stockpile of mustard gas shells was dumped off the continental shelves of the Atlantic and Pacific Oceans, and some remained at Suffield where it was buried. A decision, made by men who were no longer in power, had to be justified and defended by the government of the day, which joined an international community in banning the practice in 1975.550

Over the same period as the beginning of the environmental movement, there was a rise of anti-war protests in North America. In the United States the anti-war protests generally centred on college students, and the protestors returned to two specific issues repeatedly: the war and the draft.

Protestors and demonstrators attempted to disrupt the ability of the United States to conduct war by disrupting the infrastructure that transported troops and materiel, and by boycotting industries that manufactured weapons. Particular vehemence was directed at university laboratories that conducted defence research as part of the military-industry-academic complex. The Vietnam War was seen variously as imperialist, anti-democratic, unjust and amoral; in other words, it was a war against all perceived traditional American values.551

Not only were many Americans opposed to the war, they were opposed to being conscripted to fight the war. Draft dodgers and conscientious objectors moved North across the border into Canada in reasonably substantial numbers, sometimes covertly, sometimes openly. Canada was a moderately safe haven for Americans trying to escape. Canada was a non-combatant in the Vietnam War, but Canada was the Western representative on international commissions that attempted to enforce the numerous truces and broker a lasting peace. Several

critics from academia, such as Gabriel Kolko, found their way to Canadian campuses where they felt that their academic and intellectual freedom would be sheltered.\textsuperscript{552}

The impact on Canada of anti-war protests in the United States extended beyond increased immigration from the United States. These immigrants brought their ideals with them, and found sympathetic Canadians. As early as 1965 there were protests in Canada against the Vietnam War; one example being the targeted attack in Edmonton, Alberta on a retrofitting project of American war planes. Canadian college and university students joined in symbolic protests as a show of support of solidarity with American protestors, but they never seem to have targeted university laboratories working on grants and contracts for the Canadian and American military. The Defence Research Board issued grants and contracts to most universities with science and engineering programs, and the DRB was also the intermediary manager of the handful of grants and contracts at Canadian universities from the United States military (usually the Air Force). In spite of its best efforts to publicize itself, the Defence Research Board was relatively unknown, and by extension the university laboratories that collaborated with the DRB did not experience the kind of scrutiny and ire as comparable American university facilities.\textsuperscript{553}

Aside from the fact that Canada was not participating in the Vietnam War, unless one accepts the complicity arguments surrounding the Defence Production Sharing Agreement, there was an additional key difference with the atmosphere in Canada compared to the United States. There was no real civil rights movement in Canada. The volatile mixture of anti-war, environmental, civil rights protests combined with the coming of age of Baby Boomers in the United States was not replicated in Canada. Continental television brought all of these American issues to Canada, but the replication was muted, because Canada was not at war and Canada’s major minority was not as repressed as African-Americans (in spite of the rhetoric of many


The one aspect of the American civil rights movement that did experience parallel activism in Canada was feminism.\footnote{Victor Levant, Quiet Complicity: Canadian Involvement in the Vietnam War (Toronto: Between the Lines, 1986); Bothwell, Canada and the United States, 99-100; Sherry, In the Shadow of War, 292-307; Boyer, et al, The Enduring Vision, 669-674; Bothwell, The Penguin History of Canada, 393-394; Bothwell, Alliance and Illusion, 213-214.}

The Voice of Women was active, media-savvy, and adamant throughout the 1960s. They lost the battle on nuclear weapons when Lester Pearson accepted the joint key arrangement, but the creation of the Royal Commission on the Status of Women held a lot of promise for advancing their goals of gaining more equality for women than mere enfranchisement. The Voice of Women was also opposed to the Vietnam War and war in general. They understood the unique Canadian context and were able to organize meetings between their members, including outspoken University of Toronto professor Ursula Franklin, and the Chairman of the Defence Research Board and the Director General of the Defence Research Establishment Suffield. Not satisfied with the responses to their queries about the nature of research being conducted by DRES and the DRB as a whole, they organized a protest at DRES in 1970. The combined facts that DRES conducted chemical and biological weapons tests and that these tests were usually tripartite was more than enough evidence to condemn the activities. The Voice of Women wanted politicians to accept responsibility for the undesirable situation and to end it immediately.\footnote{Diana Chown, “Suffield, Chemical Warfare, and Canadian/US Relations,” Peace Magazine 5, no. 1 (February-March 1989), 12, \texttt{http://www.peacemagazine.org/archive/v05n1p12.htm}; Dorothy Goldin Rosenberg, “Biological and Chemical Weapons: Poisonous Cauldrons,” Peace Magazine 5, no. 6 (December 1989 January 1990), 14, \texttt{http://www.peacemagazine.org/archive/v05n6p14.htm}; K.B. Shaw and D.A. Guertin, “Questions Relating to the Barton Report,” 16 January 1989, \texttt{http://cradpdf.drdc-rddc.gc.ca/PDFS/unc112/p534902_A1b.pdf} - William Hickson Barton was a former secretary of the Board before joining the foreign service for three decades; Duckworth, One Version of the Facts, 227 – Duckworth points out that he drew ire from his colleagues on the Board for having the same surname as the leader of the protest at Suffield, Muriel Duckworth, even though they were not related.}

The additional attention was unwanted and poorly timed. The Defence Research Board was already facing ongoing scrutiny from within the government for its efficiency and organization. The Canadian Forces were looking for more responsiveness to immediate needs and were pressuring the DRB. Even though the Canadian Forces and the government were amenable to the existing special weapons research, the scrutiny of the Voice of Women put the DRB at a disadvantage in internal discussions of organization and its research program.
5.3.2 The Status of Women

The Voice of Women brought pressure to the Defence Research Board for its special weapons research and also for the employment of women. Clerks and administrative assistants were, of course, popular choices for women in the 1960s. However the overrepresentation of women in clerical positions at the DRB did not balance the underrepresentation of women in scientific and technical positions.

Women were increasingly earning university degrees throughout the 1950s and 1960s, but those with higher education were largely going into education and libraries. Defence research, especially the practical physical sciences, was seen as too challenging for women, who were presumed to be delicate and pacifist. The other problem was that women were underrepresented at universities in the physical sciences and engineering, which formed the bulk of defence research topics, although women were graduating with doctoral degrees in geography, social sciences and mathematics.\(^{556}\)

However, there were several examples, of which three will suffice, of women who were employed by the Defence Research Board as scientists. Not only were all three employed, but they were employed in positions that challenged assumptions of gender roles.

The first example is I. Moira Dunbar. Dunbar was a geographer like her brother Maxwell. Dunbar moved to Canada in 1947 and joined the Joint Intelligence Bureau of the Defence Research Board – a component of the DRB that reported to the Chiefs of Staff committee with scientific appreciations. She participated in some of the early navigational studies of the Arctic with Keith Greenaway, and the two co-authored a photographic aerial survey of the Arctic in 1956. Dunbar switched from navigation to ice research, which brought her into collaboration with Geoffrey Hattersley-Smith. She attempted to be included in a sea study of the Arctic in 1954 aboard a naval icebreaker, but was not permitted because of naval superstitions, even though she had already overcome air force regulations barring women from flying expeditions. The following year she was able to secure a spot on a Department of

Transport study. She participated in most of the Arctic research projects, including trials of the British-built hovercraft from 1966 to 1969.\(^5\)

The second example is Margaret Larnder, née Montgomery. Larnder was a member of the Canadian Women’s Army Corps during the Second World War. After the war she returned to university to pursue a graduate degree in geography with F. Kenneth Hare at McGill University. Larnder was hired as a summer student in 1948 to participate in northern studies with Hare, J. Tuzo Wilson, K.C. McClure and Donald Solandt. The summer expeditions provided some of the field research for her master’s thesis “The Climate of Labrador and its Effect on Settlement.” She was hired full time by the Defence Research Board in 1951, and found her way into operational research where she met Harold Larnder. They married in 1954 and nepotism regulations meant that she left the DRB for jobs in other government departments.\(^6\)


The third, and final, example is Anne Robison, née Merklinger. Robison was a summer student at Valcartier in 1960 before her final year of studies at Queen’s University where she earned a degree in mathematics and economics. Her husband was in the navy, so they moved to Halifax and she joined the Naval Research Establishment after graduation. Robison’s brother, Harold Merklinger, would also join NRE four years later (and then leave for a Ph.D. at the University of Birmingham from 1967 to 1971), but they avoided nepotism regulations by never working together. Robison worked in acoustics, then computer analysis before returning to acoustics. She started as a technician (non-professional staff), even though men with similar qualifications were hired as scientific officers, and the hiring committee apologized that they could not offer her a position as a technical officer (second tier professional staff); she was eventually able to obtain a position as a scientific officer.\textsuperscript{559}

Robison’s case is interesting for two reasons. First, going to sea was absolutely essential for her career as a scientific officer; no man could have avoided research voyages, but navy regulations forbade women from sea travel. Robison was adamant and was eventually permitted to travel at sea, but she had to either return to shore by sunset, or be accompanied by another woman. By the time of her third, and final, research trip she was finally treated as an equal of the male scientists.\textsuperscript{560}

The second reason Robison is an interesting case is that she continued her career in spite of being married and having children. Her first child was born in 1964; Robison quit the Defence Research Board for ten months and then she was rehired. When she had her second child she was promised unpaid leave, but a secretary was forced to quit. Robison had demonstrated her desire to continue working for the DRB and her value, whereas secretaries were seen as expendable and replaceable. Robison returned after her second child and began working flexible part-time hours for the remainder of her career. For her fourth child, in 1974, she was given paid maternity leave. After this child she returned to university, and instead of

\textsuperscript{559} Harold Merklinger, interviewed at DRDC Atlantic by the author, 29 August 2007; Anne Robison, interviewed at her home by the author, 28 August 2008; Gaede and Merklinger, \textit{Seas, Ships and Sensors}, ix-x, 30, 125.

\textsuperscript{560} Anne Robison, interviewed at her home by the author, 28 August 2008; Gaede and Merklinger, \textit{Seas, Ships and Sensors}, 30.
taking a leave of absence, she simply quit the DRB, because her husband had been transferred. When she finished her second degree she became a librarian.\textsuperscript{561}

These three women, Dunbar, Lamnder and Robison, and the challenges they faced, demonstrate why Lester Pearson created the Royal Commission on the Status of Women in 1967. This Royal Commission was chaired by Florence Bird, a broadcaster from Ottawa. The Bird Commission also included a mixture of men and women, with the men providing demographic and legal expertise and the women representing activists and successful professionals (engineer, judge, and professor). The Bird Commission’s mandate was to investigate what progress was being made in terms of women’s equality, and responded to the growing wave of feminism in Canada and North America in the mid to late 1960s.\textsuperscript{562}

The Bird Commission started its fact-finding later in 1967 when Uffen was Chairman of the Defence Research Board. The DRB provided information when requested by the Bird Commission and adhered to the new regulations imposed by the government after the reports of the Royal Commission on the Status of Women were released in 1970.

The interactions the Defence Research Board had with the Bird Commission were less antagonistic than those with the Voice of Women. Robert Uffen and Florence Bird exchanged formalities, including Bird addressing herself as Mrs. John Bird, and then designated others to exchange the relevant information. Gordon Watson responded on behalf of the DRB. Watson’s April 1969 report was a fourteen page tabulation of the DRB’s personnel statistics and policies.

\textsuperscript{561} Anne Robison, interviewed at her home by the author, 28 August 2008.
The response also included a previous reply by Whitman Morton to a 1962 request for information from the Women’s Bureau of the Department of Labour.\(^{563}\)

In 1962 Morton gave Marion V. Royce assurances that the Defence Research Board was an equal opportunity employer. No women were excluded from any jobs, but women simply did not apply for many of the jobs offered by the DRB; heating, utilities, firefighting, construction and trades were noted particularly. Morton responded to the survey by suggesting that marriage was not a bar to employment for anyone, that men and women were paid equally, that women could receive unpaid maternity leave, and that everyone was eligible to retire between the ages of 60 and 65 according to the regulations surrounding the federal government’s superannuation plan. He did note that men pay 6.5% into superannuation, whereas women pay only 5%.\(^{564}\)

Morton was summarizing explicit policies, where they existed, and general practices where nothing was mandated. However, the situation was not entirely as Morton portrayed it. A cursory analysis of some of the annual hiring and promotions tables seems to suggest that women were not paid equally, although there was no explicit policy enforcing this. Perhaps there are explanations for every single case, but it is more likely that the usual stereotypes were at play; women were perceived to be more likely to resign once they were married or had children, and therefore merited less pay (as the Selection Committee had argued in 1951). Maternity leave, as Anne Robison’s personal history indicates, was not entirely as those in DRB headquarters suggested. Professional scientists and technicians were, grudgingly, given maternity leave; expendable employees were encouraged to leave and were replaced.\(^{565}\)

Watson’s submission to the Royal Commission on the Status of Women was more extensive. In addition to repeating Morton’s arguments from seven years earlier, Watson


\(^{564}\) LAC, RG 24 A 1983-84/167 S F1 Vol 7326 File DRB 100-6 Part 4, “Letter from NW Morton (For CDRB) to Miss Marion V Royce (Director, Women’s Bureau, Department of Labour, 165 Sparks St), 9 October 1962,” and attached survey1-2.

\(^{565}\) LAC, RG 24 A 1983-84/167 S F1 Vol 7326 File DRB 100-6 Part 4, “Letter from NW Morton (For CDRB) to Miss Marion V Royce (Director, Women’s Bureau, Department of Labour, 165 Sparks St), 9 October 1962,” and attached survey1-2; LAC, RG 24 S F1 Vol 11996 File DRBS 1-0-43-2 Vol 5, “Minutes of the 20th Meeting of the Defence Research Board held at Valcartier, 29 September 1951,” 2.
summarized some additional Defence Research Board policies pertaining to employment. He stated that all staff members were eligible to upgrade their educational training by correspondence or evening courses; only scientists were eligible for leaves and scholarships to complete the final year or two of their graduate studies, or to return to school for additional training or degrees. Even accounting for the fact that about 80% of the employees were men, men disproportionately took advantage of the opportunities to retrain or complete their studies.  

According to Watson, all employees were screened by the Personnel Committee (a headquarters and establishments committee) and the Selection Committee (populated by members and former members of the Board). He also summarized the Defence Research Board’s anti-nepotism regulations as they pertained to married employees: spouses were forbidden from working in the same team, so that it would not have a negative effect on either of their career trajectories. Watson did indicate that married women had two disadvantages in the workplace. First, if her husband had to relocate for his employment, she would have to follow him. Second, if she took the allowed time off for children she would also be taking this time off from her promotions scheduling.

The bulk of Watson’s submission was a collection of extensive tables on the sex, age and level of education of all Defence Research Board employees. Two of these tables are reproduced here. The first table indicates the level of education by both age and sex of all members of the DRB. The second table shows the age and sex of all employees broken down by decade.

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Table 5.1 – Levels of Education as of 31 March 1969 (By numbers of employees)

<table>
<thead>
<tr>
<th>Levels of Education</th>
<th>Under 25 years</th>
<th>25-44 years</th>
<th>45 years &amp; over</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Some High School</td>
<td>25</td>
<td>19</td>
<td>152</td>
<td>56</td>
</tr>
<tr>
<td>High School Graduation</td>
<td>24</td>
<td>81</td>
<td>213</td>
<td>70</td>
</tr>
<tr>
<td>Post Secondary (i.e. college or some university)</td>
<td>70</td>
<td>3</td>
<td>180</td>
<td>8</td>
</tr>
<tr>
<td>Bachelor Degree</td>
<td>9</td>
<td>6</td>
<td>102</td>
<td>9</td>
</tr>
<tr>
<td>Higher Degree</td>
<td>2</td>
<td>233</td>
<td>3</td>
<td>128</td>
</tr>
<tr>
<td>Totals</td>
<td>130</td>
<td>109</td>
<td>880</td>
<td>146</td>
</tr>
</tbody>
</table>


Table 5.2 – Males and Females by Age Group in 1969

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Males</th>
<th>Females</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 20</td>
<td>7</td>
<td>13</td>
<td>20</td>
</tr>
<tr>
<td>20-24</td>
<td>133</td>
<td>97</td>
<td>230</td>
</tr>
<tr>
<td>25-34</td>
<td>421</td>
<td>80</td>
<td>501</td>
</tr>
<tr>
<td>35-44</td>
<td>577</td>
<td>76</td>
<td>653</td>
</tr>
<tr>
<td>45-54</td>
<td>762</td>
<td>136</td>
<td>898</td>
</tr>
<tr>
<td>55-64</td>
<td>345</td>
<td>73</td>
<td>418</td>
</tr>
<tr>
<td>65 and over</td>
<td>20</td>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>Totals</td>
<td>2265</td>
<td>477</td>
<td>2742</td>
</tr>
</tbody>
</table>


Table 5.2 indicates quite clearly the aging nature of the Defence Research Board. Nearly one third of all employees were between the ages of 45 and 54, and almost half were over the age of 45. The professional staff within these age groups had likely been with the DRB since 1947,
whereas the support staff may have been more mobile. The average age for women was slightly lower than that of men, and this is most clearly indicated by the relatively high numbers of women under the age of 25 employed by the DRB. That women comprise 42 percent of all employees aged 20 to 24 could indicate an increase in the number of women hired for permanent professional scientific and technical careers in defence research, but it is more likely the result of the availability of unmarried women with clerical, stenographic and administrative skills for temporary employment.

Tables 5.1 and 5.2 highlight the likelihood that young women hired by the Defence Research Board were mostly in administrative positions. Other tables submitted to demonstrate the discrepancies in sick leave across establishments and sexes show that nearly half of the women employed by the Defence Research Board were in clerical positions at DRB headquarters in Ottawa. Table 5.1 also shows that men employed by the DRB were split roughly evenly between those who had not completed high school, those who had finished high school, those who had taken some university or community college courses, those who had obtained an undergraduate degree, and those who had completed masters or doctoral degrees. Women, however, were most likely to have a high school education at most. The spread of educational backgrounds for women was consistent with Canadian averages for the time. Moreover, the levels of education received by men employed by the DRB were higher than Canadian averages, but a necessity for the type of work conducted by defence researchers.  

