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Article abstract

The Defence Research Board (DRB) of Canada is an ideal case study for the operation and organization of science in government. The history of the DRB demonstrates the ebb and flow of government interest in science and defence from 1947 to 1977. This paper traces defence research through its most transformative events: demobilization, the Korean War, the International Geophysical Year, the Glassco Commission, the 1964 *White Paper*, integration and unification of the Department of National Defence, internal reviews, the 1971 *White Paper*, the Management Review Group, and the Lamontagne Committee. This sequence of transformative events reveals the importance of politics and personalities to decision-making, and the difficult alliance of scientists with soldiers.

Politics and Defence Research in the Cold War

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Abstract: The Defence Research Board (DRB) of Canada is an ideal case study for the operation and organization of science in government. The history of the DRB demonstrates the ebb and flow of government interest in science and defence from 1947 to 1977. This paper traces defence research through its most transformative events: demobilization, the Korean War, the International Geophysical Year, the Glassco Commission, the 1964 *White Paper*, integration and unification of the Department of National Defence, internal reviews, the 1971 *White Paper*, the Management Review Group, and the Lamontagne Committee. This sequence of transformative events reveals the importance of politics and personalities to decision-making, and the difficult alliance of scientists with soldiers.

Résumé : Le Conseil de Recherches pour la Défense (CRD) du Canada est un exemple idéal pour étudier l'exercice et l'organisation de la science au sein gouvernement. L'histoire du CRD démontre l'intérêt variable du gouvernement pour la science et la défense de 1947 à 1977. Cet article décrit les événements les plus 'transformateurs' pour la recherche en matière de défense: la démobilisation, la Guerre de Corée, l'Année Géophysique Internationale, la Commission Glassco, le Livre Blanc de 1964, l'intégration et l'unification du Ministère de la Défense Nationale, des examens internes, le Livre Blanc de 1971, le Management Review Group, et le Comité Lamontagne. Cette séquence d'événements révèle l'importance de la politique et des personnalités dans la prise de décision, et l'alliance difficile des scientifiques avec les soldats.

Introduction

Defence research is a varied activity. In the most general sense it is research directed to fulfill the needs of the military. During the Cold War the Canadian military had two broad mandates towards the singular goal of preventing another war. One mandate was protecting North American territory from direct attack, and the other was protecting North America

from indirect attack (i.e. attacks against Canadian and American allies around the globe). Protection of the North American continent meant devising air and sea defences against invasion. For instance, naval defence research included basic scientific research in fields like oceanography, technical research aimed at increasing efficiencies of ships or improving tracking methods, and using operational research to combine scientific and technical knowledge with military tactics and strategies.

The Defence Research Board (DRB), which existed from 1947 to 1977, was tasked with meeting the research needs of Canada's military. A close analysis of the history of the DRB reveals much about the role of science in the federal government. Through a careful study of the organizational history of the DRB one can learn about the politics of decision-making within the federal civil service, especially the influence of personal priorities, and the conflict of scientific values with military needs within the Department of National Defence.

Origins and Organization of the Defence Research Board

The Canadian federal government has been nominally engaged in defence research since the creation of the Honorary Advisory Council for Scientific and Industrial Research in 1916 and more actively since 1935 when Andrew McNaughton assumed the Presidency of the National Research Council (NRC). During the Second World War, when the NRC was thoroughly engaged in research for the military, (acting) President of the NRC C.J. Mackenzie recognized the need for continued defence research and was instrumental in establishing a separate agency to fulfill this requirement following the war.[1]

The Defence Research Board followed the example set by the National Research Council, which was modelled on the British Department of Scientific and Industrial Research. As Chairman of the DRB from 1947 to 1956 Omond Solandt wore three different hats, similar to the ones worn by C.J. Mackenzie as President of the NRC. First, Solandt was the equivalent of a Chief of Staff, and consequently he was the Minister of National Defence's scientific adviser. Second, he was the administrative head of the entire DRB, including headquarters and the defence research

1. McNaughton's role: John Alexander Swettenham, *McNaughton*, vol. 1 (Toronto: Ryerson Press, 1968), 323, 326-343; D.J. Goodspeed, *A History of the Defence Research Board of Canada* (Ottawa: E. Cloutier, Queen's printer, 1958), 7-8; Wilfrid Eggleston, *National Research in Canada: The NRC, 1916-1966* (Toronto: Clarke, Irwin, 1978), 95-96. Mackenzie's role: Wilfrid Eggleston, *Scientists at War* (London: Oxford University Press, 1950), 255; Goodspeed, *Defence Research Board*, 8, 14, 21-35, 42; Eggleston, *National Research in Canada*, 261, 270-275.

establishments. Third, Solandt was the Chairman of the Board (properly, and confusingly, also called the 'Defence Research Board').[2]

As an organization the Defence Research Board consisted of the Board and the defence research establishments. This was identical to the National Research Council, which included an advisory council and a series of laboratories and facilities. The DRB, unlike the NRC, had a single client, and the DRB's research agenda was shaped entirely to serve the Minister and the Department of National Defence (DND), which had a clear mandate of protecting Canadians and Canadian interests at home and abroad.

The establishments were responsible for conducting the scientific research programme of the DRB. Each establishment was managed by a Superintendent, or in the case of the larger establishments, a Chief Superintendent. The Superintendents and Chief Superintendents reported to Solandt and his team of senior scientific managers at headquarters in Ottawa.

By 1950 there were ten establishments dispersed across the country. Each establishment had a different research agenda, and was located for specific scientific and military reasons. Most of the establishments were created during the war by either the military or the National Research Council; these establishments were transferred to Solandt's control starting in 1947.

Naval research was located at the bases of Canada's Pacific and Atlantic fleets in Victoria, British Columbia and Halifax, Nova Scotia. The proximity to naval researchers like John Johnstone at Dalhousie University was beneficial for the Naval Research Establishment in Halifax when it was formed during the war. Canadian Armaments Research and Development Establishment was created at an army base and proving grounds at Valcartier outside of Québec City during the war. The original research agenda included ballistics work; ballistics projects continued after the war and expanded to include the guided missiles, which occupied the most scientists and funding of all of the Defence Research Board's projects in 1950. Electronics research was moved after 1947 from NRC facilities on Montreal Road in Ottawa to the rifle range at Shirley's Bay just outside of the city so that there would be less interference from electromagnetic radiation sources in Ottawa. Electronics research was joined by chemical weapons research, especially respirator work. Research of defences against biological weapons was split into two

2. Goodspeed, *Defence Research Board*, 46. 63. For more information about the National Research Council or the Department of Scientific and Industrial Research one should look at: Yves Gingras, Richard A. Jarrell, eds., *Building Canadian Science: The Role of the National Research Council* (Ottawa: Canadian Science and Technology Historical Association, 1991); Mel W. Thistle, *The Inner Ring: the Early History of the National Research Council of Canada* (Toronto: University Press, 1966); Eggleston, *National Research in Canada*; H.W. Melville, *The Department of Scientific and Industrial Research* (London: Allen & Unwin, 1962).

locations with most of the work undertaken in Kingston, Ontario by Queen's University professor Guilford Reed, and a small testing station that was maintained by the DRB and Department of Agriculture on Grosse Île in the St. Lawrence River. The remainder of the DRB's special weapons research was conducted at Suffield, Alberta, which was chosen primarily because it was a large amount of land that could be used for tripartite (United States, United Kingdom and Canada) trials. Medical and human factors research was moved after the war from the Eglinton Hunt Club in Toronto, Ontario to the Downsview air base in the northern suburbs of Toronto. It was located in Toronto during the war, because the NRC had turned to University of Toronto medical experts Charles Best, Frederick Banting and Wilbur Franks. Solandt, a student of Best's, continued the close association of the DRB's medical research with his Alma mater. At the joint services base at Fort Churchill, Manitoba on Hudson Bay, which was accessible by rail, boat and air, the DRB chose to conduct its new Arctic research programme. Finally, operational research was integrated within the command structures of the military across the country for specific problems, or in headquarters for more general work.[3]

While all of the Defence Research Board's laboratories received new buildings between 1947 and 1954, only the Pacific Naval Laboratory and the Defence Research Northern Laboratory were truly new establishments rather than continuations or reincarnations of wartime facilities. The new naval establishment was an exercise in regional politics hidden behind the