Watson’s submission to the Royal Commission on the Status of Women also indicated how few part-time employees the Defence Research Board had. Two of the three part-time workers were women, and Watson explained that part-time employees were generally a waste of the DRB’s scarce resources. Watson also listed the three highest paid women and their positions within the DRB. The Deputy Director of Scientific Information Services (the part of the DRB responsible for the exchange of technical and scientific documents with other countries) was Alice M. Ironside. The Research Officer of the Geophysics Research Section was Moira

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Dunbar. The third woman was an unnamed Staff Officer with the Deputy Chairman (Scientific).569

The Bird Commission was struck in 1967, but it did not begin information gathering until 1968, and the Defence Research Board’s submission was early in 1969. The Bird Commission released its final report in 1970. This report contained numerous recommendations about the various women’s issues that the Commission had studied. Six of the categories of recommendations were important to the way the DRB operated: maternity leave, equal pay for equal work, access to educational opportunities, ability to attain managerial positions, increased opportunities for part-time employment and equal pensions.570

Officially, the Defence Research Board, along with the rest of the civil service, had many of these recommendations in place long before the Bird Commission presented its report. The problem in the DRB was rigorous application of the regulations. Whether it was individual managers bending the rules, or an attitude that permeated the entire institution, there had always been a problem actualizing the goal of equality in the workplace. The entire civil service, including defence research, went through a decade of improving the enforcement of the regulations that guaranteed the equal status of women in the workplace.

5.3.3 Official Languages Act and the DRB

The Royal Commission on Bilingualism and Biculturalism also reported to the government during Uffen’s tenure as Chairman of the Defence Research Board. The Laurendeau-Dunton Commission was formed in 1963 and released a preliminary report in 1965 and a series of final reports from 1967 to 1970. One important result of the Commission’s reports was the Official Languages Act of 1969, passed by the Trudeau government. The


Official Languages Act declared both French and English as official languages and that all federal departments and institutions had to provide service in either official language depending on the customer’s or client’s wishes.\(^5\)

The Official Languages Act had a profound impact on the civil service, which, to that point, was dominated largely by anglophones with little or no French-language skills. Managerial and headquarters positions of the Defence Research Board were mostly held by anglophones and this presented a problem for the majority of technical and services staff at Valcartier, as well as for the few professional scientists, like Marcel Chaput, who attempted to work at any of the other establishments.\(^6\)

Many departments of the federal government opted to parachute competent francophones into senior positions as a solution to the problem posed by the requirements of the implementation of the Official Languages Act. The parachuting process was controversial, to say the least. The linguistic realities in Canada meant that many francophones, especially those who rose to prominence in academia or business, were already fluent in two languages. This was, however, not a solution for the Defence Research Board. Competent scientific managers were few and far between in Québec where higher education was still dominated by the humanistic pursuits of the Roman Catholic Church. The DRB was already relying on the best and brightest scientists and engineers from Québec to serve on the Board and the numerous committees that supported the Board in the creation and implementation of the research program.\(^7\)

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The only option available to the Defence Research Board was to provide linguistic skills for its existing managers and other employees. Volunteers were given language training in Ottawa starting in 1963 and Québec the next year. The Ottawa training facility closed when the Civil Service Commission opened a training facility in 1964. From 1964 onwards Senior Officers and those who seemed destined to hold management positions received a year of training in French in Québec City through Université Laval and the Defence Research Establishment Valcartier (Laval also offered English for francophones on behalf of the DRB). Language training was yet another professional development opportunity in addition to the year-long training at National Defence College or formal education at universities or colleges.

Shortly after Uffen became Chairman, language training presented problems in deciding which Senior Officers could be sacrificed from their current positions in order to take the training. John Chapman received the training in 1968, and the applicants for 1967 included George Lindsey, Edward Bobyn and Archie Pennie. The decision on who was to receive the training rested with the Personnel Committee, of which Pennie as the Deputy Chairman (Operations) was chairman. To avoid conflict of interest, Pennie was discussed separately by the Chairman (Uffen) and the Chief of Personnel (Fordyce), and the impending move of Petrie to London was a compelling reason to retain Pennie in headquarters for the time being. Lindsey was already scheduled for an overseas posting to the Commonwealth Committee, so he was also given a low priority. This left Bobyn who needed the training if he was to become the Director General of DREV.574

In headquarters the problem of being able to serve clients in either English or French was solved by having the Chairman and/or the Vice Chairman and/or one of the Deputy Chairmen be bilingual, as well as the Chief of Personnel or his Deputy. In the short term this was solved fortuitously by Léon L’Heureux. Given that Bobyn was always slightly behind L’Heureux in the annual promotions, that Chapman was destined for an entirely different orbit within the government, and the untimely death of Robert Sutherland, it seems obvious that L’Heureux received the promotion to Vice Chairman on merit alone. The DRB felt it was more sensitive than other departments to the impending legislation, and it had justification for this belief given

its history of difficulties with bilingualism and biculturalism, i.e. Board and committee membership squabbles and Marcel Chaput.\footnote{LAC, RG 24 a 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Vol 3, ‘‘DRB Policy on Bilingualism’ May, 1969,’’ 8-16, and ‘‘Bilingualism in the Public Service of Canada Defence Research Board Participation’ DRBC 588-2,’’ 5-6.}

After L’Heureux became Chairman of the Defence Research Board, and the Official Languages Act came into force, the language training continued. The immersion courses offered by the Civil Service Commission were attended by civil servants from across the government. In the 1970s the participants were upwardly mobile civil servants, who were either already in senior positions or who planned to pursue a path toward management. Over the next couple of decades, the government as a whole shifted in character to emphasize bilingualism as a valuable skill for newly hired civil servants.\footnote{Beattie, Désy and Longstaff, Bureaucratic Careers, 473-475; Beattie, Minority Men in a Majority Setting, 134-138; Bothwell, The Penguin History of Canada, 462.}

In the long term, Defence Research Establishment Valcartier became a mandatory stop for any anglophone with aspirations for management positions in Ottawa. Bilingualism was politically essential for all those at the level of Director General or higher, and the bulk of language training requests came from anglophones who were managers. Francophone defence researchers already had the benefit of being bilingual, after years of being forced, in their minds at least, to work in English.\footnote{LAC, RG 24 a 1983-84/167 S F1 Vol 7407 File DRBS 173-2 Vol 3, ‘‘DRB Policy on Bilingualism’ May, 1969,’’ 4-5, 14 and ‘‘Bilingualism in the Public Service of Canada Defence Research Board Participation’ DRBC 588-2,’’ 2-4.}

The reality was that English was the working language of science and no legislation from the government was going to alter that. Most of the work done in the Defence Research Board, and more importantly by Canada’s main allies in The Technical Cooperation Program was communicated in English – it was argued that having bilingual staff officers in Washington and London was not expected to serve any practical need, except to maintain the image of bilingualism that the government wanted to project. Not only was secret defence work communicated in English, but the majority of reputable scientific journals following the Second World War were published in English. The ability to speak French had nothing to do with the ability to be a defence researcher, unless one had reason to communicate with politicians, the
press or francophone employees at Defence Research Establishment Valcartier. Even with the new legislation, which forced a few anglophones to learn French, the onus was still largely borne by francophones to learn English if they wanted to obtain a graduate degree in science or engineering and to work as a professional engineer or scientist.  

5.3.4 The Science Council, Science Secretariat and Senate Special Committee on Science Policy

The effects of the Royal Commission on Government Organization were still being felt throughout the government when the reports of the Royal Commission on the Status of Women and the Royal Commission on Bilingualism and Biculturalism were issued. The Glassco Commission had recommended significant changes to the organization of science policy in the federal government; Mackenzie had confirmed this need in a separate report. The first new mechanism put in place was the Science Secretariat of the Privy Council Office that was created in 1964. The first Director was Frank Forward, an innovator in mining techniques from Western Canada. For the first four years Forward had little authority, but in 1968 the situation was improved when he was made the primary adviser to the Cabinet. Previously, however he had commissioned several studies on the state of science and technology in Canada for the Science Council. The authors were seconded from their departments and two of the reports were authored by employees of the Defence Research Board.

The reports were all surveys of the state of scientific and technical fields in Canada and included recommendations of how to make the best use of the existing expertise for development projects, research and teaching. Only a few of the reports covered scientific and technical research in which the Defence Research Board was involved, mostly the physical sciences. The two authored by (former) Defence Research Telecommunications Establishment employees were particularly pertinent to the research program and organization of the DRB.

J. Philip Tyas was an electrical engineer from England. Tyas joined the Defence Research Telecommunications Establishment from 1954 to 1960, and the Operational Research Establishment from 1960 to 1965. From here Tyas joined the new Department of Industry, Trade and Commerce as a scientific adviser. His expertise while with DRTE had been radar, but he learned the new Program Evaluation and Review Technique (PERT) in Washington through professional development while working in operational research. It was this PERT that he applied, and trained others to apply, over his last few years in the Defence Research Board and then in the Department of Industry and in his study for the Science Secretariat and Science Council, where from 1967 to 1969 he was the Chair of Study Group on Scientific and Technical Information. The resulting two volume report was almost exclusively a survey of the available resources (libraries) and methods of collecting scientific and technical information. Given that PERT was incorporated by the DRB while Tyas was still an employee, his study for Science Secretariat and Science Council had little bearing on the DRB and more of an influence on other departments of the government.  

The other report authored by Defence Research Telecommunications employees had the more profound impact on Canadian science and the Defence Research Board. John Chapman and Peter Forsyth were seconded to the Science Secretariat from 1965 until they finished their report in 1967. Chapman and Forsyth, two of the central figures in the Prince Albert Radar Laboratory and the DRB’s satellites, covered their area of expertise, the upper atmosphere and space. In addition to summarizing the disjointed efforts across the government, university and industry they also offered recommendations. Chapman and Forsyth suggested that all of the effort in upper atmospheric research and space research had been and should continue to be applied to the problems of communications and surveillance.

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The report was formally titled *Upper Atmosphere and Space Programs in Canada* but has since become more popularly known as the Chapman Report. It laid the foundation for the direction of communications and space research in Canada for the rest of the century. The year after the publication of the Chapman Report, while he was Deputy Chairman (Scientific) of the Defence Research Board, Chapman was again pressed into service to lead a task force to create an organization to centralize Canada’s communications research and development. The result of this second study was a White Paper, “A Domestic Satellite Communications System for Canada.”

Telecommunications research had outgrown the Defence Research Board, and a new Department of Communications was created in 1969 to manage all of the government’s interests, civilian and military, in telecommunications, satellites and the upper atmosphere. It took a full year to sort out the legalities, but the Defence Research Telecommunications Establishment was severed from the DRB and turned into the Communications Research Centre. Of the researchers transferred with the facilities, a few were retained on the payroll of the DRB to keep abreast of the military implications and applications of communications research because the Chief of the Defence Staff was adamant that the military’s unique interests be recognized and continued. John Chapman was named the Assistant Deputy Minister (Research) for the new department. He held this influential position until he died in 1979.

In its earliest form the Science Council chaired by Omond Solandt was closely affiliated with the Science Secretariat. Solandt was filling double duty as the Chancellor of the University of Toronto. It was not until 1968 that the Science Council and Science Secretariat were given distinct functions. The Science Secretariat became the main civil service adviser to the Cabinet, while the Science Council was to offer sober second thoughts from a position of objectivity.

Chairman of the Board, Robert Uffen, explained to the Chief of the Defence Staff that he was...

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involved in the Science Council and that he and the other members of the Science Council had recommended this separation of responsibilities and authorities. They had also suggested an increased level of authority within the civil service for the Science Secretariat by creating a Minister of Science Policy, which would entail a supporting department and enough resources for the Science Secretariat to effectively manage science policy in the government. A Ministerial position was created in 1971, but its effectiveness was never entirely as the Science Council or Science Secretariat envisioned, as Uffen would learn personally.  

As co-sponsor of many of the Science Secretariat's studies, the Science Council was involved in the nexus of policy review that started with the Glassco Commission. The late 1960s was a particularly busy time for the review of science policy. Science and technology were increasingly important and increasingly prevalent in the government’s budget across numerous departments. Following the Second World War three men had created the government’s science policy and organization for scientific research: Howe, Mackenzie and Solandt. Howe had left politics, but Mackenzie and Solandt were called back to help advise their successors and protégés on how to realign science and technology within the government to better serve the country and to have mechanisms to inform politicians of the issues and to influence decisions.

The Defence Research Board was active in this process of policy review as a source of authors and participants. Solandt, as Chairman of the Science Council, was aware of the intricate position of the DRB and he had no interest in recommending drastic changes. He wanted to see it adapt to the new situation, but he was not going to subject the DRB to undue scrutiny from the Science Council. Nevertheless, reports issued by the Science Council would affect the DRB over the next decade. The creation of the Department of Communications and the strengthening of the mandate of the Science Secretariat had the most immediate impact on defence research.

The government, however, wanted more opinions on science policy, and created a Senate Committee to investigate science from a political perspective, rather than a scientific, bureaucratic or organizational point of view. In 1967 the Special Committee on Science Policy was created under the chairmanship of Senator Maurice Lamontagne. Lamontagne was a former

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585 DHH, Col 73/1223 Box 81, “Minutes of the Chief of Defence Staff Advisory Committee Meeting 36/68, Held in the CDS Conference Room at 0930 Hours on 18 December 1968,” 3; Grove, “Science Policy.”
professor of economics, civil servant, political adviser, Member of Parliament and starting in 1967 a Senator.\textsuperscript{586}

The Lamontagne Committee operated until 1977. It was highly influential in much of the policy review in the late 1960s, and gained even more prominence in the 1970s when it released four volumes of its recommendations – “A Science Policy for Canada.” The biggest impact of the Lamontagne Committee was on the organization and administration of grants from the government to universities.\textsuperscript{587}

5.4 Changing Leadership

After two years of internal reviews and reorganizations of the Defence Research Board, and in the midst of this atmosphere of reviewing science policy throughout the government, Uffen decided to the leave the DRB. His name was put forward for the Presidency of a handful of universities, but he turned them all down for a promotion within the public service. In August 1968 he had authored a paper that was critical of the National Research Council and the Science Secretariat. His proposal was to create a National Research Establishments Board that would report to a Minister of Science and would oversee all non-defence government laboratories and establishments, which would be closely aligned with universities, industries and provincial governments. The proposal caught the attention of Pierre Trudeau and Charles Drury who invited Uffen to assume a newly created post: the Chief Science Adviser to the Cabinet in the Privy Council Office (which also made him the Director of the Science Secretariat). Uffen’s belief in 1968 was that the changes made to the Science Secretariat made it the most influential body in the entire policy review process, and that he was given the post to lay the groundwork for his vision. It was not to be.\textsuperscript{588}


\textsuperscript{588}DHH, Col 73/1223 Box 81, “Minutes of the Chief of Defence Staff Advisory Committee Meeting 36/68, Held in the CDS Conference Room at 0930 Hours on 18 December 1968,” 3; LAC, RG 24 A 1983-84/167 S F1 Vol 4707.
In 1971 Uffen left the employment of the government and became the Dean of the Faculty of Applied Science at Queen’s University. He later served as a Vice Chairman of Ontario Hydro and on numerous commissions for the government of Ontario.

Uffen’s replacement as Chairman of the Defence Research Board was his Vice Chairman, Léon L’Heureux. L’Heureux was the final Chairman of the Board, serving until 1977, and he was also the first Chairman who was not parachuted in from another country (Solandt), another government department (Zimmerman) or university (Uffen). He was an anomaly in the government generally. L’Heureux was a francophone who was promoted from within the establishments and headquarters based on merit alone; other departments were desperately seeking bilingual managers wherever they could find them.589

5.5 The L’Heureux Years

5.5.1 Management Changes

The new Vice Chairman of the Board was Harry Sheffer. Sheffer was the former Director General of Defence Research Establishment Ottawa, and had worked in Chemical Warfare Laboratories during the Second World War. He was the Assistant Deputy Chairman (Scientific) and Scientific Adviser to the Vice Chief of the Defence Staff before he briefly succeeded John Chapman as Deputy Chairman (Scientific) and then became the Vice Chairman (see Appendix E for tables of organization).590


589 LAC, RG 2 S A-5-a Vol 6340, “Meeting Date 1969/06/05,” 10 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=3075&page_sequence_nbr=1&interval=20&PHPSESSID=efncp0n2a61j2lv9v06rsfbje7).

Sheffer’s permanent successor as Deputy Chairman (Scientific) was Edward Bobyn. Bobyn had most recently been the Director General of Defence Research Establishment Valcartier, but previously he had been the Chief Superintendent of Suffield Experimental Station and before that he had held a variety of positions at Canadian Armaments Research and Development Establishment, especially the guided missiles project.

The Board also required a new Secretary. E. Francis Schmidlin was eligible to retire, and it was essential that the next Secretary be bilingual in order to meet the new government regulations. Rolland Hurtubise, a computing expert from Defence Research Establishment Valcartier where he was also completing a Ph.D. at Université Laval in electrical engineering, was named as Schmidlin’s successor. From 1969 to 1971 he served as the Secretary of the Board, Executive Assistant to L’Heureux and special consultant on bilingualism and biculturalism. Hurtubise left the Board for an academic job in the new Public Administration program at the Université du Québec; his tour as Secretary of the Board provided him with the expertise to shift careers.591

Hurtubise’s replacement was Ronald Lowe. Lowe was the Executive Secretary, Grants and Contracts for several years before becoming the Secretary of the Board. He started in the Defence Research Board as an operational researcher.

The Department of Defence Production had been created on 1 April 1951 to replace the Department of Reconstruction and Supply, which was C.D. Howe’s mandate. The Department of Defence Production was represented on the Defence Research Board by Hartley Zimmerman the following year, and Defence Production’s representation was continuous until 1969. Following the recommendations of the Glassco Commission, the Department of Defence Production was subsumed under the Department of Industry from 1963 to 1969, and in 1965 the activities most pertinent to defence were transferred to the authority of the Minister of National Defence. At the start of fiscal year 1969, the Department of Defence Production was replaced by the Department of Supply and Services, but the new department performed few of the same duties as Defence Production and its representation on the Board was not essential. Gordon Hunter, who was Defence Production’s representative on the Board, finished his three-year

appointment, but the final two years were from his new position as Master of the Mint at the Royal Canadian Mint.\textsuperscript{592}

5.5.2 Grants and Contracts – Internal Review

The Board continued to discuss the same agenda items under L’Heureux that had been discussed under all previous Chairmen. The intramural and extramural research programs were the two main areas of interest, and they were constantly adjusted to meet external demands and the priorities of the individual Board members, especially the Chairman who exercised a great deal of control over the Board as the one who set the agenda and also the one who oversaw the implementation. The extramural program – grants to universities – had not been subjected to a deeply introspective review since its creation.

Uffen attempted to decentralize many functions from headquarters to the establishments. Each establishment was to assume more responsibility for collaborating with the subgroups of The Technical Cooperation Program as well as administration of grants and contracts. This meant that an Executive Secretary would have overseen the University Grants program as well as the Defence Industrial Research program. Each establishment was to coordinate the expert advisory committees and panels that would review the grant applications that met the needs of its intramural research program. The Directors General of all the establishments were expected to collaborate with each other to prevent overlap of grants, and this was accomplished through the Defence Research Council (the name given to the meetings between senior staff from headquarters and each of the establishments). The goal of decentralizing the grants was partially cost efficiency, but largely to allow greater collaboration between establishments and nearby

universities – geographic clustering. This drastic overhaul of grants also allowed it to overcome the perpetual complaints that the committees and panels were self-perpetuating and inhabited largely by men from Ontario and Québec.\textsuperscript{593}

The Chief of Plans was given the task of reviewing the grants and contracts program, and Gordon D. Watson, formerly of Defence Research Establishment Valcartier, delegated the work to G.T. Pullan and D.G. Thacker. Pullan and Thacker followed the terms of reference assigned by the Board, assembled the relevant statistics and consulted with the chairmen and members of the various committees and panels that supported the Board as well as the Directors General of the Establishments and senior scientists at headquarters.\textsuperscript{594}

Three reasons why the grants and contracts program needed to be reviewed were offered. First, the program had not been reviewed in over twenty years. Second, in that twenty years the Defence Research Board had gone from the second major granting agency of the government to one of the smaller ones; the National Research Council expanded its grants program, the Medical Research Council was created in 1960 and assumed what had been, to that point, the major component of DRB granting, and the Canada Council had also started allocating money for grants. The Lamontagne Committee was contemplating the wisdom of centralizing granting for the federal government, or alternative means of coordinating the piecemeal programs. Third, and finally, many government departments were reorienting to specific mission orientation, and in the newly integrated and unified Department of National Defence this was especially true.\textsuperscript{595}

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\textsuperscript{594} UTARMS, B 1988-0069/004 File “DRB,” “Letter from Ronald H Lowe (Secretary, DRB) to Gotlieb, 1 May 1972,” 1 and attachment “Notes: Meeting of Chairmen of DRB Advisory Committees and Panels Held at DRB HQ, Ottawa, Friday, 18 February 1972,” 1; LAC, MG 30 B 120 Vol 4 File 8, “Plans Report 72-5, ‘A Study of the DRB University Grants Programs’ by G.T. Pullan and D.G. Thacker, May 1972,” Forward and page 1.

\textsuperscript{595} UTARMS, B 1988-0069/004 File “DRB,” “Notes: Meeting of Chairmen of DRB Advisory Committees and Panels Held at DRB HQ, Ottawa, Friday, 18 February 1972,” 1.
Pullan and Thacker reported the growth of the budget for grants. Grants started out receiving $250,000 in the late 1940s, grew to $1.69 million by 1960 and $2 million in 1965. By 1971 grants were awarded in the amount of $3 million, which was 0.16% of the total Department of National Defence budget (and about 3% of the Defence Research Board’s budget), and both numbers were expected to hold at their current level for a few years. There were 544 grants awarded to individuals at universities across Canada.\(^{596}\)

The grants adhered to the original objectives of the program as laid out by Solandt and Mackenzie. There were three objectives that Pullan and Thacker quoted from the 1970 Extramural Grants Manual.

The first is to acquire new scientific knowledge that may prove applicable to the solution of technical defence problems; the second is to develop and support in the scientific community as a whole an interest in defence science that will have a potential value in the long-term maintenance of a defence research capability; the third is to assist in staffing with promising scientists the various establishments of the Board.\(^{597}\)

Two of the three still seemed obviously applicable, although the specific emphasis of the wording was seen to need improvement. The third goal, however, was seen as a waste of money. The Defence Research Board was averaging a recruitment of 40 new scientists each year, and they had no statistics tracking how many of these were supported by a DRB grant or were persuaded to join the DRB by a professor who had received funding in the past. Pullan and Thacker suspected that the majority were not recruited through “the benign influence of the university grants program”\(^{598}\) and that other recruiting methods were more cost effective, especially given how many graduates that Canadian universities were producing. The oldest Baby Boomers were making their way through the university system, and there was no shortage of potential candidates for the DRB to recruit.\(^{599}\)


Thacker and Pullan proposed that the three objectives of grants be rewritten, reordered and otherwise modified to meet the new emphasis of defence research and the new realities of defence priorities and university capabilities.

i) to provide funds for research on topics related to the Board’s intramural program of defence research;

ii) to support research in fields related to defence and complementary to the DRB intramural program that can be best undertaken in universities;

iii) to promote an interest in defence science in Canada that will be applicable to the long-term maintenance of a defence capability, to the development of sources of advice on scientific problems related to defence and to the expansion of defence research programs to meet national emergencies. 600

Central to these new objectives was a new ranking system for applications. Before, the grants had been evaluated by panels of qualified experts for scientific merit, first, and, second, a loosely-defined potential defence application. Now grants had to be evaluated based on their relevance to the Defence Research Board’s mandate within the Department of National Defence and then scientific merit. This meant that grants and the committees that evaluated them had to be reoriented to specific missions rather than the former science-based method. A mission-orientation of the panels and committees that evaluated grant applications meant that they could be more closely aligned with each establishment, which would allow for decentralization of management (one of many priorities that came out of the policy reviews) and for productive partnerships between establishments and nearby universities. 601

The grants system, however, had one significant problem that had always prevented a universal application. Scientists and engineers at the country’s three military colleges were only eligible to receive funding from the Defence Research Board; they could not apply to the National Research Council or any other funding agency. Applications from military academic institutions, therefore, had always been subjected to guidelines that were closer to the National Research Council’s, i.e. scientific merit alone without any consideration to potential defence


applicability. The proposed new grants system was even less forgiving to non-defence projects undertaken by the military colleges, but if those colleges were to attract quality professors, graduate students and to maintain any sort of educational calibre capable of recruiting competent undergraduate students, then basic research had to be sponsored. The most obvious solution was to lobby to have these considered by the National Research Council, or some future centralized granting agency.\footnote{LAC, MG 30 B 120 Vol 4 File 8, “Plans Report 72-5, ‘A Study of the DRB University Grants Programs’ by G.T. Pullan and D.G. Thacker, May 1972,” 8-9, 13.}

The chairmen of the panels and committees raised a series of complaints and questions about the transition from one granting system to the other. The first complaint was regarding the onerous paperwork involved in applying for, renewing and ending a grant; Thacker and Pullan claimed that they were looking into this problem, but that a solution was unlikely. The chairmen were also interested in finding out how the military communicated its needs to the Board, how basic research could be of military interest, how universities would remain independent of defence, and how the Defence Research Board would communicate its requirements to universities. L’Heureux responded to these questions by describing the role of the Scientific Advisers and the integration of Canadian Forces personnel at several establishments, but he did not mention the \textit{ex officio} status on the Board of members of the Defence Staff; L’Heureux explained that the basic research the DRB desired was to support and complement the intramural program and that this would be communicated via a brochure that was in need of updating. He skated around the issue of retaining the independence (from national defence) of universities for the obvious reason that it was an unfounded fear in the Canadian context – the question made a lot more sense in the United States where military funding to universities was much higher.\footnote{LAC, MG 30 B 120 Vol 4 File 8, “Plans Report 72-5, ‘A Study of the DRB University Grants Programs’ by G.T. Pullan and D.G. Thacker, May 1972,” 9-10; UTARMS, B 1988-0069/004 File “DRB,” “Notes: Meeting of Chairmen of DRB Advisory Committees and Panels Held at DRB HQ, Ottawa, Friday, 18 February 1972,” 2-4; Leslie, \textit{The Cold War and American Science}, 249-252.}

The final suggestion raised by the panellists was that the amount of blind reviewing should be increased. The Defence Research Board’s extramural research program had always awarded a large portion of its grants to members of the advisory panels and committees. In 1947 it was relatively easy to justify this as a consequence of the limited number of capable defence researchers in the country; in 1971 the number of researchers had expanded (and the DRB was at
least partially responsible for this), and the appearance of nepotism was harder to explain away.\textsuperscript{604}

Pullan and Thacker checked the statistics for applications received in 1970 and awarded in March 1971. Committee members generated 22 applications, and all 22 were successful and earned an average grant of $10,098. On the defence interest and academic merit rankings (both out of a maximum seven), committee members earned an average of 4.45 and 6.00, respectively. By comparison, only 60\% of non-committee member applications were successful, they earned an average of $6,281 and received an average of 3.00 for defence relevance and 4.68 for merit.\textsuperscript{605}

Either the panellists were innately better scientists with a better understanding of defence needs, or their participation on panels provided them with the insight required to write acceptable applications. Most likely it was a combination of the two.

Thacker and Pullan also compared the success rates of new applicants compared to renewals. The Defence Research Board received 358 renewal applications and 357 new applications. Of the 358 renewals 260 were renewed, 92 were given their final allotment, 4 were terminated by the Defence Research Board and had to spend the balance of their funds and 2 were terminated by the applicants (upon spending the balance of funds from previous years). 96 of the new applications were accepted. 676 of the total 715 applications were from non military college applicants. The successful applications received an average scientific merit score of 5.34, while the remainder scored 3.73. The unsuccessful applications demonstrated a very low military relevance of 1.86, whereas the successful applicants received 4.27.\textsuperscript{606}

The numbers also add weight to the argument that the grants being awarded by the DRB were not of the highest military priority, but it is not clear whether the two rankings systems simply biased the numbers in this way.


Pullan and Thacker also tabulated the results by geographic location in Canada. They discovered that applications from the Maritimes, Prairies and British Columbia received less money than applicants from Ontario and Québec, but that the applicants from the Maritimes had the highest merit and relevance rankings. The only possible explanation was that applicants from the Maritimes simply requested less money. Thacker and Pullan produced a table of these results.
Table 5.3 – Analysis of the DRB University Grants Program in Terms of Geographical Regions

<table>
<thead>
<tr>
<th></th>
<th>Maritime</th>
<th>Québec</th>
<th>Ontario</th>
<th>West</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Applications Submitted</td>
<td>46</td>
<td>140</td>
<td>295</td>
<td>195</td>
<td>675</td>
</tr>
<tr>
<td>Average Scientific Merit Rating of Applications</td>
<td>4.96</td>
<td>4.61</td>
<td>4.74</td>
<td>4.71</td>
<td>4.71</td>
</tr>
<tr>
<td>Average Defence Interest Rating of Applications</td>
<td>3.72</td>
<td>3.31</td>
<td>3.34</td>
<td>3.25</td>
<td>3.33</td>
</tr>
<tr>
<td>Average Dollars Sought</td>
<td>$9,058</td>
<td>$14,701</td>
<td>$10,776</td>
<td>$10,239</td>
<td>$11,245</td>
</tr>
<tr>
<td>Number of Successful Applications</td>
<td>28</td>
<td>80</td>
<td>177</td>
<td>129</td>
<td>413</td>
</tr>
<tr>
<td>Proportion of Applications that were successful</td>
<td>61%</td>
<td>57%</td>
<td>60%</td>
<td>66%</td>
<td>61%</td>
</tr>
<tr>
<td>Cash Awarded**</td>
<td>$158,100</td>
<td>$616,500</td>
<td>$1,121,250</td>
<td>$764,675</td>
<td>$2,660,525</td>
</tr>
<tr>
<td>Cash Awarded*</td>
<td>$158,100</td>
<td>$790,600</td>
<td>$1,358,250</td>
<td>$777,975</td>
<td>$3,084,925</td>
</tr>
<tr>
<td>Average Grant***</td>
<td>$5,646</td>
<td>$7,706</td>
<td>$6,335</td>
<td>$5,928</td>
<td>$6,297</td>
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<tr>
<td>New Normal Applications Only</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Number submitted</td>
<td>29</td>
<td>78</td>
<td>150</td>
<td>89</td>
<td>346</td>
</tr>
<tr>
<td>Number successful</td>
<td>11</td>
<td>21</td>
<td>34</td>
<td>24</td>
<td>90</td>
</tr>
<tr>
<td>Percentage successful</td>
<td>38%</td>
<td>27%</td>
<td>23%</td>
<td>27%</td>
<td>26%</td>
</tr>
<tr>
<td>Funds awarded for New Grants**</td>
<td>$53,500</td>
<td>$113,500</td>
<td>$191,700</td>
<td>$120,000</td>
<td>$478,700</td>
</tr>
<tr>
<td>Average Award (new grants)**</td>
<td>$4,864</td>
<td>$5,405</td>
<td>$5,638</td>
<td>$5,000</td>
<td>$5,319</td>
</tr>
<tr>
<td>Percentage of Program (including Special Awards)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) in terms of number of grants***</td>
<td>7%</td>
<td>19%</td>
<td>43%</td>
<td>31%</td>
<td>100%</td>
</tr>
<tr>
<td>b) in terms of dollars awarded**</td>
<td>6%</td>
<td>23%</td>
<td>42%</td>
<td>29%</td>
<td>100%</td>
</tr>
<tr>
<td>c) in terms of dollars awarded*</td>
<td>5%</td>
<td>26%</td>
<td>44%</td>
<td>25%</td>
<td>100%</td>
</tr>
</tbody>
</table>

*** excluding Special Awards, Military Colleges and grants on “balance of funds” basis
** excluding Special Awards, Military Colleges
* including Special Awards, Military Colleges
The high merit and relevance numbers for the Maritime applications stand out in Table 5.3, as Pullan and Thacker noted. The high acceptance rate for applications from the West was also remarkable and noted by Thacker and Pullan. What they did not mention was the high average of dollar amounts requested by applicants from Québec, and the lower than average acceptance rates. Québec’s numbers were skewed by the separate calculation of Special Awards, which were institutional grants to establish and maintain new laboratories; Maurice L’Abbé’s mathematical research centre at the Université de Montréal received $100,000 in 1970. The three military colleges received the other three Special Awards, which had a combined value of $45,000. These were awarded as a way of ensuring that the military colleges had adequate support for research above and beyond what was won in the grants applications process.607

As Pullan and Thacker had indicated, there were potentially bigger changes to come for extramural research. The first volumes of the Lamontagne Committee had been released before the Defence Research Board began its own internal review. The Lamontagne Committee was leaning towards further centralization of granting – the complete opposite of what Uffen and L’Heureux were contemplating. Lamontagne envisioned single granting agencies similar to the Medical Research Council and the Canada Council, and these were created in 1978 – the Natural Science and Engineering Research Council and the Social Sciences and Humanities Research Council. The two new bodies assumed responsibility for most of the government’s funding to universities for all science and engineering, but the DRB tried two years of running interdisciplinary advisory committees through the establishments before changes were legislated. Uffen’s and L’Heureux’s instinct to move University Grants and Defence Industrial Research to each of the establishments allowed the practice to continue after 1974 in a very limited and applied manner – each establishment could contract or collaborate with universities and industries on research that was essential to the completion of the intramural research program, basic scientific or engineering investigations were funded by NSERC starting in 1978.

5.5.3 Revising the Intramural Research Program, One Last Time

This overhaul of the grants program was not the only change to the Defence Research Board’s research agenda. There were numerous changes to the intramural program as a result of

project priorities, the process of decentralization and the ongoing process of integration/unification of the Canadian Forces.

Given the transfer of telecommunications research to the civilian Department of Communications, the idea of turning more of the Defence Research Board’s establishments into national laboratories was floated by Deputy Chairman (Scientific) Harry Sheffer in 1969. He discussed the possibility of merging operations in Toronto with environmental medicine and involving the Department of Transport more closely (both happened, to varying degrees). Sheffer explained that the Board had known that change was coming since 1964 when the Glassco Reports were completed, and the integration/unification event of 1967 had made the need to reimagine defence research more pressing. His colleagues on the Board responded overwhelmingly in favour of leaving the establishments as they were so as not to lose their military identity, and because the intramural research program had proved to be so flexible over the years. 608

With drastic change ruled out by the Board, all that was possible was tweaking the intramural research program. Ending projects that had overstayed their utility and starting new projects based on projections of new military needs.

Defence Research Establishments Valcartier, Atlantic and Pacific continued with their major projects, as did the Defence Research Analysis Establishment. The other three establishments experienced interruptions and alterations to their research programs.

Defence Research Establishment Ottawa, after the Defence Research Telecommunications Establishment became the Communications Research Centre in 1969, continued with a limited amount of military projects in communications and electronics, but was mostly devoted to special weapons. Moreover, the special weapons research program of the Defence Research Board was still under scrutiny for its usefulness, and for the desire to pick a single optimal location.