3. Goodspeed, *Defence Research Board*, 208-209, 214-215, 113-114, 192, 195, 137-140, 153-156, 144-148, 224, 233-235, 177-180, 167-169. For more on each establishment one can look at their official histories: Donald Avery, *The Science of War : Canadian Scientists and Allied Military Technology during the Second World War* (Toronto: University of Toronto Press, 1998); George Lindsey, ed., *No Day Long Enough: Canadian Science in World War II* (Toronto: Canadian Institute of Strategic Studies, 1997); John Bryden, *Deadly Allies: Canada's Secret War, 1937-1947* (Toronto: McClelland and Stewart, 1989); Eggleston, *Scientists at War*; John R. Longard, *Knots, Volts and Decibels: An Informal History of the Naval Research Establishment, 1940-1967* (Dartmouth, N.S.: Defence Research Establishment Atlantic, 1993), 1-2; R.P. Chapman, ed., *Alpha and Omega: An Informal History of the Defence Research Establishment Pacific, 1948-1995* (Dartmouth, N.S.: Defence Research Establishment Atlantic, 1998); Robert L. Gaede and Harold M. Merklinger, *Seas, Ships and Sensors: An Informal History of the Defence Research Establishment Atlantic, 1968-1995* (Dartmouth, N.S.: Defence Research Establishment Atlantic, 2003); H.-P Tardif, *Recollections of CARDEDREV, 1945-1995* (Courcelette: Drev, 1995); Alain Gelly and H.P. Tardif, *Defence Research Establishment Valcartier, 1945-1995: 50 Years of History and Scientific Progress* (Ottawa: National Defence, 1995); Suzanne Board, *A Brief History of the Defence Research Establishment Ottawa, 1941-2001* (Ottawa: Defence Research and Development Canada, 2002); A.M. Pennie, *Defence Research Northern Laboratory 1947-1965*, vol. DR 179 (Ottawa: Defence Research Board, 1966); John W. Mayne, *The Origins and Development of Operational Research in Canada*, vol. R83 (Ottawa: Dept. of National Defence, Operational Research and Analysis Establishment, 1980).

guise of scientific differences between the two oceans. The facility for northern research was more than just an exercise in government spending it was a laboratory to fill what Solandt saw as a unique field where Canada could contribute to the tripartite research pool. It was, in addition to the guided missile project at Valcartier, one of two broad research fields that were added by Solandt to the existing wartime research programme.

The other component of the Defence Research Board, the Board, was a replica of the advisory council of the National Research Council, but with the singular purpose of satisfying the DRB's client—the military. The Board was composed of the President of the NRC, the three Chiefs of Staff, the Deputy Minister of the Department of National Defence, and at least six representatives from universities and industries. The Board was responsible for setting the research programme of the DRB. For some of its larger and more specialised tasks only certain members of the Board, as well as supplemental experts, sat on committees. The Standing Committee on Extramural Research, for instance, included the Chairman and the academic members of the Board, and the Standing Committee was in turn supported by a series of advisory panels and subcommittees of experts from government, industry and academia.[4]

The Board and the Committees were an exercise in learning and persuasion. The Defence Research Board acquired the knowledge and opinions of experts from university and industry, while those men learned about the priorities of the Department of National Defence, which allowed them to adapt their own research in order to receive funding. Like the National Research Council, the DRB awarded grants and contracts and hired summer students and faculty, but unlike the NRC the DRB did not have a general scholarship programme; it only awarded scholarships to its own employees for degree completion or educational upgrading.[5]

4. Library and Archives Canada (LAC), Record Group (RG) 24, Series (S) F1, Volume (vol) 11995, file DRBS 1-0-43-1, vol. 1, "Note Regarding Defence Research in the Universities, 5 December 1947," and "Memorandum from Solandt to the Defence Research Board regarding Principles Governing Extra Mural Grants, 13 December 1947"; LAC, RG 24, S F1, vol. 11996, file DRBS 1-0-43-2, vol. 2, "Minutes of the Sixth Meeting of the Defence Research Board held at 10:30am, Friday, 19 March 1948," 3-7, and Annexure V (of Sixth Meeting) "Standing Committee on Extra-Mural Grants Constitution," and Annexure W (of Sixth Meeting) "Financial Policy–Extra-Mural Research Recommended by the Standing Committee on Extra-Mural Grants of the DRB," and Annexure X (of Sixth Meeting) "DRB Policy Regarding Payment of Salaries from Extra-Mural Grants," and Annexure Y (of Sixth Meeting) "Application for a Grant for Research," and "Minutes of the Eighth Meeting of the Defence Research Board held at Valcartier, 26-27 September 1948," 6; Goodspeed, *Defence Research Board*, 67, 99-100.

5. LAC, "Note Regarding Defence Research in the Universities, 5 December 1947"; 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," Annexure L (of Fifteenth Meeting) "Synopsis of Scholarship Assistance Plan."

Growing Pains and Proportional Representation

A few months after the Defence Research Board was founded, Member of Parliament Robert Winters complained that the original four Board members from university and industry were all Central Canadians and that this meant there was no representation of the Maritimes. Minister of National Defence Brooke Claxton raised the issue with Solandt, who selected John Johnstone to represent the Maritimes and Gordon Shrum for Western Canada. By the end of the year, Shrum put his position on the Board and the Standing Committee on Extramural Research to good use by securing $10,000 for the University of British Columbia to investigate nuclear physics techniques.[6]

Shrum was also a steady source of suggestions in Board meetings, some of which attempted to alter Defence Research Board policies. In 1949, for instance, he suggested that the DRB should help the University of British Columbia found an Institute of Oceanography by hiring G.R. Goldsbrough who had recently retired from his post in the United Kingdom. As important as oceanography was to the DRB's research agenda, Solandt and the rest of the Board refused to hire Goldsbrough. The DRB never made a practice of hiring faculty for universities, only awarding grants for research (meaning the employment of research assistants and covering the costs of experiments), but in the case of Goldsbrough Solandt did not raise this as an issue; Goldsbrough was undesirable because of his age.[7]

The Board's next brush with unwanted political attention for its membership, or lack thereof, started in 1950. The three-year terms of John Johnstone and Gordon Shrum expired, and they were replaced by A.E. Cameron from the Nova Scotia Technical College and an industrialist from Montréal, F.C. Wallace. Shrum took a year off before returning in 1951, because Solandt felt strongly that Board membership should not be continuous. The fact that the Board had no Western Canadian for a year escaped political notice, but Solandt was not so lucky the next year. Shrum

6. Regarding Winters, Johnstone and Shrum: LAC, RG 24, S F1, vol. 11995, file DRBS 1-0-43, "Memorandum from Minister of National Defence to Director General of Defence Research, 6 May 1947"; 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," 1. Shrum's grant: LAC, RG 24, S F1, vol. 11995, file DRBS 1-0-43-1, vol. 1, "Memorandum from MacNeill to DRB Members Regarding Grants in Aid of Research, 3 December 1947." For more information about the life of Gordon Shrum one could look at his autobiography: Gordon Shrum, Peter Stursberg and Clive Cocking, *Gordon Shrum: An Autobiography* (Vancouver: University of British Columbia Press, 1986).

7. Position on hiring faculty: LAC, RG 24, S F1, vol. 11996, file DRBS 1-0-43-2, vol. 2, "Minutes of the Sixth Meeting of the Defence Research Board held at 10:30AM, Friday, 19 March 1948," 3. Position on hiring Goldsbrough: LAC, RG 24, S F1, vol. 11996, file DRBS 1-0-43-2, vol. 3, "Minutes of the Tenth Meeting of the Defence Research Board held at Ottawa, 21 March 1949," 6-7.

and the University of Toronto chemist Andrew Gordon replaced Paul Gagnon and Otto Maass, the final two original Board members to retire. This left the Board with only one representative from Québec, the Anglophone industrialist Wallace. Journalist Georges-Henri Dagneau took Solandt and the government to task for having no Francophone members when the National Research Council had three. Solandt remedied the situation the following year by appointing Louis-Charles Simard, a Montréal pathologist.[8]

With the help of the Board Solandt increased the size of the Defence Research Board over its first three years. In 1949, Solandt created the second Five Year Plan for the Defence Research Board. The original plan, created in 1946 and 1947, predicted gradual growth. After the Second World War, the military and defence researchers had been demobilized rapidly. It was no small accomplishment for Solandt to increase the establishment ceiling to 300 scientists and a budget between five and six million dollars. The earliest events of the Cold War, the defection of Igor Gouzenko and the detonation of a Russian atomic bomb, aided in recruitment, but most of the credit belongs to Solandt.[9]

Solandt's future plan of 1949 called for an additional 100 scientific staff and another seven to ten million dollars in the budget. Postwar science, especially guided missiles and other aeronautical research projects, required more money and personnel than Solandt had foreseen. As Solandt reminded the Board, the principles on which the Defence Research Board was based necessitated this increased workload. Canada's commitment to its tripartite defence research arrangement, and to the newly formed NATO (North Atlantic Treaty Organization), meant that as long as the DRB contributed its share (especially in fields where Canada had unique expertise or requirements), then the United States and the United Kingdom would fill the gaps in the necessarily limited research programme of the DRB.[10]

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8. Marcel Martel, *Le Deuil d'Un Pays Imaginé* (Ottawa: Presses de l'Université d'Ottawa, 1997), 114; LAC, RG 24, S F1, vol. 19995, file DRBS 1-0-43, "Représentation canadienne-française by Georges-Henri Dagneau (newspaper clipping and translation)."

9. Five Year Plan: 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, and Annexure O (of Thirteenth Meeting) "A Five Year Plan for Defence Research and Development, 1950-54," 1. Solandt's recruiting success: Gordon D. Watson, "Defence Research Board: Policies, Concepts, and Organization," 74 and George R. Lindsey, "Management of Science in the Defence Research Board," 85-95 both in D.M. Grenville, C.E. Law and George Lindsey, *Perspectives in Science and Technology: The Legacy of Omond Solandt, Proceedings of a Symposium Held at the Donald Gordon Centre, Queen's University at Kingston, Ontario, 8-10 may 1994* (Kingston: Published by Queen's Quarterly, 1995). For more information about the early Cold War context one could start with: Robert Bothwell, *Alliance and Illusion: Canada and the World, 1945-1984* (Vancouver: UBC Press, 2007), 43-48.

10. LAC, "Minutes of the Thirteenth Meeting of the Defence Research Board," 6, and "A Five Year Plan for Defence Research and Development, 1950-54," 1, 2 and 4.

Tripartite exchange was not without its problems. Most famously the McMahon Act prohibited the exchange of American atomic secrets with the rest of the tripartite, even though the British and Canadians had participated in the Manhattan Project. The British embarked upon a full atomic research programme after the war, and Mackenzie ensured that the National Research Council continued work on nuclear reactors. To compensate for his recruitment of British scientists to the Defence Research Board, Solandt loaned the British Atomic Weapons Research Establishment five scientists for the first British atomic blast. Four Canadian scientists went to Australia to measure thermal effects from the blast, and a fifth went to England to cover for scientists who had left for the trial. Additionally, Solandt travelled to Australia to observe the blast in person and he offered to provide whatever assistance he could based on his previous experience with Jacob Bronowski as part of the scientific survey team that visited Hiroshima and Nagasaki in 1945. DRB participation in British atomic weapons research lasted until the British transitioned to testing thermonuclear devices, which led to the opening of scientific exchange within the tripartite by way of The Tripartite Technical Cooperation Program (later known simply as The Technical Cooperation Program after the inclusion of Australia and New Zealand).[11]

The Korean War

Solandt's plan for gradual growth received an unexpected push when North Korea (the Democratic People's Republic of Korea) invaded South Korea (the Republic of Korea) on 25 June 1950. The ensuing Korean War resulted in drastically larger defence budgets in Canada and the United States where defence budgets had previously been declining following the Second World War. The United States doubled its defence budget to deal with the Korean War, and maintained a high investment in the military to protect American interests throughout the Cold War. Canada increased its

11. The National Archives of the United Kingdom (TNA), ES 1/496, "UKAEA, AWRE, Collaboration with Canada, Hurricane, 1951," letter from Brig. G.P. Morrison, DRML to Dr. W.G. Penney, 12 November 1951; A.K. Longair, *Early Defence Atomic Research in Canada: With an Introduction on the Genesis of Nuclear Energy*, vol. 4/79 (Ottawa: Research and Development Branch, Dept. of National Defence Canada, 1979), 9, 12; Board, *A Brief History of the Defence Research Establishment Ottawa, 1941-2001*, 12-13; Margaret M. Gowing, ed. Lorna Arnold, *Independence and Deterrence: Britain and Atomic Energy, 1945-1952* (London: Macmillan for the United Kingdom Atomic Energy Authority, 1974), vol. 1, 450; vol. 2, 477. The Technical Cooperation Program, "TTCP Overview, Historical Background," http://www.acq.osd.mil/ttcp/overview/, accessed 23 September 2011; The Technical Cooperation Program, "Some Historical Comments and Background on TTCP," Prepared for the 25th Anniversary Meeting of the NAMRAD Principals Washington, D.C., 12-13 October 1983, http://www.acq.osd.mil/ttcp/overview/history25.html.

defence budget by five billion dollars, and created a new portfolio in the cabinet of Liberal Prime Minister Louis St-Laurent for C.D. Howe, the Department of Defence Production, so that Howe could exercise control over defence and the economy as he had in the Second World War.[12]

In the first year of the Korean War the Defence Research Board added 110 scientists, and 41 technical officers (a new designation in 1951). Overall staff of the DRB leapt from 1 627 employees in 1950 to 2 137 in 1951. Growth was a little less dramatic for the next two years of the war; the DRB reached 2 642 total employees in 1953, including 387 scientists and 97 technical officers.[13]

Growth on this scale in such a short period was possible because of the government's increased funding for defence, but also because of the Veterans Rehabilitation Act of 1945 (the Canadian equivalent of the G.I. Bill of Rights). The increased budget for defence gave the Defence Research Board money to hire scientists and engineers; the 1945 Veterans Rehabilitation Act provided funding for veterans to attend university or college. The timing of the Korean War was fortuitous in this sense. In 1950 and 1951 those veterans who had taken advantage of Khaki Scholarships from the Department of Veterans Affairs, or fellowships or studentships from the National Research Council, to complete their undergraduate or graduate educations were ready to enter the job market. This was the case for prominent DRB employees like John Chapman, George Lindsey and Robert Sutherland.[14]

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12. Spending increases in Korean War: Paul S. Boyer, *The Enduring Vision: A History of the American People*, Concise 3rd ed. (Boston: Houghton Mifflin, 1998), 624; Robert Bothwell, *The Penguin History of Canada* (Toronto: Penguin Canada, 2006), 378. Creation of Defence Production (in Howe's biography): Robert Bothwell and William Kilbourn, *C.D. Howe: A Biography* (Toronto: McClelland and Stewart, 1979), 255-257.

13. LAC, RG 24, S F1, vol. 11995, file DRBS 1-0-43-1, vol. 4, "Annual Report of the Chairman, DRB, September 1951," 3; LAC, RG 24, S F1, vol. 11997, file DRBS 1-0-43-1, vol. 6, "Minutes of the 24th Meeting of the Defence Research Board held at Halifax, 18 October 1952," Annexure H (of 24th Meeting) "Annual Report of the Chairman, DRB, October 1952," 2-3, and "Minutes of the 27th Meeting of the Defence Research Board held at Shirley Bay, 16 October 1953," Attachment (to 27th Meeting) "Annual Report of the Chairman," 3.

14. For some statistics on the Veterans Rehabilitation Act (and its impact on the DRB) one could look at: R.H. Lowe, "Operational Research in the Canadian Department of National Defence," *Operations Research* 8, 6 (1960): 848. For more information about Chapman, Lindsey and Sutherland one can look at their personal/professional archives: LAC, Manuscript Group (MG) 31, J 43, vol. 1, file 1-3, "Curriculum Vitae, John Herbert Chapman, 1972"; Directorate of History and Heritage of the Department of National Defence (DHH), Collection (Col) 87/253 IA-1.1 to II-8.12, box 1, file "Finding Aid– I.M.R. McKenna, January 1997"; DHH, Col 87/253 III, box 6, file 0, "Dr RJ Sutherland: a Retrospective by James Lee and David Bellamy"; George Lindsey, interviewed at his home in Ottawa by the author, 28 August 2008.