In 1970, Defence Research Establishment Suffield was again contemplated for closure. The scaled explosions tests were finally ended, and given the global negotiations that started in 1968 to ban the production, storage and testing of chemical and biological/bacteriological weapons, DRES was decreasingly likely to be used as a field testing facility of live agents. Canada was one of the signatories of 1972’s Biological and Toxins Weapons Convention, which confirmed the new limited nature of the DRB’s special weapons research.\(^6\)

However, in 1971 the Defence Research Board and the Canadian Forces had negotiated a means of continuing the research work at Defence Research Establishment Suffield. Special weapons training facilities for soldiers from Canada and the United Kingdom were co-located at DRES; for the first time, DRES was not a tripartite facility. Troops practiced their manoeuvres while wearing appropriate protective gear to become acclimatized to the kit and the situations in which they may experience chemical or biological weapons use. A further attempt to close DRES and move it to Manitoba made it to Cabinet discussions in 1974, but fell through. As a result, special weapons research remained split between DRES and Defence Research Establishment Ottawa, which was conveniently located to Chalk River.\(^6\)

The third establishment to change its research program was Defence Research Establishment Toronto. The Institute of Aviation Medicine, where Wilbur Franks worked during and following the Second World War, was renamed and refocused after unification in 1968. It became the Canadian Forces Institute of Environmental Medicine (CFIEM) and in addition to unique problems of aviators (clothing and gear to withstand high gravitation forces, low


\(^6\) LAC, RG 2 S A-5-a Vol 6436, “Meeting Date 1974/02/21,” 29-30 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=38933&page_sequence_nbr=1&interval=20&PHPSESSID=g8670ajhloa4j2i2lebdn41aq3); Defence Research Board, Defence Research Board: The First Twenty-Five Years, 32; BATUS, Dinosaurs to Defence, 115, 126; Newitt, Beyond a Wide Horizon, 96-100.
temperatures and low levels of oxygen) the CFIEM began to explore the environmental effects faced by all Canadian soldiers. This brought the mandate into conflict with the research already being done at Defence Research Establishment Toronto, so the two were merged in 1971 to create a single research entity rather than two loosely collaborating facilities. The new establishment was controlled by the Defence Research Board on behalf of the Department of National Defence and was called the Defence and Civil Institute of Environmental Medicine (DCIEM), which was an indication that the scientists and engineers were both military and civilian, more than that the problems investigated were. DCIEM possessed human centrifuges, climactic chambers and a hypobaric (low air pressure to simulate high altitudes) chamber. Later in the 1970s DCIEM added a hyperbaric (higher than normal air pressure) chamber and impact studies facilities (which was also used for civilian research).

Once the research agenda for the establishments was set in the early 1970s it has remained more or less unchanged to the present day. Individual projects have varied, but the broad fields of interest have remained unchanged.

5.6 Politics from 1969 to 1977

5.6.1 Federal Policy for Science

Robert Uffen and the Science Secretariat continued working in an attempt to consolidate authority for science policy in a single place. They were hampered by three problems. First, they did not report to a minister, so they had a limited role influencing Cabinet, which was further thwarted by the presence of the Lamontagne Committee. Second, the science-based departments and institutions were sceptical of ceding their traditional responsibilities to someone else within the government; the civil service had spent a full decade under attack, and ceding responsibilities also entailed losing budget and consequently an inability to accomplish mandates. Third, in spite of Trudeau's and Drury's initial optimism for Uffen's proposal, they were unwilling to invest their political capital to make it happen. Instead, Uffen was tasked with working out the details of proposals that were made by politicians and political advisers.

Uffen considered his role to be one of liaison between the science-based departments and Cabinet, which necessitated an ability to give advice to politicians, bureaucrats or scientists. However, temperamentally, Uffen was inclined to action and organization rather than advising and politics; Uffen's ambition met the brickwall of bureaucracy. Both Uffen and Solandt felt that what was lacking was a political supporter, a C.D. Howe (though they never called it that). Trudeau began preparatory work in 1971 by creating the Ministry of State for Science and Technology (MOSST). The mandate of the MOSST was fourfold: information and analysis, policy planning, international affairs and industrial research and development, and organization and administration. In other words it was a continuation of the Science Secretariat, but now it reported to a single Minister who in turn represented it in Cabinet. The MOSST was also consistent with the Trudeau government’s initiatives of attempting to promote Canadian interests by creating national capacities within the economy. Old projects that were not consistent with the make-or-buy policy were to be phased out and new projects had to adhere to government priorities strictly. Even with a Minister responsible, science policy still faced challenges.  

The second problem remained. The other science-based departments were still sceptical, and political realities meant that the Minister of State for Science and Technology did not wield a tremendous amount of influence in Cabinet. Numerous observers have noted that the MOSST was assigned either to junior Ministers with other ambitions or senior Ministers with other portfolios. The only solution possible to improve the situation was to delegate more authority to the MOSST, and this never happened. The Ministry was relegated to a role of observation and occasional advising, and because it was a Ministry of State it could be disbanded with an Order-In-Council. Uffen left for academia when the MOSST was created, which left others to deal with the inevitable politicking in the Ministry. Uffen's departure was publicly spun as amicable, but privately Uffen seethed about the way the science policy portfolio was handled by Trudeau.  


That Uffen was a former Chairman of the Board probably smoothed out some of the inevitable difficulties in the situation. The Defence Research Board was attempting to operate against a backdrop of multiple government bodies assuming varying degrees of responsibility for reviewing and creating science policy. That the bodies and their roles changed, certainly did not help. Stability, and a clearly articulated mandate for science in the government, science in the military, and the military in Canada were all ideals, and none were true in the early 1970s.

It became increasingly obvious that the Science Secretariat and following it the Ministry of State for Science and Technology were politically and bureaucratically impotent. The Science Council fared little better. Solandt embraced the arm’s length relationship he was supposed to have as Chairman of the Science Council, even though he had numerous contacts within government and a real ability to influence policy decisions. He ensured that the Science Council offered its advice and generated papers to foster discussion. Solandt’s successor, another Board alumnus, Roger Gaudry was neither so well connected nor willing to maintain the arm’s length relationship of the Science Council. There was a quite obvious deficiency in the attempted solutions to the problems identified by the Glassco Commission and the Mackenzie Report; there were several science policy review and advisory bodies, but none of them received authority to determine the direction of science policy, nor were they given time or authority to fulfill their mandates. In other words, there were too many cooks and none of them were actually in the kitchen.615

The science policy situation was problematic for the Defence Research Board. Two former Chairmen, Solandt and Uffen, had held two of the most promising positions of power in the policy review apparatuses. Both Solandt and Uffen had left those positions by 1972, and the positions had turned out to be less promising than expected. Both Uffen and Solandt were


disappointed, but they differed on what to do about it; Uffen opted for quiet persuasion where Solandt vented publicly.616

5.6.2 Trudeau and Defence – the 1971 White Paper

The Defence Research Board was part of the Department of National Defence. National defence policy had been under attack as long as science policy. The nuclear debate was followed by integration and unification. If the DND thought life was difficult under Pearson, they discovered that it could actually get worse. Trudeau was rightly convinced that the world had changed; to him this meant that Canada’s role in the world should change, and the military’s position in both Canada and the world had to be modified.

In 1969 Trudeau and his first Minister of National Defence (inherited from Pearson), Léo Cadieux, reduced the numbers of troops and aircraft committed to NATO in Europe. Europe, aside from the globally reviled communist incursion in Czechoslovakia in 1968, was relatively stable. The Russian communists had softened their global ambitions following the Cuban Missile Crisis, and the lack of monolithic communism, except where the Russians applied force, exposed the emptiness of the communist dream; there were no less than five distinct communist countries in the world, and each one was primarily motivated by national self interest more than global communist revolution. The Soviet Union was just another dictatorship with imperial designs and very real economic difficulties. Trudeau was criticized by his European allies, especially the United Kingdom, but he was set in his belief that NATO was overly dominated by the military and grandstanding. He was, in the long run, correct; NATO and Western Europe survived, even with diminished Canadian military presence, and Russian communism collapsed under its own weight.617


Trudeau also had domestic reasons for wanting to modify Canadian policies for national defence. Canada was prosperous, and it could be even more prosperous by cutting spending on national defence. The savings from national defence could be pumped into pensions, healthcare and the other initiatives that Pearson left as his legacy, and that were foremost on the minds of most Canadians. Pragmatists in the Department of National Defence knew that Canada’s contributions to its own security paled in comparison to the American assurances, but they insisted that Canada had to participate in order to have a say in decisions and to retain some semblance of sovereignty. Trudeau had other notions on how to maintain sovereignty, which involved spending in other areas of the Canadian economy aside from national defence, and frequently musing on the topic of sovereignty.  

A Royal Commission on Canada’s military would have been overkill, so instead Trudeau requested a new White Paper for 1971 from his second Minister of National Defence, Donald Macdonald (excluding Charles Drury who was the Acting Minister for a week between Cadieux and Macdonald). Where the 1963 White Paper on Defence had recommended an overhaul of the organization, the 1971 White Paper on Defence suggested changes to the missions and ideology driving the Canadian Forces to be more consistent with Trudeau’s White Paper on Foreign Policy of 1970. A global stand-off involving the pitched forces of communism and freedom was unlikely, but it consumed the majority of the Department of National Defence’s budget. However, Canada’s notably active military roles after the Second World War had been almost entirely in the form of rapid, mobile, and small forces ready for deployment anywhere in the world under the auspices of either NATO or the United Nations. Canada was a peacekeeper and tactical responder, even when it fought alongside allies in larger battles. The Canadian Forces needed equipment, tactics, reduced numbers of highly trained personnel, and science and technology to support this more realistic interpretation of the Canadian Forces’ role in the world (protecting Canadian sovereignty and participating in the international community to prevent wars). The new mandate expressed in the White Paper of 1971 was also more cost effective,

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meaning that the Department of National Defence’s budget could be cut or maintained at existing levels. The new political ideals for DND were troubling for the Defence Research Board.619

There were numerous specific recommendations on how the Defence Research Board should be modified to meet the new requirements of the Canadian Forces and the Department of National Defence. The DRB was praised for its role in the North, which was vital to Canadian sovereignty (but that line of research was already more or less exhausted). The White Paper also praised the DRB for its role in fostering the national economy, but lamented the need to buy American weapons. The most compelling and ominous was the suggestion that further structural changes were necessary and that a Management Review Group should be created to investigate the problem.620

In the process of creating the White Paper the Defence Research Board, especially the Chairman (L’Heureux), Vice Chairman (Sheffer) and Chief of Plans (Watson), responded. Their comments filtered through Assistant Deputy Minister (Finance) John Arnell, a former senior staff officer of the Defence Research Board. L’Heureux was the first to respond in February 1971 to the 18 January draft. L’Heureux’s complaints about the misunderstandings exemplified in the White Paper fall into two categories: those that misconstrue the international, or at least tripartite, character of defence research, and those that obfuscate the long-term nature of research with the immediate needs of the Canadian Forces.621

L’Heureux was adamant that even if Canada wanted to move towards a more sovereign and independent place in the world, defence researchers would still have to cooperate with the United States and The Technical Cooperation Program.

The Canadian policy of cooperation in research and development and in production sharing has yielded much higher returns for Canada than we have been able to give, in return, to our allies. Recently, there has been a growing tendency of our close allies to

restrict the flow of research and development information in response to what they interpret as a growing isolationism on the part of Canadian defence policy.\(^{622}\)

Even the perception that Canada was starting to diverge from American ideals and the American camp was beginning to restrict the Defence Research Board’s ability to perform its duties. Politics, in other words, were still impeding the DRB as they had been for over a decade.

L’Heureux was even more frustrated by the attitude that he hoped could change within the Canadian Forces (CF), because he knew he had little hope of changing the political climate.

There is a tendency among critics of research to consider that research should be specifically aligned [sic] to current CF operational priorities. This view overlooks the dual role of those concerned with research and scientific assistance. The DRB does have a clear responsibility to apply, or assist in applying any existing knowledge to the current priority activities of the Department and those responsibilities we try to fulfill with vigour and effectiveness. In addition, however, DRB has the long term responsibility to anticipate future requirements for scientific information sufficiently far in advance that the information will be available at the time it is needed.\(^{623}\)

L’Heureux’s preference in light of this distinction between immediate needs and future priorities was that the success of the Defence Research Board be evaluated based on projects it started ten years ago in anticipation of the most current needs of the Canadian Forces. By their very nature, the DRB’s current projects were not going to meet the current needs of the Canadian Forces.\(^{624}\)

Sheffer followed up on this line of thinking two weeks later. He argued that space was likely to be the most important topic on the ten-year horizon. Communications were already important and he predicted that American expenditures would result in recoverable, manned, space shuttles as a more efficient means of putting satellites in orbit. His prediction was off by a single year, because the Americans’ first shuttle was launched in 1982.\(^{625}\)

Watson was the third one to offer commentary a month later. He responded to the 16 March draft. Watson was concerned with the misleading wording surrounding the Defence


Research Board’s, the Canadian Force’s and Canada’s history of chemical and biological weapons. Watson wanted it to be clear that Canada had destroyed its entire stockpile of chemical weapons in 1946, and that it had never possessed biological weapons. However, protection against these two types of weapons was absolutely essential, and could only be conducted in the context of defence research, since the non-military applications were limited and it was too risky to allow the knowledge of such weapons to spread widely. The DRB’s approach was entirely defensive, and fitted within its international obligations to The Technical Cooperation Program, and in order for “Canada to play a more constructive role in arms control negotiations.” Clearly the DRB was suffering from attacks from both within and outside the department about the necessity of its role.

In spite of these objections from the Defence Research Board, the White Paper on Defence was issued in 1971. The combination of military and civilian command structures was seen as problematic in the same way that the 1963 White Paper saw the three staffs of the three Chiefs of Staff as redundant and wasteful. There was no British precedent, nor were the Glassco Commission’s recommendations current enough (owing to unification and integration), so a new Management Review Group was created in 1971.

5.6.3 The Management Review Group

The Management Review Group (MRG) was formed in June 1971. Its Chairman was John B. Pennefather, a board member of I.A.C. (Industrial Acceptance Corporation) Limited. The group contained two other prominent businessmen John D. Campbell (Canadian Westinghouse), and Henry de Puyjalon (Telesat Canada); it also included journalist and author John D. Harbron. The two representatives from within the Department of National Defence were the civilian Kenneth A. McLeod and Major-General Hugh McLachlan of the Air Transport Command. The supposed author of both the report of the MRG and the White paper was Gordon Smith, who was one of the special assistants. The report was completed in June 1972 and

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submitted in its final form in July to Minister of National Defence Edgar Benson, who was the third such Minister under Trudeau.628

The Management Review Group solicited opinions and L’Heureux responded with a letter and a handful of studies and reports. In his letter to Pennefather L’Heureux re-expressed his concern with how science and technology were valued in the Department of National Defence. He broke this concern into three categories: how scientific advice was introduced at Defence Council (such that it would be consistent with scientific advice given at lower levels of the Department), the lack of clear coordination of the research and development spectrum, and the need to make better use of science and technology to formulate the military’s equipment procurement requirements. L’Heureux was adamant that the Defence Research Board was essential, that it should remain a separate employer, that it should be run by scientists (even though he was an engineer), and that the Board should continue to rely on experts from across government, industry and academia. He recommended that Pennefather could and should talk to former Chairmen Omond Solandt or Robert Uffen, or current and former members of the Board like Louis-Philippe Bonneau, Maurice L'Abbé, Henry Duckworth or John Draper Houlding (presumably all men who were both known to Pennefather and Trudeau, but also sympathetic to the Board).629

An interim report was circulated in October 1971. In the interim report the Management Review Group suggested a new alignment of headquarters, and this structure was, more or less, what was implemented a year later based on the final report. It also contained the recommendations that were applied to defence research in 1974. The Board of the Defence Research Board was to remain as an advisory body, reporting to the Deputy Minister of National Defence. The rest of the DRB was to join with the functions of the Chief of Technical Services as a new Assistant Deputy Minister of Research, Engineering and Procurement. This new ADM was to be in charge of the research establishments, which were to perform applied research for

the department. The ADM "will provide a life-cycle engineering service for equipment and facilities.... The service will include applied research, engineering, design, contract definition, testing and engineering analysis of equipment in use." While this new organizational structure solved the problem of unifying research with development and procurement, in theory at least, it also severed the connection between the Board and defence research.

While Pennefather and the Management Review Group rejected most of L'Heureux's submission they did solicit the advice of Uffen, which they promptly ignored. Uffen was asked to consult with the MRG and the Defence Research Board, and to offer his opinions on what the MRG could change and what they should study further; he was also asked to persuade the DRB to accept the changes, or some variation of them, since the interim recommendations were not well-received. Uffen agreed with the MRG that the confusing division of authority between research, development, equipment procurement, engineering, testing and evaluation needed to be improved and that this could best be accomplished through a reduction of the number of people involved. He also agreed with the MRG that the DRB had not moved quickly enough and far enough in response to the demands of the Trudeau government. He conceded that the DRB program was probably not as relevant to the military as the statistics indicated, but he did believe the military relevance had improved since he left in 1969. However, Uffen agreed with L'Heureux that there was a real danger of long-term projects being abandoned in favour of short-term work, which would be detrimental to the department, and he agreed with L'Heureux that the DRB had undertaken its own reorganization in an attempt to meet the needs of the government (combining Defence Research Establishment Toronto with the Institute of Aviation Medicine, reducing the biological and chemical warfare program, refocusing Defence Research Establishment Pacific on Arctic sovereignty, and closer collaboration with the Chief of Technical Services).