Three projects assumed new meaning and urgency because of the Korean War. First, the Defence Research Board sent Sutherland and a military operational research officer to be integrated with army units in order to gain valuable statistics regarding troop and weapons performance in combat. Second, the special weapons researchers in Ottawa and Suffield continued their investigations of flame warfare, including using the pilot plant in Ottawa for full scale production of octal (aluminum octoate, a thickening agent). Finally, the ongoing research contract for Cominco (Consolidated Mining and Smelting) received a new urgency, and an influx of cash, to increase production of picrite (nitroguanidine) for explosives. In all three projects progress came from the availability of personnel and funding.[15]

The Korean War gave a new impetus to another initiative that Solandt had outlined in the Five Year Plan of 1949. Solandt created the Project Coordination Centre to oversee development in the Department of National Defence. Each of the Services retained engineers for development work, and was responsible for securing their own contracts with manufacturers like A.V. Roe. Technically, the Defence Research Board was responsible for all research and development in the DND. The DRB's authority over research was never disputed, but the control of development was a source of tension between the DRB and the Royal Canadian Air Force, and the Project Coordination Centre was supposed to improve the DRB's ability to track the costs of development projects without interfering with the Services' ability to secure contractors and equipment. The Project Coordination Centre did little to solve the tension, as the Chief of Air Staff made apparent in his complaints about the accuracy of Donald Goodspeed's official history of the DRB in 1958.[16]

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15. Sutherland in Korea: DHH, "Dr RJ Sutherland: A Retrospective by James Lee and David Bellamy," 1; Goodspeed, *Defence Research Board*, 171. Octal production: Goodspeed, *Defence Research Board*, 150; Board, *A Brief History of the Defence Research Establishment Ottawa, 1941-2001*, 11. Picrite production: LAC, "Minutes of the Fifteenth Meeting of the Defence Research Board," 7-8, and Annexure Q (of Fifteenth Meeting) "Memorandum to DRB Regarding Research on Picrite Production Processes," and "Minutes of the 17th Meeting of the Defence Research Board held at Ottawa, Ontario and Fort Churchill, Manitoba, 6-9 December 1950," 1; 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," and "Attachment to Chairman's Agenda for the 15th Meeting of the Defence Research Board Regarding Picrite (Avon) Production, 8 June 1950"; Goodspeed, *Defence Research Board*, 123-124.

16. LAC, RG 24, S F1, vol. 11995, file DRBS 1-0-43-1, vol. 2, "Memorandum from Chairman to the Defence Research Board Regarding Coordination of Development, 14 June 1948"; LAC, "Minutes of the Thirteenth Meeting of the Defence Research Board," 6 and Annexure N "Memorandum from Solandt to Board Regarding Project Coordination, 1 November 1949," and "A Five Year Plan for Defence Research and Development, 1950-54," 2, 6; 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," 2-4; LAC, RG 24, S F1, accession (A) 1983-84/167, vol. 7326, file DRB 100-10, "Organization, History of

The problem for Solandt and the Defence Research Board was that the Services were unhappy with the existence of the DRB in terms of competition for scarce resources, and the DRB's responsiveness to the needs of the military. Each year from 1951 to 1955 Solandt gave an anniversary address to the DRB and in every speech relations with the military was a topic of discussion. Annually he claimed that relations with the military were improving, but that there was still room for improvement. The root of the problem was the incompatibility of values of scientists and the military; the former pursue long-term knowledge, the latter expect immediate applications.[17]

Another problem that faced Solandt and the Defence Research Board was that the military was three-headed. Interservice rivalries rarely arose in Board meetings, but it was clearly always present. One of the occasions interservice differences arose was in the design specifications for gas masks in 1949. The army wanted a mask that could be worn full-time in a variety of environments, but they were willing to sacrifice perfect protection for comfort and durability. The navy preferred a mask that offered complete protection, because they had different operational expectations for gas attacks. Between the limited production that Canada's military would need and the lack of funding for more than one gas mask Solandt was in a difficult position. He stalled, discussed the matter with Otto Maass and consulted with his allies. The obvious solution was for the DRB to work on a gas mask for Arctic requirements, since Canada's allies were already working on the kinds of gas masks that would meet the needs of the army and navy.[18]

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the Defence Research Board," "Memorandum from Hugh Campbell, Chief of the Air Staff (CAS) to the Chairman of the Defence Research Board (CDRB), 11 March 1958," and "Memorandum from Goodspeed to CDRB, 12 March 1958," and "Memorandum from Zimmerman to CAS, 19 March 1958"; Goodspeed, *Defence Research Board*, 38, 58-60; W.E. Knowles Middleton, *Mechanical Engineering at the National Research Council of Canada, 1929-1951* (Waterloo: Wilfrid Laurier University Press, 1984), 172-174.

17. 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, and "Fifth Annual Birthday Address by Dr OM Solandt, CDRB, April 1952, Report No. DR 50," 17-18, and "Sixth Annual Birthday Address by Dr OM Solandt, CDRB, May 1953, Report No. DR 64," 9-10, and "Seventh Annual Birthday Address by Dr OM Solandt, CDRB, August 1954, Report No. DR 78," 2, and "Eighth Annual Birthday Address by Dr OM Solandt, CDRB, August 1955, Report No. DR 93," 13.

18. LAC, "Minutes of the Thirteenth Meeting of the Defence Research Board," 1-2, and Annexure K "Memorandum from Maass (Army HQ) to Sec/DRB Regarding Respirators, 16 November 1949," Appendix A; LAC, RG 24, S F1, vol. 11996, file DRBS 1-0-43-2, "Minutes of the Eleventh Meeting of the Defence Research Board Held at Halifax, 12 June 1949," 4-5; LAC, "Minutes of the Twelfth Meeting of the Defence Research Board held at Ottawa, 17 September 1949," 1.

The creation of Howe's new portfolio, the Department of Defence Production, both complicated and simplified the situation in defence research, development and production. It complicated the situation by adding yet another set of opinions and bureaucrats to an already tense situation, but it simplified the situation by giving Howe more latitude to operate. After a year Howe sought the appointment of one of his senior bureaucrats to the Defence Research Board in order to increase communication and collaboration. A. Hartley Zimmerman, a mining engineer on loan to the government, joined the Board for a three-year term in 1952.

The Korean War was not the first time the Moore Corporation loaned Zimmerman to Howe. Zimmerman had joined the Department of Munitions and Supply in 1941 to oversee small arms production, and later signals production (radar). When he returned to the government in 1951 it was for electronics.[19]

Meet the New Boss

Zimmerman never finished his term as a member of the Board. In 1953 the Deputy Minister of the Department of Defence Production, Reginald Brophy, made it known that he wanted to take over for Zimmerman. Howe preferred to have Zimmerman remain on the Board, but he understood the importance of having the Deputy Ministers of both Defence and Defence Production on the Board so a compromise was made—Solandt and the Minister of National Defence (Claxton until 30 June and Ralph Campney starting 1 July 1954) manoeuvred senior personnel to retain Zimmerman and allow Brophy to represent the DDP. E.Ll. Davies, who had been the Vice Chairman of the Defence Research Board since 1947 was given his wish to become the DRB's liaison representative in England as way to transition into his retirement. Solandt was also anticipating his own departure from the DRB to his next endeavour (which turned out to be Vice President of research and development for Canadian National Railways), so he arranged for Zimmerman to assume the Vice Chairmanship in 1955 and then the Chairmanship in 1956.[20]

19. Conseil de recherches pour la défense, *The Defence Research Board of Canada* (Ottawa: Defence Research Board of Canada, 196u), 4-5; Goodspeed, *Defence Research Board*, 92.

20. LAC, RG 24, S F1, A 1983-84/167, vol. 7408, file DRBS 173-5, part 1, "The Defence Research Board, Members by Appointment, General," "Memorandum from Solandt to the Secretary, 29 December 1953," and "Letter from Solandt to Minister, 29 December 1953," and "Memorandum from Solandt to the Secretary, 14 January 1954," and "Press Release, AM Saturday, 13 November 1954, Statement by Hon. Ralph Campney, MND," and "Press Release, PM, Friday, 14 January 1955, Statement by the Hon Ralph Campney, MND"; David M. Grenville, "Omond McKillop Solandt–A Biographical Sketch," in *Perspectives in Science and Technology*, Grenville, Law and Lindsey, 10.

Zimmerman's first task as Vice Chairman was to serve on the Harkness Committee, a special committee of Board members chaired by R. Dickson Harkness tasked with reviewing the Defence Research Board's biological/bacteriological warfare programme. The Harkness Committee was struck in March 1955, less than two weeks after Guilford Reed died. Reed's death imposed two issues on Solandt's DRB. First, Reed's death raised the question of the need to co-locate the biological weapons research facility at Queen's University. Second, without Reed it was not even clear that the DRB could continue its bacteriological research. Zimmerman wrote the report of the Harkness Committee, his first significant foray into policy formation for the DRB and a trial by fire of sorts for his upcoming Chairmanship.[21]

The Zimmerman Report on biological warfare offered no real revision of the special weapons programme, except to recommend that emphasis be shifted away from Reed's strengths to those of the remaining staff. As Chairman of the Defence Research Board Zimmerman decided to merge the Ontario special weapons laboratories and to close the Kingston facility, but for a brief period it looked like chemical warfare researchers would move from Ottawa instead.[22]

When Zimmerman became the Chairman of the Defence Research Board in 1956 he maintained Solandt's research programme and management structure. Of the six Board members from university and industry that he inherited from Solandt, Zimmerman renewed two, C.J. Mackenzie and H.G. Thode, and he replaced the other four when their terms ended. Zimmerman's previous experience was working with industry, and the DRB had a series of projects that were nearing the point of production, so it was prescient of Howe, Claxton, Campney and Solandt to name Zimmerman as Solandt's successor, as the events of 1957 to 1967 would prove.[23]

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21. Reed: Queen's University, "Guilford Bevil Reed," page last updated 10 July 2006, http://www.queensu.ca/secretariat/cataraqui/reed.html. Harkness Committee: LAC, RG 24, S F1, A 1983-84/167, vol. 7407, file 173-2, part 1, "Agenda Item 4 of the 32nd Meeting of the Defence Research Board–Report of the Harkness Committee," and "Harkness Committee–Summary of Facts and Conclusions, 2 June 1955."

22. Fate of Kingston laboratory: 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," and "Memorandum from H.M. Barrett (Chief of Establishments) to Director of Personnel Regarding Proposed Move of DRCL to Kingston, 14 January 1957"; Harry Sheffer, "Personal Reminiscences of Early Days," in *A History of the Defence Research Establishment Ottawa*, ed. Jim Norman and Rita Crow (Ottawa: Defence Research Establishment Ottawa, 1992), 11; Goodspeed, *Defence Research Board*, 158-159; Board, *A Brief History of the Defence Research Establishment Ottawa, 1941-2001*, 15.

23. For more information about Thode refer to his biography: Manuel Zack, Alvin A. Lee and Lawrence Martin, *Harry Thode: Scientist and Builder at McMaster University* (Hamilton: McMaster University Press, 2003).

Zimmerman was, like Solandt before him, well connected to Liberal politicians, and senior civil servants. He was one of Howe's Boys. Zimmerman had attended Royal Military College with the new President of the National Research Council E.W.R. Steacie. In the Defence Research Board Zimmerman and Solandt were not the only ones with a presumed connection to the Liberal party. All appointments to the DRB, from the unpaid Board members to scientists and secretaries, had to be approved by the Minister of National Defence.[24]

The International Geophysical Year

The first significant test of Zimmerman's scientific programme started in 1957. Planning for the International Geophysical Year began in 1950 when Lloyd Berkner, Sydney Chapman and James Van Allen suggested a reprisal of the International Polar Years of 1882-1883 and 1932-1933. They chose to hold the IGY during the increased solar activity expected from 1 July 1957 to 31 December 1958. The emphasis was still on polar research, especially Antarctica, but other topics like glaciers, the aurora and the ionosphere were added to the list of investigations. Canada, and the Defence Research Board in particular, chose to focus on Arctic and ionospheric research.[25]

All three research fields to which the Defence Research Board contributed during the International Geophysical Year had been initiated by Solandt between 1947 and 1950. The first two fields (northern research and the ionosphere) Solandt had justified as two areas in which Canada could make a unique contribution to the tripartite, because of Canada's location. Although international boundaries are still being disputed, Canada has long claimed a wide variety of territory within the Arctic Circle, and Solandt's attempts to assert scientific sovereignty in the area was consistent with the government's attempts to establish political sovereignty. Canada is also plagued by the more unpredictable nature of the ionosphere, which fluctuates in a way that makes long distance communication by radio in the North challenging. The third field to which the DRB contributed was missiles and rocketry. Here Solandt could not claim any unique Canadian need, but instead argued that Canada had to develop an expertise in order to understand the work being done in the US and UK.[26]

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24. Connection to Steacie: M. Christine King, *E.W.R. Steacie and Science in Canada* (Toronto: University of Toronto Press, 1989), 7. Explanation of Howe's Boys: Bothwell and Kilbourn, *C.D. Howe*, 131.
25. William J. Mills, *Exploring Polar Frontiers: A Historical Encyclopedia* (Santa Barbara: Abc-Clio, 2003), 319-320.
26. Goodspeed, *Defence Research Board*, 128.

Three establishments were involved in the International Geophysical Year programme—electronics in Ottawa, ballistics in Valcartier and Arctic research in Churchill. The Defence Research Northern Laboratory, however, participated in a slightly unexpected way; climate chambers in Toronto had replaced much of the utility of the Churchill establishment, so the Arctic research contribution to IGY was actually accomplished by expeditions. Geoffrey Hattersley-Smith, a glaciologist, had been visiting Lake Hazen on Ellesmere Island since 1951 for the DRB. A special expedition was organized for 1957 and 1958 to contribute to the International Geophysical Year.[27]

Instead of closing the Defence Research Northern Laboratory, Solandt and Zimmerman had it converted to a rocket range. Throughout the International Geophysical Year it was used by the United States to test research rockets. The Defence Research Board began work on a sounding rocket of its own, but it was not ready until 1959. The Black Brant project was started in 1956 in anticipation of the IGY and because the Velvet Glove (Valcartier's guided missile project) had been cancelled. The Valcartier establishment had an expertise in missiles and rocketry that was convertible to this new project, and the establishment also had a new research initiative, defence against intercontinental ballistic missiles, because even before the launch of Sputnik on 4 October 1957 it was obvious that intercontinental ballistic missiles were an attainable goal. Researchers at Valcartier were interested in the properties of the upper atmosphere in terms of detecting, tracking and destroying incoming warheads.[28]

The Defence Research Board's other ongoing project in upper atmospheric research was creating an ionogram—a map of the ionosphere that would allow accurate predictions of the behaviour of the ionosphere so that radio communications could be adapted based on the conditions at the time of emission and reception. John Chapman and the other electronics researchers of the DRB had been working from below the ionosphere, by bouncing electromagnetic radiation off the ionosphere and

27. James Marsh, "Ellesmere Island," *The Canadian Encyclopedia*, accessed 11 August 2011, http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0002578; Mills, *Exploring Polar Frontiers: A Historical Encyclopedia*, 319-320.