Uffen's conclusions and recommendations in his letter to Pennefather were a determined effort to save the Defence Research Board, the Board and the connection between them. He

praised the work being done by the Defence Research Analysis Establishment, and suggested that scientific intelligence should be improved, since Canada was spending less and would have to rely on its allies even more. Uffen suggested that instead of an Assistant Deputy Minister for Research, Development and Procurement the position should be more senior, because the responsibilities associated with it required more authority than an Assistant Deputy Minister would normally have; Uffen preferred a civilian at the Associate Deputy Minister level, which would maintain a level that was comparable to the Chief of the Defence Staff. The Associate Deputy Minister would act as the Chairman of a revitalized Board, and would behave more like a chairman of an industry; the new Board would include the CDS, and other senior military officers, the President of the National Research Council, the Secretary of the Minister of State for Science and Technology, and representatives from industry and academia. The Vice Chairman of the Board would also be the Assistant Deputy Minister for Science and Technology, and would act like the president and general manager of the defence research establishments. A second Assistant Deputy Minister for Engineering and Procurement would be held by a (retired) senior military officer with engineering experience. Uffen suggested that the Associate Deputy Minister and the Assistant Deputy Minister for Science and Technology should be held by a respected applied scientist and a francophone, i.e. L’Heureux. He also advocated for a small headquarters staff of roughly ten to serve the Associate Deputy Minister and the two Assistant Deputy Ministers for “special studies, long term planning, technological forecasting, technological assessment and feasibility studies.”

Uffen concluded his letter by mentioning that all of this reorganization could be accomplished without amending the National Defence Act, which, ominously, was the most significant piece of advice Uffen offered the Management Review Group that they retained.

In his studies of defence management throughout the Cold War, Douglas Bland has summarized the assumption behind the Management Review Group that bringing business practices to the military would immediately solve all problems of efficiency, budgeting and have, at worst, no adverse effect on military operations and missions, and, at best, actually improve military functionality. It was similar to the motivation behind the Glassco Commission. Bland, a Lieutenant-Colonel while studying for his Ph.D., repeated the justifiable concern that the

Canadian Forces had, that businessmen simply could not understand military missions, and the ones in the Management Review Group did not even try.635

The problem on which the Management Review Group focused its attention was the parallel management structures within the Department of National Defence. When it came to management issues, there was a straightforward and linear designation of authority. The Chief of the Defence Staff and the Chairman of the Defence Research Board were responsible to the Deputy Minister who reported to the Minister of National Defence (see Appendix E for tables of organization).

However, this linear designation of authority was broken in certain, well-defined situations. When the Minister required military advice he turned directly to the Chief of the Defence Staff; this was the CDS’ expertise and there was no need to confuse the issue by relaying advice through the Deputy Minister. Likewise, the Chairman of the Defence Research Board was the one who gave the Minister scientific advice. In other words, when it came to advising the Minister the CDS and the Chairman were equals with the Deputy Minister; in matters of budgeting and management the Deputy Minister was clearly superior to the Chairman and the CDS.

Each of the three parallel structures (military, science and Deputy Minister) had their own staffs, and within those staffs were overlapping responsibilities and authorities. On advising matters the Chairman of the Defence Research Board reported to the Minister directly, for management the Chairman reported to the Deputy Minister, and on matters of budgeting and finance the Chairman interacted with an Assistant Deputy Minister. It was perfectly logical if one worked in the government, especially the Department of National Defence, and completely foreign if one did not. To the Management Review Group the problem was clear. If having three Chiefs of Staff was redundant in the 1960s, then this persistent management apparatus was as well.

The only real problem in implementing the Management Review Group’s recommendations for improving the efficiency of the Department of National Defence was the National Defence Act, and Uffen seemed to think that this was not a problem, at least for the

reorganization that he proposed. The Chairman of the Defence Research Board and the Chief of the Defence Staff had legislated responsibilities to the Minister. When Assistant Deputy Minister (Finance) John Arnell was sent by Minister of National Defence Edgar Benson to the Defence Sub-Committee in Parliament to justify the proposed management structure he explained that all that was required was an amendment of the Act. According to Bland, neither Benson, nor his permanent successor James Richardson (who followed two temporary successors Jean-Eudes Dubé and Charles Drury – Drury’s second tour lasted two and a half months) bothered amending the National Defence Act; instead Benson exercised Ministerial authority when he demanded that changes in practice and culture occurred.636

The Canadian Forces were expected to adhere to the new line of authority immediately, and the Deputy Minister’s office was reorganized under four Assistant Deputy Ministers. These were: Strategic Policy and Plans, Finance, Personnel, and Research, Engineering and Procurement (i.e. Materiel). The Defence Research Board remained unaffected, directly, for the time being.637

5.7 The End

The Defence Research Board watched through 1973 as the rest of the Department of National Defence adapted to the new management structure. On 1 April 1974, the Defence Research Board became the last part of the Department to adhere to the new configuration (see Appendix E for tables of organization).

The Defence Research Analysis Establishment was severed from the rest of defence research and subsumed under the Assistant Deputy Minister (Policy). The six remaining establishments (Defence Research Establishment Atlantic, DRE Pacific, DRE Suffield, DRE Ottawa, DRE Valcartier and Defence and Civil Institute of Environmental Medicine) were part of a newly renamed Defence Research and Development Branch (DRDB). The head of the

DRDB was the Chief of Research and Development (CRAD), Edward Bobyn, who had been serving as the Deputy Chairman (Scientific). More administrative authority was delegated to the Directors General, and Bobyn oversaw a stripped down headquarters in Ottawa.638

L’Heureux and the Board continued to exist. The 1974 appointments to the Board were made on the understanding that the Board would have a diminished role. The Board’s new responsibility was advising the Minister of National Defence on research and development of science and technology and acting as a stop-gap in controlling grants until the Tri-Councils were created to deal with all government grants to universities (interestingly, the Board had decentralized much of the work on grants to the establishments in 1972). However, as the Science Council and the Science Secretariat had already discovered, advising was not as influential without budgetary responsibilities and with only ambiguously defined responsibilities. The Board was no longer in control of the purse strings or the research program of the Defence Research and Development Branch; the Chief of Research and Development acted independently within the responsibilities designated to him by the Assistant Deputy Minister (Materiel); operational research was completely separated and integrated within the Canadian Forces under the Assistant Deputy Minister (Policy). The Board’s main function was granting, and that was set to terminate as soon as the Natural Sciences and Engineering Research Council was created.639

639 LAC, RG 2 S A-5-a Vol 6436, “Meeting Date 1974/02/21,” 29-30 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=38933&page_sequence_nbr=1&interval=20&&PHPSESSID=g8670ajhloa4j2i2lebdn41aq3) and “Meeting Date 1974/04/25,” 11-12 (available online: http://collectionscanada.ca/databases/conclusions/001039-119.01-e.php?&sisn_id_nbr=39227&page_sequence_nbr=1&interval=20&&PHPSESSID=4uq9p8hf3vklvgp0mbmtlviv2); LAC, RG 24 A 1983-84/167 S F1 Vol 7407 File 173-2 Part 5, “Memorandum from E.J. Bobyn (Chief Research and Development) and L.J. L’Heureux (Chairman, DRB) to Chiefs of Establishments regarding DRB Advisory Committees, 29 April 1974,” 1; Uffen, “How Science Policy is Made in Canada,” 8; Canada, Senate Special Committee on Science Policy, and Maurice Lamontagne, A Science Policy for Canada, Vol 3: 668.
Not only had the Board lost its budgetary leverage, but the Minister, James Richardson, was not overly inclined to solicit their advice. There is disagreement over the course of events following the splitting of defence research from the Board. Tardif and Gelly claim that L’Heureux took a principled stand and resigned; the Board simply disintegrated as a result. If true, this was surely a futile but valiant attempt to demonstrate the Board’s utility.\(^{640}\)

However, the Cabinet Conclusions show that Howard Petch, by then at the University of Victoria in British Columbia, was renewed as a member of the Board in 1976 for three years. No one was eligible for renewal in 1975 and Petch’s co-appointed member in 1973, William James Cheesman of Canadian Westinghouse Company Limited and the Canadian Nuclear Association, had died. The remaining term members of the Board were all due for renewal in 1977.\(^{641}\)

Solandt made it clear that the Board still existed in 1977 (now the only thing operating under the name ‘Defence Research Board’) in an address to graduates of the Royal Military College. Gordon Watson claimed that the Defence Research Board was legislated out of existence in 1977 with an amendment to the National Defence Act, but Douglas Bland asserts that no such legislation was ever passed to alter the National Defence Act. Again, the Cabinet Minutes show that a series of Orders-In-Council in 1974 did, contrary to Bland’s assertions, alter the legislated authorities of the DRB within the Department of National Defence, but Bland seems to be correct that the legislation that Cabinet requested be drafted was never enacted. Bland’s research is the most thorough, but Watson and Solandt would have had the most intimate knowledge of events.\(^{642}\)

The confusion is unfortunate, because the sequence of events seems quite clear. That the Defence Research Board was eviscerated in 1974 is universally accepted. There also seems to be

\(^{640}\) Gelly and Tardif, *Defence Research Establishment Valcartier*, 238-239.

\(^{641}\) LAC, RG 2 S A-5-a Vol 6495, “Meeting Date 1976/03/04,” 31 (available online: [http://collectionscanada.ca/databases/conclusions/001039-119_01-e.php?sisn_id_nbr=41899&page_sequence_nbr=1&interval=20&PHPSESSID=ghabb9qk0j728276of01ssvhq5](http://collectionscanada.ca/databases/conclusions/001039-119_01-e.php?sisn_id_nbr=41899&page_sequence_nbr=1&interval=20&PHPSESSID=ghabb9qk0j728276of01ssvhq5)).

consensus that the Board was abolished in 1977 when it was obvious that the Natural Sciences and Engineering Research Council was set to assume responsibility for all grants formerly controlled by the Board. Assuming that Tardif and Gelly were incorrect about the date and that L’Heureux did, in fact, resign in protest, then the story of the demise of the Board seems to fit together nicely – rendered caretakers for grants and unheard advisers to the Minister in 1974 and officially disbanded, in a blaze of glory, in 1977.

There really was little anyone could do in 1974 although there were plenty of men who might have. John Arnell, as the Assistant Deputy Minister (Finance), saw the changes through in spite of his reservations. Charles Drury, the Deputy Minister of National Defence during the formative (Solandt) years of the Defence Research Board, was President of the Treasury Board until August 1974, and then the Minister of State for Science and Technology and Minister of Public Works until 1976. Drury had his own ministerial responsibilities, and was never made the permanent Minister of National Defence. Moreover, Drury was tasked with drafting a comment on changes to the government’s outlook on science policy that followed Solandt’s and Watson’s criticisms in Science Forum in October 1975. In his new role as Minister of State for Science and Technology Drury explained that the public was no longer willing to accept all scientific advice at face value, and that the government’s primary concern was supporting science that would derive solutions to national problems (social, economic and cultural). He discussed the overall reorientation of science policy in the federal government over the past decade. If Drury wanted to oppose the reorganization within the Department of National Defence, he probably did not have the political capital to stop Trudeau. 643

The former Chairmen of the Board were powerless. L’Heureux had little influence outside of defence research circles, and aside from his resignation he appears to have simply moved on. Uffen had left public service and returned to academia, and his solicited advice to the Management Review Group was discarded. Solandt was vehement that the decision to reorganize defence research (and the entire Department of National Defence) was a mistake. He is often quoted from the opening sentence of his article in Science Forum “The Defence Research Board has recently been dismembered in a thoughtless act of mayhem committed in the

name of administrative tidiness.” Most of Solandt’s article is a discussion of the history of success in defence research, and why the unique organizational structure of the Defence Research Board was essential to that success. However, even Solandt’s extensive contacts and influence could not reverse the decision; at best, as Watson later claimed, Solandt delayed the decision for a year.

1975 was a year of lament from defence researchers. Gordon Watson joined Solandt in Science Forum expressing disdain for the decision to reorganize defence research. Watson retired from his position as Chief of Plans in order to pursue studies in archaeology, rather than suffer through the diminished role and prestige of defence research. Watson suggests that scientists were never consulted, and that this reorganization was an obvious example of the conflict between scientists and public service administrators, who had gained the upper hand. Watson clearly articulates the series of events and attitudes that led up to the secret and surprising demise of the Defence Research Board.

After the immediate grieving process the topic was not visited again until Omond Solandt died in 1993 and a Symposium was held in his honour in 1994. Watson revisited the topic with updates based on Bland’s analysis of management and policy in the Department of National Defence and the completion of the story beyond 1975, including the Brian Mulroney government’s decision to dismantle Solandt’s other organization, the Science Council. For Watson, and his co-panellists Archie Pennie and George Lindsey, the demise and demotion of defence research in the DND organizational structure was a severe blow and an unfortunate reduction of the tangible and lasting evidence of Solandt’s legacy.

Watson was representative of the opinion of the majority of senior officers, but bench level scientists continued on with business as usual. Defence research still provided a career and interesting projects, and it made little difference to them whether their boss reported to the Deputy Minister and Minister directly, or to an Assistant Deputy Minister instead. They were

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influenced by other changes from the late 1960s more directly: the hiring of Baby Boomers, the unionisation of professional staff, the Bird Commission and the Official Languages Act. Aside from those in headquarters who were forced into retirement, the end of the Defence Research Board was more a formality. Those who remained in 1974 were already hardened to years of abuse from political whims.  

5.8 Conclusion

The Uffen and L’Heureux years are the story of the struggle to retain the relevance and importance of defence research in a political environment that was hostile towards national defence and eager to assert political control over science policy in a structured and non-personalized way. Both Uffen and L’Heureux tried to update the intramural and extramural research programs of the Defence Research Board to bring them into line with the new Canadian Forces and new political priorities (including bilingualism and equality for women). Their efforts salvaged defence research as a worthwhile activity, but it was not enough to retain scientific management in the face of business and public service administrators. Where Solandt and Zimmerman thrived because of the personal nature of science and national defence policy, Uffen and L’Heureux were no match for the new theories and methods and the new breed of administrators who brandished the theories. Uffen translated the success that had brought him to the Board, as well as the prestige of being named Chairman, into a long and equally successful career in academia and public service. L’Heureux did not fare as well; his resignation from the Board is the last time he appears in the public record.

The eventual demise of the Defence Research Board in 1977 was more than just the result of the recommendations of the Management Review Group. The demise of the DRB

648 Harold Merklinger, interviewed at Defence Research and Development Canada – Atlantic by the author, 29 August 2007; Gilles Berube and Henri P. Tardif, interviewed at Defence Research and Development Canada – Valcartier by the author, 4 December 2007; Robert Chapman, interviewed at his home by the author, 12 December 2007; Harold L. Grant, Blyth Hughes, Allen R. Milne, and B. Frank Peters, interviewed at Grant’s home by the author, 13 December 2007; Terry Foster, interviewed at Defence Research and Development Canada – Atlantic, Dockyard Pacific Laboratory by the author, 13 December 2007; John Ross, interviewed at his home by the author, 15 August 2008; Gordon Marwood, Joseph Lackner, David Selwyn and Frank Szabo, interviewed at Defence Research and Development – Ottawa by the author, 20 August 2008; Robert Walker, interviewed at Defence Research and Development Canada – Corporate, Ottawa by the author, 22 August 2008; George Lindsey, interviewed at his home by the author, 28 August 2008; Anne Robison, interviewed at her home by the author, 28 August 2008; Randall Oscevski, Jan Pope, and M. Martin Taylor, interviewed at Defence Research and Development Canada – Toronto by the author, 6 October 2008; David Beevis, interviewed at his home by the author, 27 November 2008; 6 confidential sources.
started with the election of John Diefenbaker, whose squabbles with civil servants (especially in defence over weapons procurement) resulted in the Glassco Commission. The Glassco Reports led to the Mackenzie Report, the White Papers on Defence of 1964 and 1971, the Science Secretariat, the Science Council and the Lamontagne Committee. The Laurendeau-Dunton Commission and the Bird Commission both served to harass and distract the DRB from its real function of conducting scientific research to advise the Minister of National Defence and the Chief of the Defence Staff and to provide scientific and technical solutions for the Canadian Forces. The cumulative effect of all these events was the dismantling of defence research and the removal of scientific management from within the Department of National Defence.
Chapter 6
Defence Research in a Peaceful Country

6 Conclusion

6.1 Lessons from the Defence Research Board

Four different men ran the Defence Research Board: Omond Solandt, Hartley Zimmerman, Robert Uffen and Léon L'Heureux. All four were organized and driven. The research program of the DRB was always well-planned as a result. Despite periods of doubt, the research of the DRB generally met the needs of the Services/Forces, and did so by anticipating their long-term needs. The Chairmen were always informed, more or less, of the latest scientific and technical developments of their allies, and consequently in a position to fulfill their duties to advise the Minister of National Defence and the Chiefs of Staff (or Chief of the Defence Staff).

The Chairmen, however, were all unique. L'Heureux was the least like the rest. He rose through the ranks of defence research, mostly through the guided missile project (Velvet Glove) and then through a series of management and advising positions. L'Heureux was, in other words, the prototypical ambitious civil servant. The Chairmanship of the Defence Research Board was the culmination of his career, and one that he appears to have left both triumphantly and dejectedly.

The other three Chairmen were all external appointments to the Board, and they all led charmed lives. Uffen ascended through academic administration rapidly and parlayed that ambition and success into the Chairmanship of the Board. From here he made valuable contacts with men like Pierre Trudeau that would guarantee that he continued to serve in important positions and on significant committees after he left the Defence Research Board.

Zimmerman and Solandt were blessed with notable supporters before they arrived at the Chairmanship, and were able to translate those networks into success for the Defence Research Board. Both men attended the University of Toronto, knew Liberal politicians and made distinguished contributions to the Second World War in management positions. Moreover, they had their differences as well. Where Solandt was blunt and forceful, Zimmerman was quiet and
subtle. Solandt was passionate about Arctic research and internationally renowned, and Zimmerman was a nationally recognized industrialist and keen to push through development and production projects. Solandt was significant in building the DRB from scratch, while Zimmerman was the right man to guide mature and nearly completed projects to fruition.

There were six events, or chains of events, that were highly significant in the shaping of the Defence Research Board. These transformative events were, in roughly chronological order: recruitment, the election of Diefenbaker and the ensuing reforms of the civil service, the retirement of C.D. Howe and the creation of a science policy apparatus, francophone nationalism, women's rights, and Canadian demographics.