28. LAC, MG 31, J 43, vol. 1, file 1-4, "Chapman, JH–Obituaries, Photocopies 1979-80," "CA Franklin, Proceedings of the Society of Canada, Series IV Volume XVIII 1980," 69-70; Friends of CRC, "Sounding Rockets," http://www.friendsofcrc.ca/Projects/Sounding%20Rockets/rocket.html, accessed 11 August 2011; Goodspeed, *Defence Research Board*, 127-133; Jon B. McLin, *Canada's Changing Defense Policy, 1957-1963: The Problems of a Middle Power in Alliance* (Baltimore: Johns Hopkins Press, 1967), 65-66; Gelly and Tardif, *Defence Research Establishment Valcartier, 1945-1995*, 84-100, 118-122, 135-143, 151-155; Andrew B. Godefroy, *Defence and Discovery: Canada's Military Space Program, 1945-74* (Vancouver: UBC Press, 2011), 33-43.

learning about its properties based on the strength and energy of the signal and its depth of penetration. However, the ionosphere was presumed to have a dense core and sparser layers above and below, so Chapman and his colleagues could only learn about the properties of the ionosphere up to that dense core, once their signals penetrated it they did not reflect back to earth and therefore yielded no new information.[29]

The only solution to this technical and scientific problem was to sound the ionosphere from above. Research rockets, like the Black Brant could achieve some of the desired results, but because the equipment always returns to earth, they only provide snapshots from above. What the electronics team in Ottawa needed was an artificial satellite to sound the ionosphere from above continuously and to transmit the results back to earth. The United States issued a call during the International Geophysical Year for proposals for scientific research payloads that could be launched into orbit by the rockets that the United States was building to compete with the Russians rocket that had launched Sputnik. Chapman submitted a proposal for the S-27, which was rechristened by Zimmerman as the Alouette when it was launched on 29 September 1962. The Alouette performed exactly as desired, which gave the DRB information about the ionosphere, but it also demonstrated that long-range communications could be improved by using satellite relay stations, rather than dealing with the erratic properties of the ionosphere.[30]

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29. Edward Jones-Imhotep, "Laboratory Cultures," *Scientia Canadensis* 28 (2005): 7-26; Edward Jones-Imhotep, "Nature, Technology, and Nation," *The Journal of Canadian Studies* 38, 3 (2004): 5-36; Edward Jones-Imhotep, "Disciplining Technology: Electronic Reliability, Cold-War Military Culture, and the Topside Ionogram," *History and Technology* 17 (2001): 125-175; Friends of CRC, "Radio Propagation Research," http://www.friendsofcrc.ca/Projects/PropagationResearch/PropagationResearch.html, accessed 11 August 2011; Friends of CRC, John S. Belrose, "Remembrances of a Radio Scientist," http://www.friendsofcrc.ca/Articles/Belrose-EarlyYears/Belrose%20remembrances.html, accessed 11 August 2011; Friends of CRC, Bert Blevis, "The Pursuit of Equality: The Role of the Ionosphere and Satellite Communications in Canadian Development," http://www.friendsofcrc.ca/Articles/Blevis-Pursuit%20of%20Equality/BertBlevis.html, accessed 11 August 2011; Friends of CRC, LeRoy Nelms, "DRTE and Canada's Leap into Space: The Early Canadian Satellite Program," http://www.friendsofcrc.ca/Articles/Nelms-Canada%27s%20leap/Nelms-Canada%27s%20leap.html, accessed 11 August 2011; Goodspeed, *Defence Research Board*, 192-201; Canada, Defence Research Board, *Defence Research Board : The First Twenty-Five Years / Conseil De Recherches Pour La Défense: Les 25 Premières Années* (Ottawa: Dept. of National Defence, 1972), 44.

30. Jones-Imhotep, "Laboratory Cultures," 8; Jones-Imhotep, "Nature, Technology, and Nation," 20-21; Jones-Imhotep, "Disciplining Technology," 131-133; Friends of CRC, "Radio Propagation Research"; Belrose, "Remembrances of a Radio Scientist"; Blevis, "The Pursuit of Equality"; Nelms, "DRTE and Canada's Leap into Space"; Walter McDougall, *The Heavens and the Earth: A Political History of the Space Age* (Baltimore: Johns Hopkins University Press, 1997 [1985]), 59, 118, 121, 353; Barbara B. Poppe and Kristen P. Jorden, *Sentinels of the Sun: Forecasting Space Weather* (Boulder: Johnson Books, 2006), 51-52.

In addition to the Alouette satellite the telecommunications researchers of the Defence Research Board developed new ground-based investigation techniques during the International Geophysical Year. In 1957 the Defence Research Board sought a location for a new radar laboratory in Saskatchewan that would be administered by Chapman from the Ottawa electronics establishment. The DRB favoured a site outside of Saskatoon, because of the academic expertise at the nearby University of Saskatchewan, and because it suited the joint Canada-United States scientific objectives. The recommendation reached Cabinet where it was sent back to the DRB for further consideration. Newly elected Prime Minister John Diefenbaker preferred to locate the laboratory in his riding of Prince Albert, which is where the laboratory was constructed and began operations in 1958.[31]

The decision to locate the radar laboratory in Prince Albert was symbolic of the two main sources of tension that dominated Diefenbaker's time as Prime Minister. First, the project had been suggested by the United States as a complement to work being done at Churchill with rockets. When he inaugurated the Prince Albert Radar Laboratory Diefenbaker received a message from President Dwight Eisenhower via the moon as a satellite relay station. Canadian-American relations grew more distant under Diefenbaker, as if he always insisted on communicating via the moon.[32]

Second, the location of the radar laboratory was representative of the ongoing tension between Diefenbaker and civil servants. The Liberal governments that preceded Diefenbaker had made more than a few recommendations to Solandt to be more politically astute in his decisions (Board membership and location of laboratories). On its own, the Prince Albert Radar Laboratory might have been inconsequential, but under the circumstances it was yet another example for Diefenbaker that civil servants were loyal to the Liberal government that had hired and appointed them. For civil servants it was another instance of the difficulty of working with the Chief.[33]

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31. Friends of CRC, D.R. Hansen, "The Prince Albert Radar Laboratory, 1958-1963," http://www.friendsofcrc.ca/Articles/Hansen-PARLHistory/PARL%20History%20p1.html, accessed 12 August 2011; University of Western Ontario, Physics and Astronomy, Del Hansen, "Supplementary Materials: Hansen, UWO Workshop, Nov 25, 2002," page last updated 2003.10.05, http://www.physics.uwo.ca/~drm/history/space/w_s04.html.

32. Hansen, "The Prince Albert Radar Laboratory, 1958-1963"; Dorris Jelly, "The Prince Albert Radar Laboratory," page last updated 5 February 2001, http://www.friendsofcrc.ca/Projects/PARL/PARL.html.

33. Denis Smith, *Rogue Tory: The Life and Legend of John G. Diefenbaker* (Toronto: Macfarlane Walter & Ross, 1995), 249-250, 261; Peter Charles Newman, *Renegade in Power: The Diefenbaker Years* (Toronto: McClelland and Stewart, 1963), 252.

(Re)Organization

The result of Diefenbaker's conflict with civil servants was the Royal Commission on Government Organization of 1960. The chairman was J. Grant Glassco, and he had a sweeping mandate across the entire government to bring best business practices to the civil service. The Glassco Commission reports, all five volumes of them, began to appear in 1962.[34]

Even after the creation of the Glassco Commission, Diefenbaker's feud with civil servants continued. Based on his weapons procurements, he had to decide whether to accept nuclear-armed missiles from the United States and with these a joint-key arrangement. Diefenbaker's cabinet was split. Both Diefenbaker and his Secretary of State for External Affairs did not trust the advice of the Department of National Defence, who were nearly unanimously in favour of acquiring nuclear weapons. Robert Sutherland, an operational researcher and an eloquent writer who always grasped the big picture, was given the task of preparing the internal memoranda to persuade Cabinet. When this failed, Sutherland, like Peyton Lyon from the Department of External Affairs and the Kennedy administration in the United States, went public with his frustrations.[35]

The Defence Research Board's difficulties with Diefenbaker continued up to the election campaign of 1963 that removed him from office. During the election Zimmerman made his annual recommendations of replacement members for the Board. J. Tuzo Wilson wanted to retire, and Zimmerman wanted to replace him with Robert Uffen (who would eventually replace Zimmerman as Chairman). Cabinet agreed to appoint Uffen, but disagreed with the unspoken corollary of Zimmerman's nomination and recommended that he persuade Wilson to return. Wilson agreed, but he rarely attended meetings during his second term and was finally granted his wish to

34. S.L. Sutherland, "Government Organization, Royal Commission on," *The Canadian Encyclopedia*, http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0003349, accessed 12 August 2011; George Grant, "Lament for a Nation," in *Collected Works of George Grant*, ed. George Parkin Grant et al. (Toronto: University of Toronto Press, 2000), vol. 3, 289; J.G. Glassco, Royal Commission on Government Organization (RCGO), *Management of the Public Service, Vol.1, Report of the Canada Royal Commission on Government Organization*; J.G. Glassco, RCGO, *Supporting Services for Government, Vol. 2, Report of the Canada Royal Commission on Government Organization*; J.G. Glassco, RCGO, *Supporting Services for Government (Cont'd), Services for the Public, Vol. 3, Report of the Canada Royal Commission on Government Organization*; J.G. Glassco, RCGO, *Special Areas of Administration, Vol. 4, Report of the Canada Royal Commission on Government Organization*; J.G. Glassco, RCGO, *Organization of the Government of Canada, Vol. 5, Report of the Canada Royal Commission on Government Organization* (Ottawa : Queen's Printer, 1962-1963).

35. R.J. Sutherland, "Canada's Long Term Strategic Situation," *International Journal* 17, 3 (1962): 199-223 (which was serialized in the *Globe and Mail* from 1 to 5 October 1962); McLin, 130-147; Peyton V. Lyon, *The Policy Question: A Critical Appraisal of Canada's Role in World Affairs* (Toronto: McClelland and Stewart, 1963), 128.

retire from the Board in 1966. At the time Zimmerman and the DRB were happy to be rid of the Diefenbaker government, but Diefenbaker's legacy, the Glassco Commission, continued to plague the DRB after 1963.[36]

The Glassco Reports had a profound effect on the organization of the government. The Defence Research Board as a scientific agency within the Department of National Defence was affected by Glassco's recommendations for modifications to both the science policy apparatus and the organization of the DND. The Pearson government that was elected in 1963 accepted the need for reform expressed in the Glassco Reports but sought second opinions on both defence and science policy.

For a second opinion on the recommendations of the reorganization of the Department of National Defence Paul Hellyer the Minister of National Defence and Lucien Cardin the Associate Minister turned to employees of the DND to conduct a study. The primary author was Robert Sutherland, and the result was the 1964 *White Paper on Defence*.[37]

The *White Paper* agreed with the Glassco Report that there was excessive waste in the Department of National Defence and that the simplest solution was integration and unification. Integration and unification involved removing the parallel command structures for the army, navy and air force and replacing them with a single Chief of Defence Staff. Sutherland described the move as centralizing, and compared it to recent antecedents in the United Kingdom and the United States when explaining what integration meant for the Defence Research Board.[38]

For the Defence Research Board, the *White Paper* and the process of integration and unification required significant changes. Control of

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36. LAC, RG 24, S F1, A 1983-84/167, vol. 7407, file 173-1, part 1, "Committee, Defence Research Board, General," "Memorandum from Schmidlin (Secretary of the DRB) to CDRB Regarding Board Meeting, 12 October 1962," and "Memorandum from Lowe (Executive Secretary, Grants and Contracts) to Chief Scientist Regarding Potential New Board Members of the Defence Research Board, 9 November 1962"; LAC, RG 24, S F1, A 1983-84/167, vol. 7407, file 173-1, part 2 "Committee, Defence Research Board, General," "Memorandum from Personal Assistant/CDRB to CDRB Regarding Board Members–Sequence of Appointments, 22 April 1964"; 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).

37. DHH, "Dr RJ Sutherland: A Retrospective by James Lee and David Bellamy," 3; Canada, Dept. of National Defence, *White Paper on Defence* (Ottawa: Queen's Printer and Controller of Stationery, 1964).

38. 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," 1-3.

development in the Department of National Defence had always been contentious, and the Project Coordination Centre had only achieved moderate success in ameliorating both competition between the Services for financing and tensions arising from the DRB's role as moderator. Starting in 1964 budgeting and planning of the DND's development programme was reorganized. It was removed from the DRB's mandate and placed under the aegis of the Chief of Technical Services (a new post in the integrated headquarters), who was supported by a Development and Associated Research Policy Group that included the Vice Chairman and other senior scientists of the DRB. The goal was to unify the entire spectrum from research to development. The Forces hoped that this would improve DRB's responsiveness to their needs, which they felt were better represented by their development projects than by the DRB's research programme.[39]

Another change to the Defence Research Board was necessitated by the integration of the three Services. The three separate Chiefs of Staff positions disappeared, and therefore had to be replaced on the Board. The new military representatives on the Board were the Chief and Vice Chief of Defence Staff, as well as the Chief of Technical Services.

Zimmerman made numerous changes in DRB headquarters and the Operational Research Group to deal with the new headquarters staff of the Department of National Defence. Operational researchers, unlike the rest of the scientists of the Defence Research Board, were supposed to be integrated with the military. Without a war since 1953, operational researchers found themselves working independently of the military within the DRB structure more often than not. This trend was reversed in 1964. Robert Sutherland, by then the Director General of Operational Research, reported to DRB headquarters for salaries and promotions, but to the Vice Chief of the Defence Staff for project management. It was one of the more successful attempts to make research more responsive to the needs of the DND.[40]

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39. LAC, RG 24, S F1, A 1983-84/167, vol. 7407, file DRBS 173-1, part 3, "Committee, Defence Research Board, General," "The Defence Research Board Trends and Changes by the Secretary of the DRB, 7 October 1965," 2; DHH, Col 85/333, box 1, file 260, series 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," 1-2, 7-8; Dr. A.H. Zimmerman, "Defence Research Program," *Air University Review*, March-April 1967, page created 24 July 2005, http://www.airpower.maxwell.af.mil/airchronicles/aureview/1967/mar-apr/zimmerman.html.

40. LAC, "The Defence Research Board Trends and Changes by the Secretary of the DRB, 7 October 1965," 3; DHH, "Finding Aid–I.M.R. McKenna, January 1997"; DHH, Col 85/333, box 1, file 260, series III, "Text of Speeches, Volume 2, 11 January 1962–8 May 1967," "'The Integration of the Canadian Forces' Prepared as a briefing to the Defence Research Board staff to be presented in the Elgin Theatre on Wednesday, 26 January, 1966," 9; Zimmerman, "Defence Research Program."

Pearson also sought a second opinion regarding the recommendations made by Glassco concerning science policy. He turned to the man who had been the most influential bureaucrat in the creation of science policy, C.J. Mackenzie. Mackenzie made only one alteration—the new scientific advisory body that Glassco recommended should be placed within the Privy Council Office instead of the Treasury Board. The result was the Science Secretariat, which was to fill a similar role to the Honorary Advisory Council that had been created in 1916. A second body, the Science Council, was created with Omond Solandt as its first Chairman to provide arm's length recommendations.[41]

The two bodies collaborated to issue a series of influential reports, one of which was authored by John Chapman regarding the future of Canada's space research. A year later Chapman wrote a second report, this time a *White Paper*, on the topic. Chapman's two reports laid the groundwork for a separate Department of Communications, which would research and develop domestic satellites. To that point there had only been two Canadian satellites and both had been designed and built by the electronics establishment of the Defence Research Board. In 1969 that establishment was severed from the DRB and placed within the Department of Communications where it was rechristened the Communications Research Centre. Chapman, who was the Deputy Chairman (Scientific) of the DRB was transferred to the Department of Communications where he was named the Assistant Deputy Minister (Research).[42]

Internal Reviews and External Overhauls

1969 was a year of change for the Defence Research Board. Robert Uffen, Zimmerman's successor, left the DRB after only two years as Chairman to become the Chief Science Advisor to the Cabinet, a position he held for a further two years before returning to academia. His replacement was his Vice Chairman, Léon L'Heureux, who had joined the DRB in 1947 and worked on the missiles and rockets projects before

41. Mackenzie's role: Donald J.C. Phillipson, "Chalmers Jack Mackenzie," *The Canadian Encyclopedia*, http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0004939, accessed 12 August 2011; R.F. Legget, "Chalmers Jack Mackenzie," *Biographical Memoirs of the Fellows of the Royal Society* 31 (1985): 432.

42. J.H. Chapman et al., Science Council of Canada, *Upper Atmosphere and Space Programs in Canada*, vol. 1 (Ottawa, Queen's Printer, 1967); Charles Mills Drury, Canada, Dept. of Industry, *White Paper on a Domestic Satellite Communication System for Canada / Livre Blanc sur un Système Domestique de Télécommunications par Satellite pour le Canada* (Ottawa: Queen's Printer, 1968); Vera Pavri-Garcia, "'Technological Doublespeak': Metaphors, Public Policy and the Development of Canada's First Domestic Communications Satellite System, 1966-1970 (Ph. D. thesis: University of Toronto 2005), 71-74, 89-96, 119-120; Godefroy, *Defence and Discovery*, 91-92, 155-172, 180.

entering management. 1969 was also the year that the Trudeau government's Official Languages Act came into force, which mandated that government services had to be offered in English and French. L'Heureux was fluently bilingual, but other senior scientists like Chapman and George Lindsey had to be excused from their duties so they could receive training in French in order to continue in their management positions.[43]

One of L'Heureux's most significant tasks was to revise the grants and contracts system of the Defence Research Board. The military had long complained that the DRB's research programme was out of touch with their needs; this was especially true of the grants which were devoted to basic research at universities. The process of integration and unification brought a new focus on the DRB to increase efficiencies to the benefit of the entire department.