The first sequence of significant events was recruitment. From 1947 to 1950 the Defence Research Board grew slowly by recruiting veterans. Some were mid-career while others were new graduates. Recruitment and funding for defence and the DRB spiked from 1950 to 1953 because of the Korean War. From 1953 to 1977, after Solandt's initial success in building the DRB, recruitment was the more straightforward job of replacing retirements and the annual turnover of employees. For the most part, employees who last five years in defence research, spend their entire careers working for the military.

The second sequence of events was, ultimately, the most transformative for the Defence Research Board. Following the election of John Diefenbaker there was a conflict between Diefenbaker and the Department of National Defence over the fallout from the Avro Arrow cancellation, and the Chief's indecision during the nuclear debate. Diefenbaker's punishment of the civil service was the Royal Commission on Government Organization (Glassco). The Glassco Reports recommended an overhauling of the Department of National Defence, including the Defence Research Board. Lester Pearson was elected in 1963 and he requested a second opinion, from within the DND, regarding the recommendations for restructuring. The 1964 White Paper led to integration and unification of the Canadian Forces. A new White Paper in 1971 called the Canadian Forces mission orientation into question, and renewed the demands for reorganization of the department, including the DRB. The 1972 Management Review Group's report was the final event in the string of management reviews that led to the evisceration of the Board, the separation of operational research and defence research, and the rise of public service
administration methods over scientific management within defence research (see Appendix E for tables of organization).

The third set of events also stemmed from the election of John Diefenbaker. C.D. Howe had always been the Cabinet Minister most attuned to the needs of scientists and engineers. When he left politics in 1957 there was a void in the creation of a national science policy. The Glassco Commission brought attention to this void, and C.J. Mackenzie, the second most influential man in Canadian science policy, agreed that there was a problem. The Science Secretariat, Science Council and Senate's Special Committee on Science Policy (the Lamontagne Committee) all mused about how to fill the void left by Howe, although none of them framed it this way. The proposals by the Science Secretariat, Science Council and Lamontagne Committee were all decent and reasonable, but without a powerful minister, who had both political capital and an innate ability to get the right advice from the right people, science policy was as doomed as scientific management (the most lasting changes brought about by the three bodies was the creation of a Department of Communications in 1969 and two new granting agencies in 1978 – Natural Sciences and Engineering Research Council and Social Sciences and Humanities Research Council).

Like national defence policy, science policy became more attuned to the needs of professional administrators and politicians concerned with elections and regionalism. It was no longer enough to have influence, a network of contacts and to be an excellent manager of relationships to become an administrator within the government, there was a growing demand for those who were professionally trained in business or public administration. Administrative tidiness, as Solandt labelled it, was more important than a tradition of excellence stemming from a complex network of interactions that did not fit the academically defined bounds of best business practices.

The fourth set of events that shaped the Defence Research Board was its brushes with francophone nationalism. It began in 1951 when Paul Gagnon was not renewed to the Board and escalated with the separatist rumblings of Marcel Chaput. While in the midst of dealing with the distraction of the Royal Commission on Bilingualism and Biculturalism, the Board had to respond to internal criticism regarding the number of francophone committee members and
grants going to francophone universities. The Official Languages Act had the best of intentions, but simply could not legislate away the fact that the language of (defence) science is English.

The fifth set of events involved another minority group of defence researchers. The Voice of Women brought two important issues to the attention of the Defence Research Board. First and the more significant nationally, was the issue of women's equality. The DRB was typical in its absurd attitudes and unequal treatment, and the Royal Commission on the Status of Women brought change slowly to the DRB and the government in general. Second, the Voice of Women was part of two other radical movements in the 1960s that focused specific attention on the activities of the DRB. In the midst of antiwar and environmental protests, the DRB was an obvious target, especially its special weapons projects at Suffield, Ottawa, Kingston and Grosse Île. Neither of these protests actually affected the DRB's program, since the Board believed that it was doing everything scientifically necessary to avoid disasters, including taking the required steps to have the best defences available in the event of a war.

The sixth and final event that shaped the Defence Research Board was Canadian demographics. This comes back to the original transformative sequence of events – recruitment and the Korean War. By the late 1960s the Baby Boom generation was finishing university and the mid-career men, who had been running the DRB since 1947, were retiring. The G.I. Generation replaced the original managers of the DRB, and the Baby Boomers joined as junior scientists. What might have been, in other career paths, a culture and generation shock was not as strong in the DRB, because those Baby Boomers drawn to defence research were the least ideologically opposed to the core values of the G.I. Generation. At a time of science and national defence policy reviews, as well as management upheavals, separatist musings, women's rights and anti-war protests, the generation gap was the least of anyone's concerns.

6.2 Epilogue, Defence Research Since 1977

Much like the Defence Research Board, the Defence Research and Development Branch lasted for nearly a quarter century. For career bench scientists, and most defence researchers fall in this category, there was not much of a distinguishable difference between the DRB and the DRDB. There was even little to distinguish, at the establishment level, between DRDB and its replacement, Defence Research and Development Canada (DRDC).
6.2.1 Defence Researchers as Civil Servants

The changes that affected bench scientists were similar to the ones that influenced civil servants throughout the government, much to the chagrin of scientists who thought of themselves as a unique culture. Their job descriptions were, of course, quite different from a policy analyst's elsewhere in the government, but the rise of professional public administrators and their fluctuating ideas of how civil servants should be administrated governed the quotidian matters of defence researchers.

The introduction of collective bargaining gave civil servants new legal rights in their relationship with each other as employees and employers. Scientists and engineers throughout the government, including in defence research, felt that their special professional status was diminished. Engineers and scientists in the Defence Research Board had always been treated as a separate and absolutely essential entity. Supporting staff like maintenance, shop workers, administrative assistants and the like were essential in supporting the scientists and allowing them to perform their duties. Unionisation, and the later realignment following the Management Review Group, reduced the special standing of engineers and scientists. Defence research, which had previously enjoyed a somewhat independent justification for existence, was given a new priority level in line with the reduced standing of the entire Department of National Defence.

6.2.2 Defence Research and Canadian Science Policy

When defence research was reorganized in 1974 there had been over a decade of reviews of organization, defence and science in the federal government. Three science policy bodies remained. The Science Council, under the chairmanship of Roger Gaudry who had succeeded Omond Solandt in 1972, was well down its path to obscurity and eventual dispersal in 1993. It was an arm’s length body with little direct influence on the government, and even less interest from the government in requesting advice. The Science Council’s era of extreme relevance, when it was aligned with the Science Secretariat and issued reports written by men like John Chapman and Solandt, was over.649

The Science Secretariat had already disappeared. In 1971 it was transformed into the Ministry of State for Science and Technology (MOSST). Robert Uffen, the former Chairman of the Defence Research Board, had grave misgivings about the MOSST’s role as adviser and coordinator. He knew that without control of budgetary measures the MOSST was unlikely to influence or coordinate science policy in the government. This is true at the Cabinet level of the government, where influential politicians are rewarded with the purse strings of the big departments, and it is true on the civil service side where bureaucrats look to their Minister for support of their mandate.

The Ministry of State for Science and Technology was merged with the Minister of Regional Industrial Expansion in 1990 and renamed the Minister of Industry, Science and Technology. In 1995 this new Ministry was merged with the Ministry of Consumer and Corporate Affairs to create the Minister of Industry position in the Cabinet. The Minister of Industry oversaw Industry Canada and Statistics Canada. In 2008 a new variation of the Minister for Industry, Science and Technology was created, independent of the Minister of Industry. Gary Goodyear, the current Minister of Industry, Science and Technology also holds the position of Minister of Federal Economic Development Agency for Southern Ontario - he is the Member of Parliament for Cambridge, Ontario. In their various guises science and technology have always been a secondary consideration of a Minister; or the concern of a Minister with no other claim to power or influence in Cabinet. Critics in the science and science policy communities have lamented the lack of adequate attention, funding and influence for science policy in federal politics - they crave the next C.D. Howe to return science policy to its rightful position of importance.

The one political body that wielded significant influence in the science policy field was the Senate Committee chaired by Maurice Lamontagne. After nearly a decade of contemplating and maneuvering the government announced that it was going to implement the recommendations made by the Lamontagne Committee; this significant change to the way grants were handled started in 1978. Previously, grants were awarded by a series of bodies within the federal government: the National Research Council, the Medical Research Council and the Defence Research Board, among others. The Medical Research Council had been created in 1960 to reduce the duplication of the medical grants being provided by the NRC and the Defence
Research Board. Lamontagne envisioned a similar centralization of all granting by the federal government.

The Lamontagne Committee finished its reports in 1977, and in May 1978 the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC) were created to control all of the non-medical and non-artistic grants (which were controlled by the Medical Research Council and the Canada Council, respectively). These new Councils were all arms length from intramural research programs like the National Research Council and the Defence Research and Development Branch; Lamontagne suggested that this would avoid any conflicts of interest. Both NSERC and SSHRC followed the model of funding established by the National Research Council in 1917 (which were borrowed from the Department of Scientific and Industrial Research in the United Kingdom). They awarded studentships and fellowships to graduate students, and grants to faculty members for the conduct of research.

The creation of a single government body to administer grants in the physical sciences, engineering and biology solved many of the problems faced by universities in obtaining grants. For instance, military colleges were previously unable to acquire any grants from the National Research Council and had to turn to the Defence Research Board even if the projects had no potential military application. Grants to military colleges had always been handled separately by defence research, and the new Natural Science and Engineering Research Council apparatus solved this problem.

However, the centralized granting agency created a different set of problems. Because of the arms length intermediary (Natural Science and Engineering Research Council) between the government laboratories (National Research Council and Defence Research and Development Branch) and universities there was only a limited opportunity to ensure that the university research projects would complement the intramural research projects of the government. Each establishment of the DRDB could issue contracts to university researchers for work that was an essential complement to work being done intramurally. All other projects that would previously have obtained funding from the Defence Research Board on the basis of scientific merit and military applicability were placed in the broad pool at NSERC where the military applicability was ignored, for the most part. In order to ensure that university-based researchers were working
on projects of interest to DRDB establishments defence researchers had to do a better job communicating their needs to university researchers, as they had already known when Léon L’Heureux was Chairman of the Defence Research Board and had overhauled the grants ranking procedures. Defence researchers also had to lobby through various means to ensure that NSERC evaluated such applications carefully beyond mere scientific merit.650

The other part of the mandate of both the Natural Sciences and Engineering Research Council and the Social Science and Humanities Research Council was to advise the Minister of State for Science and Technology. This united the coordinating efforts for all science and technology within the government, including grants to university researchers, within a single Ministry, but it also separated the intramural and extramural research. Civil servants attempted to coordinate the government’s scientific research, and appointed members coordinated the government’s support of research in universities and industries. The Trudeau government, on the advice of the Lamontagne Committee, had finally given the MOSST a reasonably significant budget, but Cabinet had not created the legislative authority required for the science-based departments to heed the coordinating attempts of the MOSST. The centralized SSHRC and NSERC advisory bodies found that they had little more ability to persuade the government to increase funding to universities and industries than they had had as members of the Board of the Defence Research Board, the Council of the National Research Council, or the advisory committees and panels of both the Board and the Council. Budgeting was a political responsibility, and was subject to the ebb and flow of the agendas of elected officials, rather than constant demand for increased funding that emanated from universities.

The final change in granting occurred in 2000, when the Medical Research Council of Canada was renamed the Canadian Institutes of Health Research (CIHR). It continues to report to the government through the Minister of Health, but like the Natural Sciences and Engineering Research Council and the Social Sciences and Humanities Research Council it is kept at arm’s length through its staffing. CIHR, like the Medical Research Council before it, plays a significant role in determining what university and hospital research receives funding, and therefore what Canadian priorities are in medical and health research.

650 Harold Merklinger, interviewed at Defence Research and Development Canada – Atlantic by the author, 29 August 2007; Robert Walker, interviewed at Defence Research and Development Canada – Corporate, Ottawa by the author, 22 August 2008; Gaede and Merklinger, Seas, Ships and Sensors, 141-143.
6.2.3 Chiefs of Operational and Defence Research

Management of defence research has been consistent in terms of personnel. Robert Uffen was the last head of defence research to be recruited from outside of the intramural programs. The final Chairman of the Defence Research Board was L’Heureux and his long-time colleague through the guided missiles and ballistics programs at Valcartier, Edward Bobyn, was the first Chief of Research and Development. Bobyn held the position until 1983 when he retired and was replaced by Derek Schofield, who had started in the British defence research establishments before immigrating to Canada in 1955; Schofield worked at the Defence Research Establishment Atlantic and as the Scientific Adviser to the Vice Chief of the Defence Staff before becoming the second CRAD. From 1992 to 1997 the third CRAD was Kenneth Peebles. Peebles left the CRAD position to work within the NATO science and technology organization and consulted with Canadian defence researchers on further changes. The fourth CRAD was John Leggatt. Leggatt worked at DREA and DRE Ottawa before becoming the final CRAD (See Appendix E for tables of organization).

Outside of defence researchers, the Chief of Research and Development was rarely known. However, outside of operational research, George Lindsey’s name is well known. As Chief of the Operational Research and Analysis Establishment from 1974 to 1987 (and previously the Director General of the Defence Research Analysis Establishment from 1968 to 1974) Lindsey published frequently and widely. Even in retirement Lindsey continued to be active with the Canadian Institute of Strategic Studies. He published most frequently on the topic of Canada’s aerospace defence, which was one of his primary areas of concern professionally. Lindsey also continued the Sutherland tradition of discussing defence in the Canadian context, and with the declining funding of the Department of National Defence from 1967 to 1987 Lindsey often implored the government to increase the budget.


652 DHH, Col 87/253 IA-1.1 to II-8.12 (Box 1) File “Finding Aid – I.M.R. McKenna, January 1997;” George Lindsey, interviewed at his home in Ottawa by the author, 28 August 2008; Martin, “Nuclear Physicist George Lindsey Was DND’s ‘Best Mind.’”
6.2.4 Canadian Defence Priorities in the World

However, over Lindsey’s tenure as chief operational researcher Canada’s defence needs, as defined by the government and influenced by world affairs, changed. Starting in the early 1970s the United States and Russia agreed to restrictions and limitations on armaments. Canada, and then the United States, opened diplomatic recognition of mainland (communist) China, and Pierre Trudeau and President Richard Nixon visited China in the span of five years. The spectre of global war was diminishing in the 1970s, while the fear of depleting crude oil reserves increased. The sudden growth in power of oil producing countries rebalanced the international scene, and reminded the world that there was more to global affairs than the bipolar conflict between communism and democracy. For Canadians, resource shortages, especially gasoline, was a derivative effect of being the northern neighbour of the United States. For all the Trudeau rhetoric of sovereignty and independence, Canada was unavoidably North American.653

Détente, as the era of reduced East-West tension was known, experienced setbacks in 1980. The Russians invaded Afghanistan and Ronald Reagan was elected President of the United States. Reagan denounced the Evil Empire, and beefed up American military spending. He even promised that Edward Teller and the other American wizards would end the period of deterrence by building an elaborate missile defence system dubbed ‘Star Wars’ after the popular movie series. Properly it was known as the Strategic Defense Initiative; the most charitable interpretation was that Reagan wanted to ensure that no American lives would be lost during an unprovoked attack, and that the United States, unharmed, would have a range of possible responses. As a hardened Cold Warrior, there were fears that Reagan actually wanted the missile shield as a means of preventing retaliation after the United States attacked Russia. Understandably, Star Wars led to a new round of defence spending by the two superpowers and new fears of global conflict. The fears were short-lived, but the Canadian government and Department of National Defence had to respond to the new externalities.654

In 1987 the Brian Mulroney government issued a fresh White Paper on Defence. It was the first one in 16 years. The White Paper promised increased funding for capital acquisitions to situate Canada firmly in the Western camp of the destabilized world. The crowning acquisition was to be nuclear-powered attack submarines that would assert Canada’s claim to sovereignty in the Arctic Ocean.655

The promised funding never materialized, and the capital acquisitions disappeared from the books. Canadians did not want new weapons (or perhaps more accurately, they did not want to pay for new weapons), and the global atmosphere was not nearly as ominous as it seemed in the early 1980s. Mikhail Gorbachev was reaching out to the West to end the cycles of military spending that were bankrupting Russia, and domestically he moved away from rigid communist dictatorship to eventual democratic-style elections. The Berlin Wall, the physical symbol of the Iron Curtain and the conflict with communism came down in 1989. Russia proper reappeared following the dissolution of the Soviet Union in 1991.656

The end of the Cold War signalled a new era in international relations. Communism still existed in China, Vietnam, North Korea and Cuba (among others), but the fall of Russian-led communism raised hope in the West that the other communist nations would follow suit. As well, nuclear weapons still existed, and the collapse of the Soviet Union had dispersed some of the stockpile to a variety of states with varying degrees of political stability. While fears of a globe-consuming nuclear showdown between the United States and Russia abated, concerns about the increasing proliferation of nuclear weapons and the potential for limited and localized uses of nuclear weapons raised concerns around the world. These fears surrounding proliferation had always existed, but the end of the Cold War meant that countries, like the United States and Canada, had to reorient their worldviews. Diametrically opposed political ideologies had simplified what had always been a complicated situation. There are many people and countries


in the world, and they have competing needs for resources and complicated histories of interactions that inform current and future behaviour.\textsuperscript{657}

To address this changed world, the new Liberal government of Canada, led by Prime Minister Jean Chrétien, requested a new White Paper on Defence. It was provided in 1994. The world might have changed, but Canada was still committed to containing violence in the world as a means of preserving Canada’s security. The Canadian government made further reductions to Canada’s contribution to NATO, and to the budget of the Department of National Defence. The world was more uncertain, but also more secure than it was prior to 1991; the government felt that the DND could fulfill its mandate with less money.\textsuperscript{658}

6.2.5 Defence Priorities and Defence Research – DRDC

Within the Defence Research and Development Branch, the place to cut was obvious. Suffield had always been the establishment threatened with closure, but it was providing unique services. Moreover, there were two naval research facilities, and the properties of the two oceans were not that different, or at least not different enough to justify more than 45 years of individual study. The Defence Research Establishment Pacific was closed in 1995. A few scientists and supporting staff were retained in Esquimalt to run a dockyard laboratory – a return to DREP’s origins – but the rest were transferred to Halifax to the Defence Research Establishment Atlantic. Given the higher than average satisfaction with the living conditions on Vancouver Island, many opted for retirement over the move to Halifax, especially those of the Silent Generation and the oldest Baby Boomers.\textsuperscript{659}

Later in the 1990s the Chrétien government pushed for further cuts to the Department of National Defence. John Leggatt, the final Chief of Research and Development, created a new program review to deal with budget cuts. The study included former Chief of Research and


\textsuperscript{659}Harold Merklinger, interviewed at Defence Research and Development Canada – Atlantic by the author, 29 August 2007; Robert Chapman, interviewed at his home by the author, 12 December 2007; Harold L. Grant, Blyth Hughes, Allen R. Milne, and B. Frank Peters, interviewed at Grant’s home by the author, 13 December 2007; Terry Foster, interviewed at Defence Research and Development Canada – Atlantic, Dockyard Pacific Laboratory by the author, 13 December 2007; Chapman, \textit{Alpha and Omega}, 140; Gaede and Merklinger, \textit{Seas, Ships and Sensors}, 6.
Development, Kenneth Peebles, and future head of defence research Robert Walker. The three men investigated multiple options for defence research including increasing spending, joining the National Research Council and returning to a format similar to the Defence Research Board. Peebles and Walker recommended moving away from the current structure within the Materiel Group to something more independent. Science and technology were needed broadly within the country, and it was not possible to rely on outside sources to provide the types of research done in the Defence Research and Development Branch. However, contracted work was generally cheaper than an intramural research program, so defence research going forward would have to balance essential work that had to be done internally with work that could be done better and cheaper outside of the government. Decades of defence and communications research had created a variety of spin-off companies in Ottawa, Québec, Toronto, Winnipeg, Halifax and Victoria, among other places. The study concluded that a new organization for defence research would be better suited to the new threats that Canada’s security and sovereignty faced.660

In 2000 the Defence Research and Development Branch disappeared and it was replaced by Defence Research and Development Canada (DRDC). Each of the establishments was renamed according to the formula: DRDC Location (Atlantic, Valcartier, Ottawa, Toronto and Suffield). John Leggatt remained as the head of DRDC wearing two administrative hats. He was the Chief Executive Officer of DRDC, and the Assistant Deputy Minister (Science and Technology).

The new level of authority gave defence research direct access to the Deputy Minister, and the Minister when necessary. It was similar to the Defence Research Board in terms of its level within the government, but absent the Board of external advisers and the numerous committees and panels of scientific and technical experts. Leggatt as Chief Executive Officer of DRDC was responsible for the research program the same as the Chairman of the DRB. As the Assistant Deputy Minister, Leggatt was responsible for scientific and technical advising within the Department of National Defence, again similar to the original role of the Chairman of the DRB (see Appendix E for tables of organization).

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Three years later operational research returned to the administrative authority of Defence Research and Development Canada. The Centre for Operational Research and Analysis (CORA), as it was now called, became DRDC CORA. As with all the research centres, DRDC CORA is managed by a Director General, who is aided by a Chief Scientist and a Deputy Director General.

Decision-making remains decentralized in Defence Research and Development Canada, with the broad research direction of each research centre defined from DRDC Corporate in Ottawa. However, each Director General has fairly broad latitude to make decisions about the centre’s specific research projects, and to form ties with industries and universities to contract out research. Each research centre also continues to hire summer students, although given the limited visibility of DRDC in Canada the students generally only come from local universities.

In the wake of the rise of global terrorism, specifically the attacks on the World Trade Center in New York on 11 September 2001, Defence Research and Development Canada expanded its research in counter-terrorism. In 2005 DRDC created the Centre for Security Science (DRDC CSS) to cooperate with Public Safety Canada on research relevant to the safety and security of Canadians against acts of terrorism. Research is conducted across the centres of DRDC, as well as other government laboratories and at universities and industries. The CSS program is split between technical questions (the Public Security Technical Program – PSTP) and questions surrounding weapons of mass destruction (the Chemical, Biological, Radiological-Nuclear, and Explosives – CBRNE – Research and Technology Initiative – CRTI). PSTP is further subdivided into protecting the infrastructure, surveillance and intelligence, and emergency management.

In 2006 Robert Walker took over as Assistant Deputy Minister and Chief Executive Officer from John Leggatt. Leggatt entered the consulting business. Walker released a new Defence Science and Technology Strategy, which was yet another attempt to carefully align the needs of the Canadian Forces with the abilities of defence researchers. This service of the military as the main client has always been the primary mission of defence research, and managing this relationship remains a work in progress.

In 2011, several of the scientific Assistant Deputy Ministers in the federal government moved to new postings. Walker left Defence Research and Development Canada for the
embattled Atomic Energy of Canada, Limited. His replacement was Marc Fortin who moved to DRDC from Agriculture Canada, and prior to joining Agriculture he was a scholar at McGill University.
Appendix A: Ministers of National Defence, 1939 to Present

Prime Minister: William Lyon Mackenzie King

Norman McLeod Rogers
19 September 1939 – 10 June 1940

Charles Power (Acting)
11 June 1940 – 4 July 1940

James Ralston
5 July 1940 – 1 November 1944

Andrew McNaughton
2 November 1944 – 20 August 1945

Douglas Abbott
21 August 1945 – 9 December 1946

Brooke Claxton
10 December 1946 – 15 November 1948

Prime Minister: Louis St-Laurent

Brooke Claxton
15 November 1948 – 30 June 1954

Ralph Campney
July 1, 1954 – June 20, 1957

Prime Minister: John Diefenbaker

George Pearkes
21 June 1957 – 10 October 1960

Douglas Harkness
11 October 1960 – 3 February 1963

Gordon Churchill
12 February 1963 – 21 April 1963

Prime Minister: Lester Pearson

Paul Hellyer
22 April 1963 – 18 September 1967

Léo Cadieux
19 September 1967 – 19 April 1968

Prime Minister: Pierre Trudeau

Léo Cadieux
20 April 1968 – 16 September 1970
<table>
<thead>
<tr>
<th>Name</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edgar Benson</td>
<td>28 January 1972 – 31 August 1972</td>
</tr>
<tr>
<td>Jean-Eudes Dubé (Acting)</td>
<td>1 September 1972 – 6 September 1972</td>
</tr>
<tr>
<td>Charles Mills Drury (Acting)</td>
<td>7 September 1972 – 26 November 1972</td>
</tr>
<tr>
<td>James Richardson</td>
<td>27 November 1972 – 12 October 1976</td>
</tr>
<tr>
<td>Barnett Danson (Acting)</td>
<td>13 October 1976 – 2 November 1976</td>
</tr>
<tr>
<td>Barnett Danson</td>
<td>3 November 1976 – 3 June 1979</td>
</tr>
<tr>
<td>Prime Minister: C. Joseph Clark</td>
<td></td>
</tr>
<tr>
<td>Allan McKinnon</td>
<td>4 June 1979 – 2 March 1980</td>
</tr>
<tr>
<td>Prime Minister: Pierre Trudeau</td>
<td></td>
</tr>
<tr>
<td>Gilles Lamontagne</td>
<td>3 March 1980 – 11 August 1983</td>
</tr>
<tr>
<td>Prime Minister: John Turner</td>
<td></td>
</tr>
<tr>
<td>Jean–Jacques Blais</td>
<td>30 June 1984 – 16 September 1984</td>
</tr>
<tr>
<td>Prime Minister: Brian Mulroney</td>
<td></td>
</tr>
<tr>
<td>Robert Coates</td>
<td>17 September 1984 – 11 February 1985</td>
</tr>
<tr>
<td>Name</td>
<td>Dates</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Marcel Masse</td>
<td>21 April 1991 – 3 January 1993</td>
</tr>
<tr>
<td>Prime Minister: A. Kim Campbell</td>
<td></td>
</tr>
<tr>
<td>Thomas Siddon</td>
<td>25 June 1993 – 3 November 1993</td>
</tr>
<tr>
<td>Prime Minister: Jean Chrétien</td>
<td></td>
</tr>
<tr>
<td>David Collenette</td>
<td>4 November 1993 – 4 October 1996</td>
</tr>
<tr>
<td>M. Douglas Young</td>
<td>5 October 1996 – 10 June 1997</td>
</tr>
<tr>
<td>Art Eggleton</td>
<td>11 June 1997 – 25 June 2002</td>
</tr>
<tr>
<td>John McCallum</td>
<td>26 June 2002 – 11 December 2003</td>
</tr>
<tr>
<td>Prime Minister: Paul Martin</td>
<td></td>
</tr>
<tr>
<td>David Pratt</td>
<td>12 December 2003 – 19 July 2004</td>
</tr>
<tr>
<td>Bill Graham</td>
<td>20 July 2004 – 5 February 2006</td>
</tr>
<tr>
<td>Prime Minister: Stephen Harper</td>
<td></td>
</tr>
<tr>
<td>Gordon O'Connor</td>
<td>6 February 2006 – 14 August 2007</td>
</tr>
<tr>
<td>Peter MacKay</td>
<td>14 August 2007 –</td>
</tr>
</tbody>
</table>
Appendix B: Department of National Defence Expenditures, 1945 to 1977

<table>
<thead>
<tr>
<th>Fiscal Year Ending Closest to 31 December</th>
<th>DND Allocation (in thousands of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1945</td>
<td>2,263,674</td>
</tr>
<tr>
<td>1946</td>
<td>365,938</td>
</tr>
<tr>
<td>1947</td>
<td>154,263</td>
</tr>
<tr>
<td>1948</td>
<td>256,092</td>
</tr>
<tr>
<td>1949</td>
<td>372,596</td>
</tr>
<tr>
<td>1950</td>
<td>759,779</td>
</tr>
<tr>
<td>1951</td>
<td>1,400,709</td>
</tr>
<tr>
<td>1952</td>
<td>1,864,533</td>
</tr>
<tr>
<td>1953</td>
<td>1,792,043</td>
</tr>
<tr>
<td>1954</td>
<td>1,647,594</td>
</tr>
<tr>
<td>1955</td>
<td>1,643,260</td>
</tr>
<tr>
<td>1956</td>
<td>1,685,823</td>
</tr>
<tr>
<td>1957</td>
<td>1,705,773</td>
</tr>
<tr>
<td>1958</td>
<td>1,664,313</td>
</tr>
<tr>
<td>1959</td>
<td>1,542,545</td>
</tr>
<tr>
<td>1960</td>
<td>1,534,411</td>
</tr>
<tr>
<td>1961</td>
<td>1,647,055</td>
</tr>
<tr>
<td>1962</td>
<td>1,594,645</td>
</tr>
<tr>
<td>1963</td>
<td>1,717,208</td>
</tr>
<tr>
<td>1964</td>
<td>1,562,405</td>
</tr>
<tr>
<td>1965</td>
<td>1,571,539</td>
</tr>
<tr>
<td>1966</td>
<td>1,663,992</td>
</tr>
<tr>
<td>1967</td>
<td>1,783,965</td>
</tr>
<tr>
<td>1968</td>
<td>1,796,956</td>
</tr>
<tr>
<td>1969</td>
<td>1,814,700</td>
</tr>
<tr>
<td>1970</td>
<td>1,724,500</td>
</tr>
<tr>
<td>Year</td>
<td>Value</td>
</tr>
<tr>
<td>------</td>
<td>---------------</td>
</tr>
<tr>
<td>1971</td>
<td>1,871,600</td>
</tr>
<tr>
<td>1972</td>
<td>1,911,700</td>
</tr>
<tr>
<td>1974</td>
<td>2,602,000 ‘Protection of Persons and Property’</td>
</tr>
<tr>
<td>1975</td>
<td>2,890,000 ‘Protection of Persons and Property’</td>
</tr>
<tr>
<td>1976</td>
<td>3,397,000 ‘Protection of Persons and Property’</td>
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<tr>
<td>1977</td>
<td>4,136,000 ‘Protection of Persons and Property’</td>
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</table>
Appendix C: Deputy Ministers of National Defence and Chiefs of Staff (*Ex Officio* Board Members), 1947 to 1977

<table>
<thead>
<tr>
<th>Deputy Minister</th>
<th>Tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>W. Gordon Mills</td>
<td>-1948</td>
</tr>
<tr>
<td>Charles Mills Drury</td>
<td>1948-1955</td>
</tr>
<tr>
<td>Air Marshal Frank Miller</td>
<td>1955-60</td>
</tr>
<tr>
<td>Elgin Armstrong</td>
<td>1960-1971</td>
</tr>
<tr>
<td>Sylvain Cloutier</td>
<td>1971-1975</td>
</tr>
<tr>
<td>Charles Robert Nixon</td>
<td>1975-1982</td>
</tr>
</tbody>
</table>

*Chiefs of Staff, 1947 to 1964*

<table>
<thead>
<tr>
<th>Chief of the Naval Staff</th>
<th>Tenure</th>
<th>Chief of the General Staff (Army)</th>
<th>Tenure</th>
<th>Chief of the Air Staff</th>
<th>Tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vice Admiral H.E. Reid</td>
<td>1947</td>
<td>Lieutenant-General Charles Foulkes</td>
<td>1951</td>
<td>Air Marshal Robert Leckie</td>
<td>1947</td>
</tr>
<tr>
<td>Officer Name</td>
<td>Year</td>
<td>Rank</td>
<td>Year</td>
<td>Rank</td>
<td>Year</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------</td>
<td>------------------------------</td>
<td>------------</td>
<td>-----------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Vice Admiral</td>
<td>1956-60</td>
<td>Lieutenant-General</td>
<td>1958-61</td>
<td>Air Marshal</td>
<td>1957-62</td>
</tr>
<tr>
<td>Harry DeWolf</td>
<td></td>
<td>Samuel Findlay Clark</td>
<td></td>
<td>Hugh Campbell</td>
<td></td>
</tr>
<tr>
<td>Vice Admiral</td>
<td>1960-64</td>
<td>Lieutenant-General</td>
<td>1961-64</td>
<td>Air Marshal</td>
<td>1962-64</td>
</tr>
<tr>
<td>Herbert Rayner</td>
<td></td>
<td>Geoffrey Walsh</td>
<td></td>
<td>Clarence Dunlap</td>
<td></td>
</tr>
</tbody>
</table>

Military Representatives on Board of Defence Research Board, 1964 to 1977

<table>
<thead>
<tr>
<th>Officer Name</th>
<th>Tenure</th>
<th>Rank</th>
<th>Year</th>
<th>Rank</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief of the Defence Staff (1967 to 1977)</td>
<td>Tenure</td>
<td>Vice Chief of the Defence Staff</td>
<td>Tenure</td>
<td>Chief of Technical Services</td>
<td>Tenure</td>
</tr>
<tr>
<td>Air Chief Marshal Frank Miller</td>
<td>1964-66 (not on Board)</td>
<td>? (Reyno)</td>
<td>?</td>
<td>Air Marshal C.L. Annis</td>
<td>?</td>
</tr>
<tr>
<td>General Frederick Sharp</td>
<td>1969-72</td>
<td>Lieutenant-General M.R. Dare</td>
<td>?</td>
<td>Lieutenant-General D.A.G. Waldock</td>
<td>?</td>
</tr>
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</table>
### Appendix D: Members of the Board, 1947 to 1977

*Ex Officio* Members

<table>
<thead>
<tr>
<th>Defence Research Board Headquarters</th>
<th>National Research Council</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chairman</strong></td>
<td><strong>Tenure</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*DRB Headquarters Staff (Chief Scientist and Deputy Chairman are Term Positions on Board)*

<table>
<thead>
<tr>
<th>Secretary</th>
<th><strong>Tenure</strong></th>
<th>Chief Scientist</th>
<th><strong>Tenure</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>William Barton</td>
<td>1949-1952</td>
<td></td>
<td>Deputy Chairman</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tenure</td>
</tr>
<tr>
<td>Name</td>
<td>Terms</td>
<td>Position</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------</td>
<td>-----------------------------------------</td>
<td></td>
</tr>
<tr>
<td>J.C. Clunie</td>
<td>1952-1953</td>
<td>Deputy Chairman (Scientific)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deputy Chairman (Operations)</td>
<td></td>
</tr>
<tr>
<td>Archie Pennie</td>
<td>1953-1954</td>
<td>Tenure</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1967-1968</td>
<td></td>
</tr>
<tr>
<td>Garnet Dunn</td>
<td>1955-1961</td>
<td>John Chapman</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1968</td>
<td></td>
</tr>
<tr>
<td>E. Francis Schmidlin</td>
<td>1961-1969</td>
<td>Harry Sheffer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1968-1969</td>
<td></td>
</tr>
<tr>
<td>Rolland Hurtubise</td>
<td>1969-1971</td>
<td>Edward Bobyn</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1969-1977</td>
<td></td>
</tr>
<tr>
<td>Ronald Lowe</td>
<td>1971-1973</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.E. Léger</td>
<td>1973-?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Term Members**