There was also a second motivation to improve the granting system. The two Francophone members of the Board had complained to Zimmerman in 1964 that Francophones were underrepresented on the committees and panels that awarded grants, and as a result were not receiving their share of DRB extramural funding. Zimmerman solicited suggestions for new members of committees and panels, but otherwise ignored the issue that he felt was largely groundless.[44]

Of the two reasons for reorienting the grants and contracts programme, the military justification received more weight. Following an extensive internal review of the programme in 1971 it was overhauled. When grants and contracts were first created they followed the National Research Council model of evaluating proposals based on scientific merit first, and a loosely defined military applicability second. The panels and committees that evaluated the proposals were formed with this priority system in mind; each panel evaluated submissions within their area of scientific expertise. Under L'Heureux these priorities changed. Proposals were evaluated using a rubric for military applicability first and scientific merit second. L'Heureux created new panels that were specific to each individual mission of the Department of National Defence and the DRB;

43. LAC, RG 24, A 1983-84/167, S F1, vol. 7407, file 173-2, part 3, "'Bilingualism and Biculturalism Report to the Defence Research Board,' 5 June 1968," 1; George Lindsey, interview.

44. 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, and "Letter from Zimmerman to Dean Bonneau and Dr. Gaudry, 8 April 1964," 1-2, and "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."

the result was panels of experts with a range of scientific expertises directed at a particular priority of the DND. Because each of the establishments had different missions, the panels were more closely aligned with them rather than headquarters.[45]

L'Heureux's attempt to overhaul the Defence Research Board through internal review and reorganization was not enough to save it from further scrutiny. In 1971 the Trudeau government issued a new *White Paper on Defence*. One of the questions it posed was why the DRB had not yet reorganized as suggested in the Glassco Reports. The crux of the problem as L'Heureux saw it was that there was a general confusion in the military and amongst politicians about what role the DRB was intended to fill. Everyone agreed that the DRB was supposed to meet the scientific and technical needs of the military, but L'Heureux went to great lengths to explain the lag time between starting work on a specific project, the attainment of expertise and the production of tangible results; in his estimation this took about five to ten years and he pointed to past projects like his own experience in guided missiles. His complaints fell largely on deaf ears.[46]

The Trudeau government was unhappy with the resistance to change in the Department of National Defence towards the 1971 *White Paper*. A Management Review Group was formed later in the year and in 1972 it released a secret (even from the DND) report that recommended further changes to the administrative structure of the DND, especially the Defence Research Board. The Group was, like the Glassco commissioners, composed of experts in organization and administration from outside the military. Complaints that business experts cannot be expected to understand the nuances of the military, especially military science and technology were ignored.[47]

In 1974, the Defence Research Board was eviscerated because of the recommendations of the Glassco Commission, two successive *White Papers* and the Management Review Group. The Board, operational research and the research establishments were all separated. The establishments became the Defence Research and Development Branch of the Materiel Group within the Department of National Defence, while

45. LAC, MG 30, B120, 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," 1-13.
46. DHH, col. 85/333, files 069-080, "Memorandum from L.J. L'Heureux to the Minister Regarding The White Paper on Defence, Comments on Draft of 18 January 1971, 5 February 1971," 2-5; and files 089-102, "Memorandum from G.D. Watson for the Chairman, DRB to Mr. Gordon Smith (Policy Adviser to the Minister) Regarding The 1971 White Paper on Defence Policy, Comments on Draft of 16 March 1971, 22 March 1971," 3-4; Canada. Dept. of National Defence, *White Paper on Defence* (Ottawa: Information Canada, 1971).
47. Douglas L. Bland, "Institutionalizing Ambiguity: The Management Review Group and the Reshaping of the Defence Policy Process in Canada," *Canadian Public Administration* 30, 4 (1987): 528, 531-532, 534; Gelly and Tardif, 237-240.

operational research was fully integrated into the office of the Assistant Deputy Minister (Policy). The Board reported to the Minister and oversaw the extramural research programme. The intramural research programme of the establishments was managed completely within the framework of the DND. Solandt, by this time retired from his post as Chairman of the Science Council, was outraged by this reorganization of the DRB and lambasted the government in a frequently quoted article in *Science Forum* for the government's failure to understand the subtleties of managing science and technology, and the reckless drive by the government to apply administrative best practices from business models.[48]

Defence research as a government activity survived the 1974 reorganization but the Board's days were numbered. The Board had always been responsible for advising the Minister and administering grants and contracts, which continued after 1974. However, in 1967 the Special Committee on Science Policy was struck and chaired by Senator Maurice Lamontagne. Lamontagne recommended that all government grants be doled out by centralized agencies, rather than individual departments like the National Research Council or the Defence Research Board. In 1977 the Natural Sciences and Engineering Research Council and the Social Sciences and Humanities Research Council were created to complement the existing centralized efforts of the Medical Research Council (now Canadian Institutes of Health Research) and the Canada Council. The Natural Sciences and Engineering Research Council assumed the responsibility for grants from the Board. L'Heureux resigned in protest once it was obvious that the Board was not going to be consulted by the Minister of National Defence for scientific advice and the Board no longer held any purse strings.[49]

Conclusion

The organizational history of the Defence Research Board reveals the impact of political priorities on decision-making. It was politics that dictated geographic and linguistic representation on the Board, and political expediencies and personal connections that often trumped scientific

48. Bland, "Institutionalizing Ambiguity," 547-549; O.M. Solandt, "The Defence Research Board's Untimely End: What it Means for Military Science," *Science Forum* 8, 5 (1975): 19-21.
49. For more on Lamontagne see: Robert Bothwell, "Lamontagne, Maurice," *The Canadian Encyclopedia*, http://www.thecanadianencyclopedia.com/index.cfm?PgNm=TCE&Params=A1ARTA0004490, accessed 12 August 2011; Parliament of Canada, "Lamontagne, The Hon. Maurice, P.C., M.Sc., F.R.S.C., F.R.S.A.," http://www.parl.gc.ca/parlinfo/Files/Parliamentarian.aspx?Item=776de450-8dd8-4a7b-94b3-ead0c17a8f18&Language=E&Section=FederalExperience, accessed 12 August 2011; Gelly and Tardif, 237-240 (although it should be noted that Tardif and Gelly seem to be confused about the timing of L'Heureux's resignation—placing it in 1974 instead of 1977).

considerations in the choice of location for each of the establishments. For a research organization within the federal government, the necessity of serving political interests is expected, but the variety of levels on which politics affected the DRB is informative—from the petty interference in the mundane decision of whether to allow a Board member to retire to the drastic and deep changes to the organization brought about by the Glassco Commission, two *White Papers* and the Management Review Group.

The other element in the transformation of the DRB's organization was the clash of scientific values and military needs. From the conflict over the line in the sand demarcating where research ends and development begins, to the inevitable debate over the ordering of priorities and the pursuant funding of projects, the DRB's relationship with the military (and the three Services' relationships with one another) was turbulent.

Against this backdrop of forces that led to changes in the organization of defence research, the Defence Research Board instituted a successful research programme. Omond Solandt expanded the DRB to meet the military's needs in the Korean War, and Hartley Zimmerman's research programme for the International Geophysical Year led to Canadian prominence in satellite communications.

Defence research since 1974 has been no less successful, but the history of defence research since 1974 reveals the ongoing importance of politics to organizational decision-making. In 2000, after an internal review motivated by the budgeting efficiencies of Jean Chrétien and Paul Martin, the Defence Research and Development Branch was replaced by Defence Research and Development Canada, which has similar structuring and authority to the Defence Research Board. This latest reorganization is further proof that history has an uncanny ability to repeat itself in new and interesting ways.