<table>
<thead>
<tr>
<th>Name</th>
<th>Terms</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charles Best</td>
<td>1947-1949</td>
<td>Professor, University of Toronto</td>
</tr>
<tr>
<td>R. Dickson Harkness</td>
<td>1947-1949, 1953-1956</td>
<td>Vice President, Northern Electric</td>
</tr>
<tr>
<td>Name</td>
<td>Years</td>
<td>Position</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Paul Gagnon</td>
<td>1947-1949, 1949-1951</td>
<td>Professor, Université Laval</td>
</tr>
<tr>
<td>Otto Maass</td>
<td>1947-1949, 1949-1951</td>
<td>Professor, McGill University</td>
</tr>
<tr>
<td>Gordon Shrum</td>
<td>1947-1950, 1951-1954</td>
<td>Professor, University of British Columbia</td>
</tr>
<tr>
<td>John Johnstone</td>
<td>1947-1950</td>
<td>Professor, Dalhousie University</td>
</tr>
<tr>
<td>Ray Farquharson</td>
<td>1949-1952</td>
<td>Professor, University of Toronto</td>
</tr>
<tr>
<td>H. Greville Smith</td>
<td>1949-1952</td>
<td>President, Canadian Industries Limited</td>
</tr>
<tr>
<td>F.C. Wallace</td>
<td>1950-1953</td>
<td>Vice President, Smith and Stone Limited</td>
</tr>
<tr>
<td>Alan Emerson Cameron</td>
<td>1950-1953</td>
<td>President, Nova Scotia Technical College</td>
</tr>
<tr>
<td>Andrew Gordon</td>
<td>1951-1954</td>
<td>Professor, University of Toronto</td>
</tr>
<tr>
<td>A. Hartley Zimmerman</td>
<td>1952-1955</td>
<td>Director, Department of Defence Production</td>
</tr>
<tr>
<td>Louis-Charles Simard</td>
<td>1952-1955</td>
<td>Professor, Université de Montréal and Notre Dame Hospital</td>
</tr>
<tr>
<td>Hubert Welsford</td>
<td>1952-1955</td>
<td>Executive, Dominion Engineering Works</td>
</tr>
<tr>
<td>Robert Charles Wallace</td>
<td>1953-1955</td>
<td>Head, Arctic Institute of North America</td>
</tr>
<tr>
<td>Harold Duncan Smith</td>
<td>1953-1956</td>
<td>President, Nova Scotia Institute of Science</td>
</tr>
<tr>
<td>Randolph Diamond</td>
<td>1954-1957</td>
<td>Executive, Consolidated Mining and Smelting</td>
</tr>
<tr>
<td>Reginald M. Brophy</td>
<td>1955-1958</td>
<td>Deputy Minister, Department of Defence Production</td>
</tr>
<tr>
<td>Louis-Paul Dugal</td>
<td>1955-1958</td>
<td>Professor, Université Laval</td>
</tr>
<tr>
<td>Harry Thode</td>
<td>1955-1958, 1958-1961</td>
<td>Professor, McMaster University</td>
</tr>
<tr>
<td>Name</td>
<td>Years</td>
<td>Position</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>William Archibald</td>
<td>1956-1959</td>
<td>Professor, Dalhousie University</td>
</tr>
<tr>
<td>Herbert Lank</td>
<td>1956-1959</td>
<td>President, Du Pont Company of Canada</td>
</tr>
<tr>
<td>Thomas Ingledow</td>
<td>1957-1960</td>
<td>Chief Engineer, British Columbia Electric</td>
</tr>
<tr>
<td>Pierre Gendron</td>
<td>1958-1961</td>
<td>Dean, University of Ottawa</td>
</tr>
<tr>
<td>David Aaron Golden</td>
<td>1959-1962, 1962-1965</td>
<td>Deputy Minister, Department of Defence Production</td>
</tr>
<tr>
<td>John W.T. Spinks</td>
<td>1959-1962</td>
<td>President, University of Saskatchewan</td>
</tr>
<tr>
<td>John H. Shipley</td>
<td>1959-1962</td>
<td>Vice President, Canadian Industries Limited</td>
</tr>
<tr>
<td>J. Tuzo Wilson</td>
<td>1960-1963, 1963-1966</td>
<td>Professor, University of Toronto</td>
</tr>
<tr>
<td>John F. McCreary</td>
<td>1960-1963, 1963-1966</td>
<td>Head of Paediatrics, University of British Columbia</td>
</tr>
<tr>
<td>Louis-Philippe Bonneau</td>
<td>1961-1964, 1964-1967</td>
<td>Dean, Université Laval</td>
</tr>
<tr>
<td>David L. Thomson</td>
<td>1961-1964 (incapac.)</td>
<td>Dean, McGill University</td>
</tr>
<tr>
<td>Roger Gaudry</td>
<td>1962-1965, 1965-1968</td>
<td>Vice President of Ayerst, McKenna &amp; Harrison; Vice Rector, Université de Montréal</td>
</tr>
<tr>
<td>Robert Uffen</td>
<td>1963-1966</td>
<td>Principal, University of Western Ontario</td>
</tr>
<tr>
<td>Gordon Hunter</td>
<td>1965-1968, 1968-1971</td>
<td>Deputy Minister, Department of Defence Production; Master of the Royal Canadian Mint</td>
</tr>
<tr>
<td>Henry Duckworth</td>
<td>1965-1968</td>
<td>Vice President, University of Manitoba</td>
</tr>
<tr>
<td>Allan Bishop Van Cleave</td>
<td>1966-1969, 1969-1972</td>
<td>Director, University of Saskatchewan</td>
</tr>
<tr>
<td>Name</td>
<td>Years</td>
<td>Position</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Wilfred Bigelow</td>
<td>1966-1969, 1969-1972</td>
<td>Professor, University of Toronto and Toronto General Hospital</td>
</tr>
<tr>
<td>Howard Hillen Kerr</td>
<td>1966-1969</td>
<td>Principal, Ryerson Institute of Technology</td>
</tr>
<tr>
<td>Napoléon LeBlanc</td>
<td>1968-1971</td>
<td>Vice-Rector, Université Laval</td>
</tr>
<tr>
<td>Maurice L’Abbé</td>
<td>1968-1971, 1971-1974</td>
<td>Vice-Rector, Université de Montréal</td>
</tr>
<tr>
<td>J. Maurice LeClair</td>
<td>1971-1974, ?</td>
<td>Deputy Minister, Health; Deputy Minister, Ministry of State for Science and Technology</td>
</tr>
<tr>
<td>Larkin Kerwin</td>
<td>1971-1974, 1974-1977</td>
<td>Rector, Université Laval</td>
</tr>
<tr>
<td>John D. Wood</td>
<td>1971-1974, 1974-1977</td>
<td>Vice President of Alberta Trailer Company</td>
</tr>
<tr>
<td>George Forbes Otty Langstroth</td>
<td>1971-1974, 1974-1977</td>
<td>Dean, Dalhousie University</td>
</tr>
<tr>
<td>Jean-Marc Lalancette</td>
<td>1971-1974, 1974-1977</td>
<td>Vice-Rector, Université de Sherbrooke</td>
</tr>
<tr>
<td>William C. Gibson</td>
<td>1971-1974</td>
<td>Professor, University of British Columbia</td>
</tr>
<tr>
<td>Howard Earle Petch</td>
<td>1973-1976, 1976-1977</td>
<td>Vice President, University of Waterloo; President University of Victoria</td>
</tr>
<tr>
<td>Allen Maurice Lansdown</td>
<td>1974-1977</td>
<td>Professor, University of Manitoba</td>
</tr>
</tbody>
</table>
Appendix E: Headquarters and Liaison Staff, 1947 to 1977

Place of Defence Research Board in Department of National Defence, 1947 to 1974
1947 Table of Organization

Chairman and Director General

3 Scientific Advisers to 3 Chiefs of Staff

Defence Research Members: London and Washington

Deputy Director General

Chief of Administration

Superintendents of Establishments
1949 Table of Organization

Chairman and Director General

Defence Research Members: London and Washington

Deputy Director General

Chief of Administration
Scientific Adviser to the Chief of the General Staff

Deputy Director General (A) and Scientific Adviser to the Chief of the Naval Staff
Deputy Director General (B) and Scientific Adviser to the Chief of the Air Staff

Superintendents of the Establishments
1950 Table of Organization

Chairman

Defence Research Members: London and Washington

Vice Chairman (Added *ex officio to Board*)

Chief of Administration

Deputy Director General (A) and Scientific Adviser to the Chief of the Naval Staff

Scientific Adviser to the Chief of the General Staff

Deputy Director General (B) and Scientific Adviser to the Chief of the Air Staff

Superintendents of the Establishments
1951 Table of Organization

Chairman

Defence Research Members: London and Washington

Vice Chairman

Chief of Administration

Deputy Director General (A) and Scientific Adviser to the Chief of the Naval Staff

Deputy Director General (C) and Scientific Adviser to the Chief of the General Staff

Deputy Director General (B) and Scientific Adviser to the Chief of the Air Staff

Superintendents of the Establishments
1952 Table of Organization

Chairman

Vice Chairman

Chief of Administration

Deputy Director General (A) and Scientific Adviser to the Chief of the Naval Staff

Deputy Director General (B) and Scientific Adviser to the Chief of the Air Staff

Deputy Director General (C) and Scientific Adviser to the Chief of the General Staff

Defence Research Members: London and Washington

Deputy Director General (D)

Superintendents of Establishments
1955 Table of Organization

- **Chairman**
- **Vice Chairman**
- **Chief of Establishments**
  - Superintendents of Establishments
- **Chief of Administration and Secretary of the Board**
  - General Services
    - Personnel Services
    - Joint Intelligence Bureau
    - Public Relations Officer
- **Chief Scientist**
  - 3 Scientific Advisers to 3 Chiefs of Staff
  - Defence Research Members: London and Washington
  - 7 Directors of Programmes
1957 Table of Organization

Chairman

Vice Chairman

Chief of Administration and Secretary of Board

Chief of Establishments

Superintendents of Establishments

General Services

Personnel Services

Joint Intelligence Bureau

Public Relations Officer

3 Scientific Advisers to 3 Chiefs of Staff

Defence Research Members: London and Washington

7 Directors of Programmes

Chief Scientist (Term Member of Board)
1961 Table of Organization

Chairman

- Secretary of the Board and Personal Assistant to the Chairman

Vice Chairman

- Chief of Establishments
- Comptroller
- Chief of Personnel
- 3 Scientific Advisers to 3 Chiefs of Staff
- Defence Research Members: London and Washington
- 7 Directors of Programmes

Chief Scientist (Term Member of Board)

Superintendents of Establishments
1964 Table of Organization

Chairman

Secretary and Personal Assistant

Vice Chairman

Administration Functions


Scientific Advisers to the Vice Chief of the Defence Staff and Chief of Technical Services

Chief of Establishments

Chief Scientist (Physics and Engineering)

Chief Scientist (Chemistry and Biology)

Superintendents of Establishments
1965 Table of Organization

Chairman

Secretary and Personal Assistant

Vice Chairman

Defence Research
Members: London, Washington and Paris

Superintendents of Establishments

Administration Functions

Scientific Advisers to the Vice Chief of the Defence Staff and Chief of Technical Services

Chief Scientist (Physics and Engineering)

Chief Scientist (Chemistry and Biology)
1967 Table of Organization
Place of Defence Research and Board in Department of National Defence, 1974 to 1977
Place of Defence Research in Department of National Defence, 1977 to 2000
Place of Defence Research in Department of National Defence, 2000 to present

Tables do not show all personnel or levels of management. They are intended to be illustrative of some significant lines of authority.
Appendix F: Selection of Canadian Defence Research Scientists, 1947 to present

Abrams, John – Superintendent of Operational Research Group, Scientific Adviser

Arnell, John – Defence Research Chemical Laboratory, headquarters, Assistant Deputy Minister (Finance)

Barrett, Hugh – Superintendent of Suffield, exchanged with Porton Down, Chief of Establishments

Barton, William – assistant secretary and secretary of the Board

Bobyn, Edward – Canadian Armaments Research and Development, Superintendent, Director General, Deputy Chairman, First Chief of Research and Development

Bull, Gerald – University of Toronto Institute of Aerophysics student, Canadian Armaments Research and Development Establishments

Carrie, G. Milroy – Liaison, headquarters

Carruthers, J. Alexander – Defence Research Chemical Laboratory, British atomic tests in Australia

Chapman, John – Defence Research Telecommunications Establishment, Prince Albert Radar Laboratory, Deputy Chairman, First Assistant Deputy Minister (Research) at Department of Communications

Chaput, Marcel – Chemical Warfare Laboratory, Defence Research Medical Laboratory, Operational Research Group, separatist

Clunie, J.C. – Secretary of the Board, Defence Research Kingston Laboratory

Cole, Ian – Operational Research Group

Cowie, W.E. – Defence Research Chemical Laboratory
Croal, James – Defence Research Northern Laboratory, International Geophysical Year

Cruikshank, Alexander – loaned from Atomic Energy of Canada, Limited for British atomic tests in Australia, hired by DRB and seconded to AECL

Dacey, John – Superintendent of Chemical Warfare Laboratory

Davies, Emlyn Llewellyn – Superintendent of Suffield Experimental Station, Deputy Director General, Vice Chairman, Defence Research Member London

Davies, Frank – Defence Research Telecommunications Establishment

Dunbar, I. Moira – Joint Intelligence Bureau, headquarters

Dunn, Garnet – Chief of Administration, Secretary of the Board

Eon, Guy – headquarters, oversight of radar projects

Field, George – Scientific Adviser, Deputy Director General, Chief Scientist, Deputy Chairman and Vice Chairman

Fordyce, Alec M. – headquarters, Comptroller

Forsyth, Peter – Defence Research Telecommunications Establishment, Prince Albert Radar Laboratory

Fortin, Marc – Assistant Deputy Minister (Science and Technology), Chief Executive Officer of Defence Research and Development Canada

Franklin, Colin – Defence Research Telecommunications Establishment

Goforth, Wallace – headquarters

Grummet – loaned from Atomic Energy of Canada, Limited to send to the United Kingdom during British atomic tests in Australia

Hattersley-Smith, Geoffrey – northern exploration

Henderson, George – Naval Research Establishment
Hogarth, Jack – Defence Research Telecommunications Establishment

Hurtubise, Rolland – Defence Research Establishment Valcartier, Secretary of the Board

Ironside, Alice M. – headquarters

Johnstone, John – Naval Research Establishment

Kendall, Richard – Defence Research Chemical Laboratory, British atomic tests in Australia

Kerrigan, Geoffrey – Defence Research Chemical Laboratory, British atomic tests in Australia

Keyston, John – loaned by British, Superintendent of Naval Research Establishment, Vice Chairman, scientific adviser to NATO

Langstroth, George – Superintendent of Suffield Experimental Station and Naval Research Establishment, father of Board member George Forbes Otty Langstroth

Larnder, Harold – Bawdsey, Operational Research Group

Larnder (née Montgomery), Margaret – Operational Research Group

Leggatt, John – Defence Research Establishments Atlantic and Ottawa, Final Chief of Research and Development, First Assistant Deputy Minister (Science and Technology) and Chief Executive Officer of Defence Research and Development Canada

L’Heureux, Léon – Canadian Armaments Research and Development Establishment, Scientific Adviser, Superintendent, Vice Chairman, final Chairman

Lindsey, George – Operational Research Group, Director General, Chief

Longair, Alexander – headquarters

Lowe, Ronald – Operational Research Group, headquarters, Secretary of the Board

MacNeill, R.G. – Secretary of the Board

Martineau, Richard – headquarters, Secretary of the Board, Liaison
Merklinger, Harold – Defence Research Establishment Atlantic

Morrison, G.P. – Superintendent of Canadian Armaments Research and Development Establishment, Liaison

Morton, N. Whitman – Superintendent of Operational Research Group, Deputy Director General, Scientific Adviser, Chief of Personnel, Liaison

Peebles, Kenneth – Chief of Research and Development

Pennie, Archie – Secretary of the Board, superintendent of numerous establishments, Deputy Chairman (Operations)

Perren, E.A. – Superintendent exchanged from Porton Down to Suffield Experimental Station

Petrie, William – Superintendent of Operational Research Group, Chief Scientist, Deputy Chairman

Pope, C.A. – Public Relations Officer

Pullan, G.T. – headquarters

Reed, Guilford – Defence Research Kingston Laboratory, Queen’s University

Robison (née Merklinger), Anne – Naval Research Establishment

Rose, D.C. – loaned from National Research Council to act as Superintendent of Canadian Armaments Research and Development Establishment

Schmidlin, Emil Francis ‘Frank’ – Suffield Experimental Station, Personal Assistant to the Chairman and Secretary of the Board

Schofield, Derek – Defence Research Establishment Atlantic, Scientific Adviser, Chief of Research and Development

Scott, James – Defence Research Telecommunications Establishment
Sheffer, Harry – Chemical Warfare Laboratories, Defence Research Kingston Laboratory, headquarters, Chief Scientist, Deputy Chairman, Vice Chairman

Solanst, Omond – first Chairman

Spohn, Elizabeth Sarita - headquarters

Stedman, Ernest – Scientific Adviser

Sutherland, Robert – Superintendent of Operational Research Group, author of 1964 White Paper

Taber, Harold – Liaison

Tate, Parr – Defence Research Chemical Laboratory, loaned to British atomic tests in Australia

Thacker, D.G. – headquarters

Tyas, J. Philip – Defence Research Telecommunications Establishment, Operational Research Group, Program Evaluation and Review Technique

Uffen, Robert – Member of the Board, Vice Chairman, Chairman, Chief Science Adviser to Cabinet

Walker, Robert – Defence Research Establishment Atlantic, Assistant Deputy Minister (Science and Technology) and Chief Executive Officer of Defence Research and Development Canada, Vice President of Atomic Energy of Canada, Limited

Warren, Eldon – Defence Research Telecommunications Establishment

Watson, Gordon D. – Canadian Armaments Research and Development Establishment, Superintendent, headquarters, Chief of Personnel, Chief of Plans

Whillans, Morley – Superintendent of Defence Research Medical Laboratory, headquarters

Wiggin, N.J.B. – Deputy and Superintendent, Defence Research Chemical Laboratory, Defence Research Medical Laboratory, Chief of Plans
Zimmerman, A. Hartley – Member of Board for Department of Defence Production, Vice Chairman, Chairman
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- ADM – Admiralty and Ministry of Defence
- AIR – Air Ministry and Ministry of Defence
- AVIA – Ministry of Defence, Aviation and Aerospace
- AY – DSIR and Ministry of Industry
- BT – Hovercraft Reports
- DEFE – Ministry of Defence
- DSIR – Department of Scientific and Industrial Research
- ES – Atomic Weapons Research Establishment
- HO – Home Office
- SUPP – Ministry of Supply
- WO – War Office

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